Research in Higher Education, Vol. 43, No. 4, August 2002 (© 2002)

ASSESSING INSTITUTIONALIZATION OF CURRICULAR AND PEDAGOGICAL REFORMS

Carol L. Colbeck

Stakeholders often want evidence that curricular and pedagogical reforms will endure, but institutionalization of reforms is typically assessed superficially, if at all. This study involved developing and testing an Institutionalization Process Model. The model was developed from literature on institutional theory and a qualitative investigation of factors influencing institutionalization of externally funded curricular and pedagogical reforms at 7 engineering schools. The reforms focused on content (design), method (group projects), and improving the climate for students underrepresented in engineering. The model posits that regulative, normative, and cognitive institutionalization processes affect the likely diffusion of curricular and pedagogical reforms beyond faculty members directly involved in the reform effort. Subsequently, institutional data and a faculty survey conducted at the seven engineering schools were used to test the model using logistic regression. Findings showed that cognitive institutionalization indicators had a stronger influence than regulative or normative indicators on diffusion of design and group projects. The normative indicator of perceived support for teaching was the only significant predictor of increased sensitivity to the needs of underrepresented students.

KEY WORDS: curriculum reform; institutionalization; teaching change; institutional theory.

Universities, colleges, and departments spend much money, time, and effort to revise and reform their undergraduate curricula (Ratcliff, 1997) and to encourage teaching improvement (Barr and Tagg, 1995). Many of these reform efforts are also supported by external funding agencies. Providing seed money for curricular reform, however, does not guarantee that reforms will last.

Scholars who have examined curricular change in postsecondary education have noted that the reform process progresses in several stages. First, internal and external forces are felt as pressures to implement curricular change (Conrad, 1978; Stark and Lattuca, 1997; Toombs and Tierney, 1991). Next, a university, college, or department plans a solution (Stark and Lattuca, 1997; Toombs and

Carol L. Colbeck is Associate Professor and Senior Research Associate, Center for the Study of Higher Education (CSHE), The Pennsylvania State University.

Address correspondence to: Carol L. Colbeck, Center for the Study of Higher Education, The Pennsylvania State University, 400 Rackley Building, University Park, PA 16802; clc15@psu.edu.

0361-0365/02/0800-0397/0

Tierney, 1991). This planning process is likely to involve considerable conflict as different groups maneuver to ensure their interests are represented (Conrad, 1978). The stage during which the reform is implemented is a trial process (Toombs and Tierney, 1991). The final stage, when the reform becomes part of business as usual, has been called "institutionalization" by Toombs and Tierney and "internalization" by Stark and Lattuca. The processes that occur during the last stage are critical to the duration of reform efforts. Despite its importance to the change process, institutionalization often receives little consideration by organizational participants (Toombs and Tierney, 1991).

The research described in this study involved developing and testing a theory-based model of institutionalizing curricular and pedagogical reforms. Institutional theory, derived from sociological studies of organizations, provides a framework for understanding change—and deep-seated resistance to change (DiMaggio and Powell, 1983; Meyer & Rowan, 1977; Scott, 1995). Institutionalization is the process by which a significant new structure or practice is incorporated into a system of existing structures and practices (Scott, 1995). Curricular and pedagogical reforms become institutionalized in colleges and universities when organizational participants no longer perceive the reforms as special projects but as integral parts of organizational functioning (Curry, 1992).

THEORETICAL AND EMPIRICAL BACKGROUND

Institutionalization processes may be regulative, normative, or cognitive (Scott, 1995). Regulative processes involve formal rule setting, monitoring, and sanctioning activities. Individuals may acknowledge the existence and even the validity of institutionalized rule systems without necessarily believing the rules are fair, right, or appropriate. Institutions function effectively as individuals determine the cost of violating formal or informal rules is too high. For example, as regional or specialized accrediting agencies implement new competency-based criteria, few postsecondary institutions or programs are willing to risk losing accreditation. Thus, institutionalization occurs as individuals find it expedient to comply with the rules.

Normative processes are grounded in a collective sense of what is appropriate (March, 1994). Similar to regulative processes, normative processes involve a sense of following rules. Individuals follow normative rules, however, because they perceive that doing so is morally appropriate as well as legally correct. For example, as faculty believe administrators' and colleagues' assertions that student learning is enhanced by participation in active or collaborative learning, they may modify their courses to incorporate group projects. Thus, institutionalization occurs as individuals deem it socially responsible to honor informal obligations.

Cognitive processes involve widespread acceptance and practice of an activity. Activities and behaviors become institutionalized as people take them for

granted as fundamental aspects of social life. An indicator of cognitive institutionalization is the prevalent belief that a given activity or structure is conceptually correct (Scott, 1995). Additional evidence of cognitive institutionalization is shown when individuals carry aspects of the activity into other endeavors, when other individuals in the organization adopt similar activities, or when participants in other organizations also adopt or adapt the activities (DiMaggio and Powell, 1983).

In his study of innovation in academic organizations, Levine (1980) suggested five alternative final results of innovation efforts. Two results involve ending the reform effort directly (termination) or indirectly (resocialization) by getting reform participants to renounce their innovative ideas. Two results (enclaving and boundary contraction) involve restricting organizational responsiveness to the original or subsequent reforms. The present study focuses on the one result of innovation efforts described by Levine that signals institutionalization—diffusion. Diffusion occurs as characteristics of the innovation spread throughout the organization. An important indicator of diffusion is prevalence: the number of individuals engaging in a reformed practice (Goodman & Associates, 1982; Scott, 1995).

