Conceptualizing Faculty Adaptability in Enacting Curricular Change

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Conceptualizing faculty adaptability in enacting curricular change

Abstract

In this theory paper, we seek to conceptualize faculty adaptability as self-regulation during curricular change. We highlight the expanded set of responsibilities that faculty engage with as part of their effort to (re)shape the engineering curriculum. Based on the literature, we illustrate how adaptability is multi-faceted; it has different aspects that are manifested differently in different contexts. Moreover, this research conceptualizes a university as an environment that represents dynamic contexts. Consequently, faculty do not have fixed tasks; rather, they engage in broad roles. Although knowledge about effective teaching and learning exists, and theories of change strategies are considered, the lack of the understanding of the behavior of engineering faculty as change agents, and as the unit of analysis, during the process of change, remains a major contributor against more robust change efforts. Without the comprehensive understanding of the adaptability of key change agents in the educational system, and as they respond to dynamic and changing contexts, the effective enacting of curricular change initiatives remains unfulfilled. Ultimately, we aim to use this conceptual model to compare faculty adaptability in different contexts of curricular change.

1. Calls for change in engineering education: Enabling change agents

Calls for change in engineering education has constantly been shaped by "changing times and paradigms" (Felder, 2004, p. 32). The *context* within which engineering graduates are educated, and are expected to contribute in the workplace, has always been a dominant factor in frameworks for calls for change (Jamieson & Lohmann, 2009). Characteristics of the context such as the influence of the global economy, the knowledge-based economy, changing demographics, increased integration among engineering disciplines and environmental factors are just some examples (Katehi et al., 2004). In many of the national reports that call for change in engineering education, the lack of preparation of engineering graduates to address the challenges of a changing world are cited (e.g., Duderstadt, 2008; National Academy of Engineering [NAE], 2005; National Research Council [NRC], 2007; National Science Board [NSB], 2007; Nielsen, 2011). The reports do not only cite the quality of outcomes but also point the to the lack of comprehensive understanding of the learning process (e.g., NAE, 2005) affecting both the design of the engineering curriculum and the delivery of the curriculum (Duderstadt, 2008).

In addition to characterizing the problem, national as well as international calls for change, tend to provide solutions in the form of recommendations. Proposed recommendations include addressing pedagogy issues, such as student-centeredness and authentic learning experiences, which integrate into the curriculum the humanities, global competencies, teamwork and communication skills (Borri & Maffioli, 2007; King, 2008; Nielsen, 2011). However, challenges exist in implementing these recommendations (Borrego, Froyd, & Hall, 2010; NSF, 2008). Recommendations characterize *what* engineering education should look like with little attention to *how* to implement change (ASEE, 2009). See, for example, a list of recommendations provided by the ASEE report on *Creating a culture for scholarly and systematic innovation in engineering education* (2009), Table 1. The suggested actions are listed for engineering faculty, chairs and deans. The recommendations are provided in broad terms without clear articulation of the realization process of these aspirations. Investments in understanding effective pedagogies have been made (Borrego et al., 2010; NRC, 2012; Prince & Felder, 2006). However, challenges continue to exist for faculty to adopt and scale research-based pedagogies and interventions (ASEE, 2009; 2012; NRC, 2012; PCAST, 2012). The same ASEE report (2009) cites the following quote about the hardest part of change:

"The hard part of being adaptive and innovative is that often it forces us to change ourselves, our environments, or both. These changes can evoke strong emotions and take us away from our momentary efficiencies and comfort zones by forcing us to unlearn old skills, [and] tolerate momentary chaos and ambiguity in order to move forward..." (Bransford, 2007, p. 2)

Table 1. Suggested actions for individuals in the educational system, including faculty, offered as recommendations for change in engineering education. Suggested actions often lack clear mechanism for implementation. (ASEE, 2009)

Stakeholder	Suggested action
Engineering faculty, chairs, and deans	- Link engineering education practice and research - Support and recognize educational innovation - Prepare future faculty - Integrate the curriculum - Promote learning through entrepreneurship - Educate the global engineer - Develop leaders - Promote learning through service - Enhance faculty experience