Persistence of curricular and pedagogical change in colleges and universities, then, may involve regulative changes in organizational structures and policies, normative changes in organizational values, and cognitive changes in participants' beliefs and behaviors. Previous research on institutionalization of academic reform has focused on processes that might be classified within one or two institutionalization process categories, but not within all three. Some researchers have found evidence of regulative institutionalization processes in mission and policy statements, administrative positions, and budgets (Kanter, 1983). Bringle and Hatcher (2000) found, for example, that campuswide institutionalization of service learning was associated with establishment of a centralized service learning office funded from the operating budget. Similarly, a community college district determined that innovative student learning initiatives might be institutionalized by incorporating them in the colleges' strategic planning processes (Palomar Community College District, 1999).

Regulatory and structural modifications may not make lasting differences in curricular and teaching practice, however, unless there are also corresponding changes in the normative climate of an organization. "Unless an innovation becomes valued, it will lack a constituency capable of lobbying for its continuation" (Curry, 1992, p. 11). Dannefer, Johnston, and Krackov's (1998) study of curricular reform in eight medical schools found that success depended on communication strategies that promoted participants' sense of ownership of the reform—a normative institutionalization process.

To persist, however, reforms may also need to become valued—and practiced—by a larger group than the original innovators. Cognitive institutionaliza-

tion processes involve changes that occur as more and more organizational participants adopt beliefs and behaviors consistent with the reform. Rogers (1983) described how innovations spread from originators to a small group of "early adopters" (perhaps 12 to 15 percent of an organization's members), to an "early majority" (another one third of the members), and perhaps to another, more skeptical one third, the "late majority" of the organization's members. Cognitive institutionalization will not happen if those involved in implementation are the only organizational members who know about the innovations. For example, although Indiana University provided substantial funding for projects designed to foster strategic change, Powers (2000) found that awareness of the projects and their impact was limited to those actually involved with each project. Cognitive institutionalization is also unlikely when many organizational participants either disagree with the reform or have no experience with practices advocated by the reform. At the University of Massachusetts, Boston, an attempt to reform the general education curriculum by emphasizing critical skills more than content failed, in part, because many faculty did not believe teaching for multiple goals was possible. Moreover, despite an externally funded training effort, the faculty did not know how to incorporate critical thinking concepts into the content of their courses (Civian, Arnold, Gamson, Kanter, and London, 1996).

Scott (1995) suggests that regulative, normative, and cognitive institutionalization processes are conceptually distinct. The three conceptions are grounded in differing assumptions about justifications for compliance and indicators of persistence and legitimacy. Theoretical differences are not always easy to distinguish, however, in the often messy world of practice. A collection of individuals and organizations actually implementing curricular reforms bring multiple perspectives to the task of ensuring their reform efforts will last (Stark and Lattuca, 1997). Scott acknowledges that it may be possible to combine the insights from the different processes into a single integrated model.

RESEARCH OBJECTIVES

The purpose of this study was to develop and test a conceptual model that considers the combined impact of regulative, normative, and cognitive institutionalization processes on the persistence of curricular and pedagogical reforms. The research proceeded in two phases. The first phase involved exploratory qualitative research to induce a set of institutionalization process indicators from the actual experiences of a multi-institution curricular and teaching reform effort. This phase of the research sought to answer the following questions: What do participants in a reform effort consider are good indicators of lasting change? Which of those indicators involve regulative, normative, cognitive institutionalization processes? The second phase involved assessing the impact of institutionalization processes on diffusion of curricular and teaching reforms among

faculty. This phase of the research sought answers to the questions: To what extent does regulative, normative, and cognitive institutionalization processes influence the diffusion of curricular and pedagogical reforms? What is the relative impact of each set of indicators?

ENGINEERING REFORM AS AN EXAMPLE

This study focused on a multi-institutional reform effort in a single field, engineering. While the reform effort was specific to engineering, many basic processes involved in curriculum planning or reform are likely to be similar across disciplines and institutions (Stark and Lattuca, 1997). Undergraduate engineering reforms funded by the National Science Foundation (NSF) during the last decade provided the inspiration and the sites for the development of an Institutionalization Process Model. The sites included seven member schools of the Engineering Coalition for Excellence in Education and Leadership (ECSEL), a coalition funded by NSF from 1990 to 2000 to increase active and collaborative learning in the form of team-based design projects and to increase the participation of women and underrepresented minorities in engineering. Restoration of design in engineering curricula became an ECSEL goal because of industry concerns that schools were failing to teach students practical applications of basic scientific and engineering knowledge (Augustine, 1996). Design projects typically involve openended problems that resemble the work of professional engineers. Student teams have built solar-powered cars, compact disc players, and portable shelters for the homeless, and have worked with industry representatives to improve the design of power tools. ECSEL adopted increasing diversity as a goal because African Americans, Hispanics, Native Americans and women are severely underrepresented in the field (Engineering Workforce Commission, 1997).

ECSEL's design and diversity goals are analogous to two of five reform goals for disciplinary majors advocated by the Association of American Colleges (AAC): the connection of learning to students' lives and the reduction of barriers for underrepresented students (AAC, 1985). Engineering is an applied field with a high degree of paradigmatic consensus (Braxton and Hargens, 1996). High consensus fields (engineering, math, and science) may face greater challenges than lower consensus fields (social sciences and humanities) in achieving reforms in connecting learning and inclusiveness (Lattuca and Stark, 1994). If engineering, as an extreme case, can achieve some degree of reform success in these areas, other disciplinary fields are likely to learn valuable lessons from its example.

The engineering coalition consists of the City College of New York (CCNY), Howard University, Massachusetts Institute of Technology (M.I.T.), Morgan State University, Penn State University, and the Universities of Maryland and

Washington. ECSEL schools vary greatly in mission, funding, size, and student population. Most ECSEL schools are public; one is private. The schools place varying emphases on the relative importance of teaching and research. For the smaller ECSEL schools, NSF funding for the coalitions' goals made a notable difference in their budget. For some of the larger schools, the NSF funding for ECSEL was nice, but certainly not necessary to maintain work as usual. Student populations range from predominantly white, to ethnically diverse, to predominantly African American. Of the seven ECSEL schools, five were among the top 15 U.S. engineering schools with the largest African-American graduating classes in 1993–1994 (Reichert and Absher, 1997). The proportion of women graduating with baccalaureate degrees from ECSEL engineering schools (20 percent) is slightly higher than the national average of 18 percent (Engineering Workforce Commission, 1997).

PHASE 1: MODEL DEVELOPMENT

The model development phase of this research began after ECSEL had already implemented the first series of curricular reforms and was beginning the next series. ECSEL reform efforts from 1990–1995 focused on development of hands-on design courses for first-year students. Reforms from 1996–2000 focused on adding design projects to existing or new upper-division courses. This shift in emphasis provided an opportunity to examine what happened to reforms of first-year courses when attention and funding shifted to new projects.

As part of a coalition-wide evaluation effort in spring 1996, a team of five researchers conducted one-hour interviews with 127 individuals at the seven ECSEL engineering schools. Those interviewed included 29 administrators (deans, associate deans, and department heads), 10 ECSEL principal investigators (one each for the seven schools and three for cross-coalition activities) 53 faculty, and 38 staff, including administrators of women and minority in engineering programs, computer support specialists, ECSEL local evaluators, and instructors. (The categories sum to 130 because three individuals served in two roles.) Interviews included three sets of questions asking about the respondents' involvement in ECSEL, their perceptions of institutionalization, and their opinions about cross-coalition cooperation. Questions about institutionalization asked how implementation of goals for years 6–10 had affected the reforms already implemented during ECSEL's first 5 years and whether the respondents perceived congruence between ECSEL goals and the goals of their engineering schools. As they discussed how implementation of Year 6–10 initiatives were affecting first-year courses initiated during the coalition's first 5 years, ECSEL leaders, faculty, and administrators revealed what they considered as indicators o of lasting change. Detailed notes (often by two researchers) were taken during the interviews.

Researchers' notes of the interviews were analyzed to determine similarities and differences among indicators mentioned by respondents within each school and across the seven schools. Indicators were then classified by type (regulative, normative, or cognitive) and analyzed for their probable impact on the duration of first-year engineering design courses at each school. A formative evaluation report was shared in fall 1996 with deans, chairs, and local principal investigators at the seven ECSEL schools to elicit their feedback about the findings (Fairweather et al., 1996). Their feedback was incorporated in a detailed description of institutionalization indicators derived from ECSEL participants' comments about duration of first-year courses (Colbeck, 1999).

Regulative Institutionalization Processes

Regulative institutionalization processes provide guidelines for organizational and individual behavior. If the guidelines are violated, sanctions result. Indicators of regulative institutionalization of first-year design courses as discussed by ECSEL participants included the number of years until accreditation review, funding from the operating budget, curricular requirements, and faculty rank.

1. *Accreditation:* The accrediting agency for engineering, like many other specialized and regional accrediting agencies, has recently changed from an emphasis on assessing inputs to an emphasis on assessing outcomes. As Stark and Lowther (1989) have shown, professional fields and liberal arts disciplines encourage many similar student learning outcomes. By 2001, all engineering schools must be reviewed under new Accrediting Board for Engineering and Technology (ABET) criteria, which require that schools demonstrate that their students have achieved skill competencies in areas such as design, communication, and teamwork. Several ABET-required competencies are introduced in ECSEL first-year courses. Many ECSEL participants believed that ABET's new requirements legitimized their reform efforts. As one department chair said, design courses would continue even without external funding because the courses met ABET criteria. Another administrator said the ECSEL helped his school tackle quick changes to meet accreditation standards. A dean felt that the part of the reason for the success of ECSEL reforms at his college was the coincidence of ECSEL funding with the changes in ABET requirements. The probable impact accreditation on diffusion of reform may rest in the degree to which the evaluation criteria reinforce the reform and on the timeframe for review. The sooner a program or school is due for review under accreditation criteria that are related to a reform, the more faculty will engage in activities related to the reform.
2. *Operating Budget:* Initially, NSF funding designated for ECSEL provided most of the financial support for the innovative courses and pedagogical

reforms. Deans and department heads at several ECSEL schools indicated these efforts were more than a soft money fad when they began paying for them from regular department or school budgets. Institutionalization appeared less certain for programs still primarily supported by soft money. At one school, an administrator acknowledged that he was using indirect cost recovery funds to continue support of the first-year course even though the course was not a specific goal of the current funding period. One dean expressed concern about the adverse impact of state budget cuts and as a result, wondered what would happen when NSF-ECSEL funds "run out." Another dean asserted, "questions of institutionalization are financial." When administrators assume financial responsibility for reforms by funding them from the operating budget rather than soft money, faculty are likely to perceive the importance of the reforms to the department or college.