There is a need to understand the enablers and barriers for individual faculty to change. Two related factors that contribute to the challenge of implementing change are the *status-quo*, represented by organizational structures and systems that make up the educational process (Borrego et al., 2010; NSB, 2007) and *change agents*, represented by faculty and administration leaders who are willing to embrace change efforts while viewing these efforts as scholarly-sound and as based on research (Borrego & Henderson, 2014). In the past, the problem of *enabling* faculty and administration leaders to emerge as change agents to change the status quo has been characterized as a "shift" in emphasis from teaching to learning (Seymour, 2002) and as "maintaining balance" between theory and practice (Reynolds & Seely, 1993; Seely, 1999). However, efforts to guide faculty and administration leaders in the change process remain implicit (Borrego & Henderson, 2014). Although knowledge about effective teaching and learning exists, and theories of change strategies are considered, the lack of the understanding of the behavior of change agents, as a unit of analysis, during the process of change, remains a major contributor against more robust change efforts. Without the comprehensive understanding of the adaptability of key change agents in the educational system, and as they respond to dynamic and changing contexts, the effective enacting of curricular change initiatives remains unfulfilled.

2. Faculty roles and contributions to curricular change

In order to effectively implement proposals for curricular change, a careful understanding of the relationship between stakeholders and the curriculum is necessary. Henderson et al. (2010, 2011) developed a categorization of strategies used to create change in STEM education. Based on their categorization, which is developed after reviewing 191 journal articles published between 1995 and 2008 on the topic, change strategies can be mapped into one of four categories: disseminating pedagogy; developing reflective teachers; enacting policy; and developing a shared vision. The categorization by Henderson et al. (2010, 2011) is consistent with other efforts to categorize theories of change (e.g., Amundsen & Wilson, 2012) and has been utilized by Borrego & Henderson (2014) to identify ways to increase the use of evidence-based teaching in engineering education. Most importantly, the framework highlights the efforts of faculty as agents for change in all four categories. However, while the several theories are provided as suggestions for change patterns in engineering education, the link between faculty (as active agents for change) and the curriculum (as an embodiment of many of the assumptions of

the educational system) remains implicit. While change strategies consider various stakeholders, the central role that faculty play during the process remains generic and prescriptive without emphasis on *how* faculty actually respond to calls for change.

Understanding faculty roles and contribution to curricular change requires understanding the complexity in developing the "ideal curriculum." The engineering curriculum went through different waves of transformation (see, for example, Seely, 1999, 2005; Seymour, 2002; Wankat, 2004). A common theme has been bridging the gap between the preparation of graduating engineers and the needs of the workplace (Seely, 2005). The question of the fit between engineering faculty, with their focus on engineering science, and their ability to translate the theoretical applications in ways that are effective for preparing engineers has always been of concern (Walker, 1989). In the past, in most engineering curricula, students did not interact with engineering faculty until late in their sophomore year. Initial efforts to focus on design courses in the first year in the curriculum was an attempt to allow students to interact with engineering faculty early in the curriculum (Agogino, Sheppard, & Oladipupo, 1992; Pavelich, Olds, & Miller, 1995). At the same time, challenges started to emerge to effectively integrate design into the engineering curriculum (e.g., Crawley, 2002) and to identify effective ways for assessment (Dym et al., 2005). Some faculty were comfortable engaging in a pedagogy based on project-based learning (PBL) (Smith et al., 2005). Employers started to recognize the qualities that PBL provides for students, including communication, teamwork skills and interest in life-long learning (Oakes, Coyle, & Jamieson, 2000; Smith, 2004).

The constantly changing nature of the engineering curriculum, in concert with economic, social and global contexts, continuously call for engineering faculty to adapt, by incorporating new content as well as utilizing effective educational interventions. A recent study on *The Global State of the Art in Engineering Education* identified features that distinguish current leaders and emerging leaders in engineering education by comparing their different curricular approaches (Graham, 2018). Some of the identified curricular features included design- and make-based learning, collaborative cultures, academic rigor in the engineering fundamentals, multidisciplinarity, work-ready environments and self-directed learning (Graham, 2018). Additionally, pedagogical features associated with current leaders included "technology-based extra-curricular activities" and "emerging capabilities in online and blended learning" (p. 30). The expansive and evolving nature of the engineering curriculum, in terms of both content and form, points to the changing nature of the role of faculty.