3. *Curricular Requirements:* At some ECSEL schools, first-year design courses were required for graduation and enrollments were high. At one school, transfer students were required to take the course, regardless of their class standing. At other ECSEL schools, first-year design courses were electives. At one school, since departments did not give credit for graduation for the first-year course, the school administrators scrambled to find other ways to encourage students to take it, including cross-listing it as a technical writing course. After initial student interest, however, enrollments declined. Thus, when a reformed course becomes either a major or school requirement for graduation or a prerequisite for other classes, enrollments appear to remain high, and the course becomes an enduring part of the curriculum.
4. *Faculty Rank:* Requiring a reformed course will not guarantee institutionalization if faculty are not rewarded—or are even punished—for teaching it. During ECSEL's first 5 years, a few junior faculty who invested extra time and effort to develop and teach first-year design courses were denied tenure by their university review committees. Interviews revealed the shock had reverberated throughout the coalition. Since then, active participation in ECSEL reforms at a national level contributed to positive promotion decisions for some faculty at several ECSEL schools. Several deans and department chairs asserted that lasting reform depended on involving junior faculty in implementation of ECSEL initiatives. Pretenure faculty may be more likely to be attuned to promotion and tenure criteria consistent with ECSEL's goals than their colleagues who already have tenure.

Normative Institutionalization Processes

Normative institutionalization processes involve communication of values (what has worth) and norms (how things should be done). They provide a social framework for appropriate involvement and action. Indicators of normative institutionalization include administrators' and colleagues' support for teaching.

5. Perceived *support for teaching:* Deans' and chairpersons' abilities to regulate faculty behavior directly are limited. In academic settings, effective administrators lead by moral persuasion. ECSEL experiences suggest that visible administrative commitment to teaching contributes to diffusion and durability of reforms. At some ECSEL schools, deans and chairpersons even taught sections of the first-year design course themselves. Faculty may feel more comfortable adopting innovative teaching methods if they perceive their colleagues are also supportive of teaching and curricular reform. Initially, ECSEL did an excellent job of involving faculty who were already interested in design, often because of their prior experiences working in industry. Faculty members at two schools told interviewers that they became interested in implementing design or group projects only after they had been assigned to teach the first-year course. An electrical engineer initially resistant to ECSEL said, for example, "I taught [the first-year course] and enjoyed it, even though it was a different style of teaching. . . . [The course] is a reasonable introduction to what engineers are and do." At the time of the interview, he was developing an upper-division course incorporating visualization of small-scale testing with ECSEL support. In some cases, however, practical responsibility for teaching design was consigned to an enclave of adjunct faculty and graduate teaching assistants. Faculty who perceive their administrators and colleagues support teaching may be more likely to engage and persist in the use of reformed curricular and pedagogical practices.

Cognitive Institutionalization Processes

Cognitive institutionalization processes occur as more and more individuals assume that an activity is naturally they way things are done, and act accordingly. Indicators of cognitive institutionalization include faculty beliefs about learning consistent with the reform, use of teaching practices similar to those advocated by the reform, and adoption of reform attitudes and practices by faculty who never participated directly in the reform effort.

6. *Beliefs About Learning:* One predictor of cognitive institutionalization of curricular and pedagogical reforms may be when more and more faculty members believe that undergraduate students should—and, in fact, *do*—learn the concepts and practices advocated by the reform effort. In the ECSEL coalition, such concepts include design, teamwork, and openended, real-world problems. One faculty member said that "it should be taken as given" that design should be a specific part of the curriculum.
7. *Teaching Practices:* Faculty members' use of innovative practices such as using computers or active, student-centered practices in their teaching may also be associated with adoption of innovations advocated by ECSEL. Many of the faculty and department chairpersons interviewed already took for

granted the appropriateness of group design projects for senior capstone courses. Several respondents told us of their own or their colleagues' participation in other funded engineering education projects advocating active and collaborative learning.

8. *Reform Involvement:* Finally, involvement in reform efforts constitutes a special category of faculty behavior for this analysis. ECSEL participants are examples of Rogers' (1983) "early reform adopters" who very likely to hold beliefs and engage in behaviors consistent with the reform. The model hypothesized that faculty who were involved with ECSEL would be more likely than faculty who were not directly involved to adopt changes consistent with the coalition's goals.

Diffused Reforms

Institutionalization occurs as increasing numbers of individuals adopt the behaviors and attitudes associated with the innovation (Goodman and Associates, 1982). ECSEL's two primary goals were to incorporate engineering design in undergraduate courses and curricula, and to increase the diversity of engineering graduates by improving the climate for women and underrepresented minority students. Design involved both curricular content (principles and processes of problem identification, specification, solution, building, and testing) and pedagogical process (collaborative learning on team-based projects). Coalition attempts to achieve diversity goals involved sensitivity training for faculty and outreach and support efforts for students. The Institutionalization Process Model (see Figure 1) posits that diffusion of curricular and pedagogical reforms is the product of regulative, normative, and cognitive institutionalization processes.

PHASE 2: MODEL TESTING

The second phase, testing the Institutionalization Process Model, began from the premise that institutionalization of ideas and practices advocated by a reform effort will occur as increasing numbers of faculty adopt the teaching methods and attitudes promoted by the reform effort. Data from three sources were used to assess the relationships between regulative, normative, and cognitive indicators of institutionalization processes and faculty members' self-reported changes in practices and attitudes advocated by ECSEL. First, another round of interviews conducted in fall 1999 with seven deans and associate deans, 10 department heads, and seven principal investigators supplied information about number of years to ABET review, past and current funding levels for ECSEL courses, and which ECSEL courses were required for graduation. Second, course reports completed by local evaluators at each ECSEL campus in 1997–1998 supplied information about the total number of engineering courses and ECSEL courses

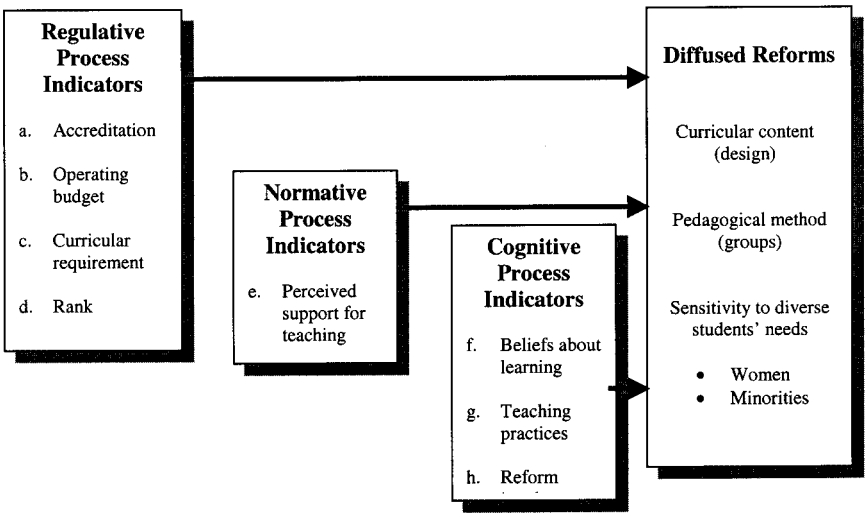

FIG. 1. Institutionalization process model.

on each campus. The "ECSEL Faculty Survey," administered in fall 1997, provided the third data source for these analyses. The survey asked faculty about their level of involvement with ECSEL, the frequency of their use of various teaching practices, their beliefs about student learning on their campuses, and their perceptions of support for teaching from their college colleagues and leaders. The survey also asked whether their approaches to teaching or their sensitivity to the needs of underrepresented engineering students had changed since 1990, the year ECSEL began.

The survey was mailed to a sample of 663 faculty members at the seven ECSEL institutions. Of that number, local evaluators identified 267 as having been involved with the coalition and 396 as having no ECSEL involvement.[1] The overall response rate was 44 percent, or 291 faculty. Information about gender, ethnicity, or department was not collected for this analysis. Consequently, we are unable to evaluate the degree of response bias that may be present. Table 1 reports the distribution of faculty respondents by institution and faculty members' own reports of whether or not they were involved with ECSEL. As can be seen there, respondents who had been involved with the coalition were more likely to respond than those who had not. Table 2 lists and defines the independent variables used in these analyses.

Four items assessed the dependent variables involving changes in curricular content, pedagogical methods, and sensitivity to the needs of diverse students.

TABLE 1. Distribution of Faculty Respondents to 1997 Survey Across Institutions

	Involved in ECSEL?		
Institution	No	Yes	Total
City College of New York (CCNY)	12 (50.0%)	12 (50%)	24 (8.3%)
Howard University	7 (29.2%)	17 (70.8%)	24 (8.3%)
Massachusetts Institute of Technology (MIT)	0 (0.0%)	15 (100%)	15 (5.2%)
Morgan State University	1 (11.1%)	8 (88.9%)	9 (3.0%)
Pennsylvania State University	38 (53.8%)	34 (47.2%)	72 (24.7%)
University of Maryland	25 (46.3%)	29 (53.7%)	54 (18.6%)
University of Washington	29 (38.2%)	47 (61.8%)	76 (26.1%)
No institution given			17 (5.8%)
Total	112 (38.5%)	162 (55.7%)	291 (100%)

Faculty were asked to report whether there had been decreases, no change, or increases over the past 7 years in their:

- use of design projects in their undergraduate engineering courses,
- use of group or team projects in their undergraduate courses,
- sensitivity to the needs of women students,
- sensitivity to the needs of underrepresented minority students.

Because only 1.1 percent or less of the responding faculty reported decreases in each of these areas, those responses were combined with the no change responses to set up a scale where 0 = no change or decrease and 1 = increase.