The engineering curriculum exists in a context; many of the change calls are initiated by external factors influencing the engineering curriculum. However, the actual realization of these calls falls upon the engineering faculty as change agents. Without the contribution of faculty, the implementation of change is not robust (Besterfield-Sacre et al., 2014). Faculty are being asked to engage in structured change efforts (Henderson, Finkelstein, & Beach, 2010), to work together in interdisciplinary groups (Henderson et al., 2008) and to become partners in the change process (Henderson & Dancy, 2008; Henderson et al., 2010). However, while there is a recognition of the fundamental role that faculty play, no sufficient attention has been given to their adaptability in response to change.

Individual characteristics have been identified as a constraint on faculty's willingness to engage in change (Murray & Macdonald, 1997; Norton et al., 2005; Prosser & Trigwell, 1999). Furthermore, the reward system and the already existing expectations in the engineering disciplines have been brought into attention as barriers to change (Besterfield-Sacre et al., 2014). Faculty have an individual agency to make decisions that is not usually attuned to in change proposals (Kezar & Eckel, 2002; Wejnert, 2002). Different change proposals assume immediate adoption from faculty, when in reality the lack of willingness to adapt, or only superficial adoption results in ineffective change (Henderson, 2005; Henderson & Dancy, 2005; Seymour, DeWelde, & Fry, 2011). Table 2 lists aspects of the role of faculty that are not considered early in calls for change and end up being considered as barriers for change.

Table 2. Faculty attributes as conceived in the literature to be barriers to change.
(Adapted from Besterfield-Sacre et al., 2014).

Faculty attributes that are cited as barriers to change
• Expectations of content coverage
• Limited instructor time
• Lack of training
• Departmental norms
• Dealing with student resistance
• Dealing with class size and room layout
• Time structure
• Institutional reward system
• Institutional culture
• Research priorities

3. Studying faculty adaptability

Adaptability can be broadly defined as the willingness to change behavior. The change in behavior can be either in response to change in the environment, *reactively* (Pulakos et al., 2000), or for making necessary modifications to attain new goals, *proactively* (Griffin and Hesketh, 2003). Because this study focuses on examining faculty's ability to respond to curricular change in different contexts, understanding performance adaptability in dynamic and changing situations is necessary. Research over the past two decades on performance adaptation has witnessed substantial growth, with the majority of the research coming from management and organizational literature (Baard, Rench, & Kozlowski, 2014). Adaptability has been described as a phenomenon that can be promoted at the individual- (Macey & Schneider 2008; Shoss et al., 2012; Stokes et al.; 2010), team- (Driskell et al., 2006; Wiedow & Konradt, 2011), and organizational levels (Birdi et al., 2008; Sonenshein, 2010). Internal and external factors have been found to influence the nature (what), levels (where) and mechanisms (how) of adaptation (Baard et al., 2014).

Following the conceptual taxonomy developed by Baard et al. (2014), performance adaptability as a phenomenon can be viewed from a *domain-general* perspective or *domain-specific* perspective. The domain-general perspective situates adaptability as a generic capability with the underlying assumption that adaptability is a stable trait which can be generalized across domains (Ployhart & Bliese, 2006; Pulakos et al., 2000; Pulakos et al., 2002). In this generic perspective, adaptability was examined by (1) studying job performance of individuals; or (2) by comparing adaptability across individuals. Alternatively, in the *domain-specific* perspective, adaptability is assumed to require knowledge and skills that are unique to the domain within which it is applied (Holyoak, 1991; Kanfer & Ackerman, 1989). In this specific perspective, adaptability was examined by (1) comparing change in performance from routine to novel tasks; or (2) observing change of performance as a process over time.