Analytical Methods

Cross-tabulations were used to assess bivariate relationships between individual regulative, normative, or cognitive institutionalization items and self-reported changes in curricular content (design) pedagogical method (groups), and sensitivity to the needs of women and underrepresented minority students over the past 7 years. The results are shown in Appendix A. Next, factor analyses were used to determine whether survey items grouped into distinct dimensions that represented indicators of institutionalization. (Factor loadings and Chronbach's alphas for the resulting scales are shown in Table 2.) Finally, logistic regression was used to assess the "net effect" (i.e., after controlling for all others variables in the model) of each institutionalization indicator on changes in curricular content, teaching method, and sensitivity to diverse students.

TABLE 2. Variable Names, Type, Values, and Data Source

Variable	Type: Items and Scales (factor loadings in parentheses)	Values	Data Source
Regulative Indicators			
• ABET (years to review)	Item	Range = 1–4 Mean = 2.8	Administrator interviews
• Operating budget (% of course support from institutional funds)	Item	Range = 1–3[a] Mean = 2.5	Administrator interviews
• Curricular requirement (ECSEL courses required as % of total courses)	Item	Range = 1–3[b] Mean = 1.6	Administrator Interviews & Course reports
• Faculty rank	Item	Range = 1–4[c] Mean = 3.16	Faculty survey
Normative Indicator			
• Support for Teaching Scale	Scale items: my college of engineering's administration supports teaching (.754), sufficient incentives are given for teaching in my college (.801), my university's administration supports teaching (.814), faculty in my college support teaching (.627), teaching is appropriately weighted in the promotion & tenure process in my college (.779), my department chairperson supports teaching (.676)	Range = 1–4[d] Mean = 2.68 S.D. = .62 Alpha = .87	Faculty survey

TABLE 2. Variable Names, Type, Values, and Data Source (*Continued*)

Variable	Type: Items and Scales (factor loadings in parentheses)	Values	Data Source
Cognitive Indicators			
• Beliefs (about student learning in own college)	Scale items: graduates of my college understand the design process (.796), graduates of my college can apply the design process (.812), students in my college learn teamwork (.733), graduates of my college understand how groups work (.757), graduates of my college are well prepared for the engineering work force (.756)	Range = 1–4[d] Mean = 3.05 S.D. = .48 Alpha = .85	Faculty survey
• Use computers in teaching	Scale items: Use of computational tools or software (.849), computer-aided or machine-aided instruction (.828)	Range = 1–3[e] Mean = 2.16 S.D. = .61 Alpha = .60	Faculty survey
• Use student-centered teaching practices	Scale items: Use of student presentations (.803), student evaluations of other students' work (.755), term/research papers (.661), multiple drafts of written work (.728)	Range = 1–3[e] Mean = 1.96 S.D. = .54 Alpha = .73	Faculty survey
• ECSEL involvement	Item	0 = no, 1 = yes Mean = .60	Faculty survey

[a]1 = low (67–75%), 2 = medium (80–81.1%), 3 = high (89.2–95%).
[b]1 = low (0.9–2.2%), 2 = medium (3.1–3.6%), 3 = high (7.7–14.9%).
[c]1 = instructor, 2 = assistant professor, 3 = associate professor, 4 = full professor.
[d]1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree.
[e]1 = never, 2 = sometimes, 3 = often.

Following a procedure recommended by Cabrera (1994), institutionalization process indicators were entered into the logistic regression analyses in four sequential steps to assess whether adding an additional set of variables accounted for significant increases in the variance in the dependent variables. In each step, the model was assessed via the goodness of fit ratio (G^2/df), proportion of cases correctly predicted (PCP), and the χ^2 for the model. Cabrera recommends that a particular logistic regression model be accepted whenever the G^2/df ratio is less than 2.5. PCP provides an overall indicator of the goodness of fit of the model. PCP values greater than .55 signify a good fit for the model. The model χ^2 assesses whether the independent variables (as a group) are significantly associated with the dependent variable. Regulative, normative, and cognitive indicators were entered on successive steps. ECSEL involvement was added separately on the fourth step due to its expected power in predicting the various changes. Listwise selection of cases was used for each model.

Tables 3 and 4 report the results of the best fitting model for each dependent variable. The logistic regression coefficients identify those institutionalization indicators that, net of all the other variables, are significantly associated with increases in the use of design projects, group projects, and sensitivity to the needs of women or minority students. The delta-p statistic reflects the incremental change in the dependent/outcome variable (e.g., change in use of design) due to a unit change on the measurement scale of the independent variable (e.g., use of student-centered teaching practices). The critical region for rejecting null hypotheses was set at $p < .10$ for two reasons. First, the sample size was small; therefore deviations from the null hypothesis needed to be bigger to demonstrate significance than they would need to be with larger sample (Moore and McCabe, 1989). Second, because this was exploratory research, the cost of making a type II error—accepting a false null hypothesis—seemed greater than the cost of making a type I error—rejecting a true null hypothesis (Hanushek and Jackson, 1977).

Summary of Findings

Increased Use of Design Projects

Sixty-three percent of all survey respondents indicated that they had increased their use of design projects in their undergraduate classes between 1990 and 1997. The net effect of the institutionalization indicators on changes in use of design in undergraduate teaching is shown in Table 3. Use of student-centered teaching practices ($p < .001$) and ECSEL involvement practices ($p < .10$) both affected the likelihood that faculty members had increased their use of design projects. Every one-unit increase (on a 1–3 scale) in the use of student-centered teaching practices increased the likelihood that faculty were using more design

projects by 21 percent. Faculty involved in ECSEL were 13 percent more likely than those not involved to have increased their use of design projects in undergraduate classes. This model correctly predicted nearly 68 percent of the cases.

Increased Use of Group Projects

Sixty-four percent of the survey respondents indicated that they had increased their use of group projects in their undergraduate classes between 1990 and 1997. The net effect of each institutionalization process indicator on the likelihood of increased use of group projects as determined by logistic regression is also summarized in Table 3. Net of all other indicators, the proportion of ECSEL courses required for graduation ($p < .10$), use of student-centered teaching practices ($p < .05$), and ECSEL involvement ($p < .01$) predicted increased

TABLE 3. Predictors of Increased Use of Design Projects and of Group Projects (scale ranges in parentheses)

	Increased Use of Design Projects		Increased Use of Group Projects	
Variables	*Beta*	Delta-P	*Beta*	Delta-P
Regulative Indicators				
Years to ABET review (1–4)	.24		−.25	
Operating budget (1–3)	−.51		.58	
Curricular requirements (1–3)	−.01		.53*	.11
Faculty rank (1–4)	.14		−.12	
Normative Indicators				
Perceived support for teaching (1–4)	−.17			
Cognitive Indicators				
Beliefs about student learning (1–4)	.47		.50	
Computer-aided teaching practices (1–3)	−.05		−.09	
Student-centered teaching practices (1–3)	1.16****	.21	.80**	.16
ECSEL Involvement (*0–1*)	.60*	.13	.86***	.17
N	212		214	
Probability	.63		.64	
G^2	246.10		240.53	
df	203		205	
G^2/df	1.21		1.12	
PCP	67.9%		76.6%	
χ^2, df	26.90, 9***		27.04, 9****	

*$p < .10$, **$p < .05$, ***$p < .01$, ****$p < .001$.

faculty use of group projects. ECSEL involvement had a large and strong impact. Faculty involved with ECSEL were 17 percent more likely to have increased their use of group projects than faculty not involved with ECSEL. Use of student-centered teaching practices also had a strong impact. For every one-unit increase (on a 1–3 scale) in the use of student-centered teaching practices, faculty members (regardless of any ECSEL involvement) were 16 percent more likely to use group projects in their undergraduate classes. Although ECSEL courses as a percentage of those required for graduation was significant at $p <$ .10 confidence level, the impact of this variable was equivocal. Increased use of group projects was most likely among faculty who worked at schools where the ECSEL courses required for graduation as a percentage of total engineering courses were in the medium range (between 3 and 4 percent). This finding may be confounded by the wide variation in size among the small sample of colleges—a limitation of this exploratory study. Further research with a larger sample of colleges may be necessary to determine if increase curricular requirements has a positive or negative impact on diffusion of reform. Nevertheless, this model is especially strong, correctly predicting 76.6 percent of the cases.

Increased Sensitivity to the Needs of Women Students

Fifty percent of the faculty indicated their sensitivity to the needs of women students had increased over the previous 7 years. Cognitive institutionalization indicators were not significant, and their inclusion reduced the goodness of fit of data of the model. The best fitting model for the net effect of each predictor of increased sensitivity to the needs of women students (which included only regulative and normative indicators) is shown in Table 4. The only indicator significantly associated with increased sensitivity to the needs of women students was perceived support for teaching ($p < .01$). Every one-unit increase (on a 1–4 scale) in faculty members' perceptions that their colleagues and administrators supported teaching was associated with a 16 percent increase in the likelihood that faculty had become more sensitive to women students' needs. This model correctly predicted nearly 60 percent of the cases.

Increased Sensitivity to the Needs of Underrepresented Minority Students

Fifty percent of the faculty respondents indicated their sensitivity to the needs of underrepresented minority students had increased since 1990. As with the model for sensitivity to women students' needs, the inclusion of the cognitive institutionalization indicators reduced the goodness of fit between the data and the minority students' needs model. The best fitting model, which includes only regulative and normative indicators, is presented in Table 4. The only indicator significantly associated with increased sensitivity to the needs of minority stu-

TABLE 4. Predictors of Increased Sensitivity to Needs of Women, Minority Students (scale ranges in parentheses)

	Increased Sensitivity to Women's Needs		Increased Sensitivity to Minorities' Needs	
Variables	*Beta*	Delta-P	*Beta*	Delta-P
Regulative Indicators				
Years to ABET review (1–4)	–.11		.02	
Operating budget (1–3)	.26		.09	
Curricular requirements (1–3)	.12		.07	
Faculty rank (1–4)	.16		.1	
Normative Indicators				
Perceived support for teaching (1–4)	.66***	.16	.66***	.16
Cognitive Indicators				
Beliefs about student learning (1–4)	—		—	
Computer-aided teaching practices (1–3)	—		—	
Student-centered teaching practices (1–3)	—		—	
ECSEL Involvement (*0–1*)	—	—	—	—
N	213		212	
Probability	.50		.50	
G^2	283.28		283.51	
df	208		207	
G^2/df	1.36		1.37	
PCP	59.6%		59.9%	
χ^2, df	11.21, 5***		9.71, 5*	

*$p < .10$, **$p < .05$, ***$p < .01$, ****$p < .001$.

dents was perceived support for teaching ($p < .01$). Every one-unit increase (on a 1–4 scale) in faculty members' perceptions that their colleagues and administrators supported teaching was associated with a 16 percent increase in the likelihood that faculty had become more sensitive to minority students' needs. This model correctly predicted nearly 60 percent of the cases.