Because most of studies on adaptability come from the literature in management and organizational theory, a gap exists in the study of *faculty* adaptability. Adaptation is a broad concept that can be applied to different levels of organizational structures. As described before, a significant portion of the literature describes aspects of faculty willingness to change (e.g., Clark et al., 2004; Matusovich et al., 2014) or reflective practice (Borrego, 2007; Mettetal, 2001). However, in the proposed conceptualization of faculty adaptability, the focus is on integrating *mechanisms* of adaptation as applied to *faculty responses* as active individuals in curricular change. Faculty members are unique in an organizational structure for different reasons. First, their level of commitment is not always for the institution they work for as they are members of broad research communities and fields of study. Second, faculty members possess higher

levels of autonomy which enable them to work with minimal supervision compared to other professions. Third, faculty members motivation for change (or response to change) is largely driven by research and discovery and not just by the desire to be promoted in an organizational hierarchy or to fulfill prescribed tasks. All these factors make the study of faculty adaptability a unique one and one of interest.

4. Conceptualizing adaptability as self-regulation

4.1 Self-regulation as a framework: Underlying assumptions

Self-regulation involves the active construction of goals from the given information in the external environment (Azevedo, 2009; Pintrich, 2000; Zimmerman, 1986, 1989, 1990, 1994). It has been used widely in the learning sciences to study mechanisms of learning. Some of the underlying assumptions of self-regulation as a framework is that learners are *active* in constructing goals and attempting to achieving them; that learners have *control* over their learning through their ability to monitor, control and regulate their learning; and that there is *goal or criterion* which provides the standard for assessing regulation. One more assumption underlying self-regulation is that regulatory activities act as *mediators* between the person and the context within which the person exists (Pintrich, 2000). This assumption is particularly important in this study where faculty adaptability is viewed to be context driven.

4.2 Models for self-regulation and link to the study of adaptability

Several models for self-regulation exist. The triadic model, for example, links the person, self-behavior and the environment (Zimmerman, 1989). In a refined model by Zimmerman (2000), self-regulation takes a cyclical phase model, where forethought leads to performance, followed by self-reflection, Figure 1. The Winne and Hadwin model (1998) provides more granularity by including monitoring and control within each phase of learning while delineating between task definition and goal setting (Greene, & Azevedo, 2007). Pintrich (2000) provides an overview of the common themes of models of self-regulation, where models can be organized along two dimensions: (1) *phases of regulation*, which include forethought (planning or activation); monitoring; control; and reaction (reflection); and (2) *areas of regulation*, which include cognition; motivation; behavior; and context.

4.3 Proposed model to study faculty adaptability as self-regulation

Our revised self-regulation model in adaptability is shown in Figure 2 below. It is inspired by the cyclical model proposed by Zimmerman (2000); however, it is modified to include a willingness aspect for each phase of the cycle. A similar modification has already been proposed by Zimmerman & Moylan (2009) who observed that individuals in demanding contexts seek personal initiative and involve more motivational aspects than passive engagement. Their modified framework added self-control and self-observation in each phase. In the forethought (or planning) phase, in particular, they added task analysis of self-motivation beliefs as part of the phase. The operationalization of the definition of each phase as it applies to faculty adaptability is provided in Table 3. In the discussion below, the integration in the revised model of faculty *willingness* to engage in each phase of self-regulation as adaptation in curricular change is highlighted.

Willingness for planning in curricular change involves significant attention to the allocation of *time* and *effort*. Planning is conceptualized in models of intentions and intentional planning as a behavioral intention (e.g., Gollwitzer, 1996). In such models, willingness for planning represents a formation of intention that is linked to subsequent behaviors (Ajzen, 1988, 1991) and is largely based on theories of achievement motivation (Ames, 1992; Dweck & Leggett, 1988; Wolters, Yu, & Pintrich, 1996). *Willingness for adjusting in curricular change* represents the faculty's control and regulation of behavior. Adjusting has the aspect of persistence (Karabenick & Sharma, 1994) and is an indicator for motivation

(Nelson-Le Gall, 1981, 1985). The link between adjusting, as a behavioral area of regulation, and willingness, as an affective area of regulation, can be explained as an attempt to "control anxiety and self-worth" (Pintrich, 2000, p. 468) in anticipation of reward or in avoidance of consequences (Weiner, 1986; Zimmerman & Kitsantas, 1997). *Willingness for reflecting on curricular change* involves observing one's performance, with the motivation of assessing outcomes with respect to goals (Baker 1979; 1989; Schneider & Pressley, 1997; Schraw et al., 1995). An environment that enables self-observation (Zimmerman & Martinez-Pons, 1986) and self-experimentation (Zimmerman, 1998, 2000) during the activity is usually an environment that induces effective self-monitoring.
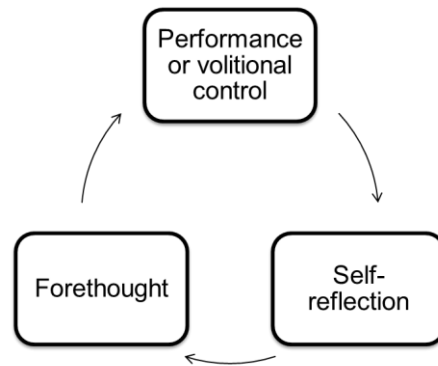

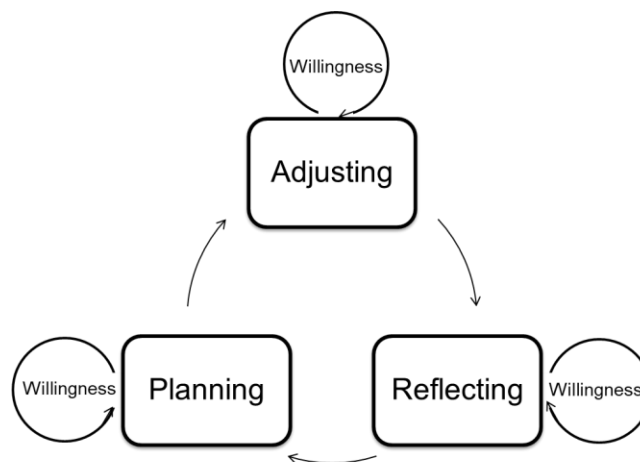*Figure 1. The cyclical phase model of self-regulation (Zimmerman, 2000).*

Figure 2. Conceptualization of adaptability as self-regulation in this study.

Table 3. Operational definitions for the various phases of self-regulation for the purpose of study faculty adaptability.

Phase	Definition
Planning	Planning involves target goal setting of task-specific goals that can be used to guide behavior, in general, and for monitoring, in particular
Self-reflection	Self-reflection is the efficacy of exhibiting cognitive judgement and change of behavior as a result of affective reaction, evaluation of tasks or evaluation of context
Adjusting	Adjusting is the efficacy of changing behavior due to observed negative discrepancies between a goal and current state
Willingness	Willingness involves being open to change and acting based on plans, previous information or other internal or external factors

5. Summary and future work: developing an instrument for studying context-driven adaptability

Faculty are being asked to engage in a variety of activities that are changing in nature and scope (ASEE, 2012; NAE, 2005; PCAST, 2012). Calls for change in engineering education continue to ask of faculty to master an expanded set of responsibilities. Role theory contrasts between fixed, formalized tasks, which can be evaluated in terms of proficiency behavior, and emergent work roles, which can be evaluated in terms of adaptive behavior (Ilgen & Hollenbeck, 1991). In this framing, the nature of work roles is linked with the contexts in which they exist (Griffin, Neal, & Parker, 2007).

Faculty members tend to value autonomy; self-driven innovations (vs. administrative-driven); inclusive opportunities for feedback; community; recognition and efficacy (Bolman & Deal, 1991; Borrego & Henderson, 2014; Guerra et al., 2014). The *context* of curricular change shapes the behavior that is valued in the organization for effective work (Scott & Davis 2015; Thomson, 2003). Previous studies of change in engineering education did not account for the full range of behaviors that faculty are expected to contribute in order for successful implementation of change (Borrego et al., 2010; NRC, 2012; Prince & Felder, 2006). Challenges exist in the implementation of effective strategies, including adoption and scaling-up, where faculty emerge as central change agents in affecting change in the college education experience (Bekki et al., 2017; Borrego & Henderson, 2014). Future work intends to develop an instrument, based on the conceptualizing of faculty adaptability as self-regulation, to compare faculty adaptability in different curricular change contexts.

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