IMPLICATIONS FOR PRACTICE IN ENGINEERING AND OTHER DISCIPLINES

The findings indicate that, even after controlling for ECSEL involvement, cognitive institutionalization indicators had a stronger influence than regulative or normative indicators on increases in faculty acceptance of teaching practices inherent in ECSEL's design goal. The use of student-centered teaching practices

and ECSEL involvement were the only consistent and unambiguously significant predictors of changes in curricular content (design), and pedagogical method (use of group projects). Despite the coalition's goal of increasing the diversity of engineering graduates, however, ECSEL involvement was unrelated to changes in faculty members' self-reported sensitivity to the needs of women or minority students. The normative institutionalization indicator of perceived support for teaching was the only significant predictor of changes in sensitivity to the needs of women students and minority students.

When the faculty survey was conducted in 1997–1998, faculty who had ever been involved in ECSEL in any way comprised about 22 percent of the total number of engineering faculty at the seven schools. Because the number of faculty involved in ECSEL was relatively small, institutionalization of ECSEL reforms required diffusion of the coalition's goals and practices to faculty who had never been involved in the coalition. Thus, the most important influences on change are those that remain significant even after controlling for reform involvement. These point to the "levers" that administrators and faculty reform leaders in engineering as well as other disciplines might pull in order to spread the reforms to other faculty, especially as external funding for any specific reform effort comes to an end.

When controlling for ECSEL involvement, the use of student-centered teaching practices predicted increased use of design and group projects in the classroom. This finding may reflect the cumulative effect of various reform efforts on changes in curriculum and faculty teaching practices. Even as ECSEL endeavored to restore teaching the art and practice of design to the engineering curriculum, other forces for reform on ECSEL campuses (e.g., ABET, industry, and deans' agendas) also advocated teaching practices that focused more on student engagement in learning than on faculty performance. It appears that as engineering faculty accepted that it was worth the effort needed to engage in such student-centered teaching practices as allowing students to evaluate each other's work, engage in research, and give presentations in class, they were also more likely to assign complex design projects and group projects. Experience at ECSEL schools suggests that one way to encourage such acceptance on the part of somewhat reluctant faculty is to encourage (if not assign) them to teach redesigned courses that require innovative teaching practices. Arranging for such a faculty member to work with a colleague who has already taught that course using active and collaborative methods may be another way to help the "newer" faculty member ease into a course that relies on innovative teaching methods. Once faculty attempt reformed practices, they are likely to try them again, even if they were not successful the first time (Moskalski, 2000).

Irrespective of ECSEL involvement, faculty members' perceptions that their administrators and colleagues support teaching in general predicted increased sensitivity to the needs of women and underrepresented minority students. This

finding suggests that administrators' and faculty leaders' efforts to promote effective teaching and learning are noticed by faculty, and those efforts may well have positive benefits for underrepresented students. Such efforts are likely to benefit all students as more faculty respond to normative pressures to take teaching seriously.

IMPLICATIONS FOR THEORY

There are at least two possible reasons why normative and cognitive institutionalization processes had more impact on diffusion of reforms than regulative institutionalization processes: degree to which the institutionalization process directly affects individual faculty and perceived opportunities to evade sanction. Accreditation, budget, and curricular requirements each involve a limited number of faculty. On each campus in the ECSEL engineering example, a small core group of faculty and administrators had responsibility for ensuring compliance with new ABET accreditation standards. On other campuses in other fields, faculty are likely to be aware of changes in accreditation standards only to the extent they have been asked to respond to new assessment efforts. Similarly, the only faculty members likely to know that some courses are externally funded are those teaching such courses, and they may be wondering if they will still be teaching the courses after external funding ends. Indeed, even some faculty teaching courses funded by a reform effort may be unaware of the external funding. Similarly, most faculty may know whether a given course number and title is required for graduation but not know whether the course includes content or methods advocated by the reform. How a course is actually taught, as well as what is taught, moreover, may vary across instructors.

Normative indicators appear to affect faculty more than regulative indicators. Socialization as well as institutionalization theories would suggest that faculty members would be quite likely to be influenced by their perceptions of the beliefs and behaviors of their peers. Given their professional status and tradition of independence, faculty may be less likely to be influenced by their perceptions of the beliefs and behaviors of their administrators. Most current faculty were socialized to their profession during a period when research was valued over teaching even more than it is now. Furthermore, the tradition for faculty autonomy in the classroom is especially strong. Therefore, some faculty may be at best dimly aware of their colleagues' and administrators' involvement in curricular and pedagogical reform efforts. More faculty, however, are likely to be aware of the extent to which their colleagues and their administrators support teaching in general. In the ECSEL engineering example, the normative institutionalization indicator of perceived support for teaching did influence increased sensitivity to the needs of women and minority students.

Cognitive institutionalization processes involve faculty members' own beliefs

and behaviors, so they have a direct affect on changes in course content and teaching method. It is perhaps no surprise that involvement in a reform effort is associated with changes that were promoted by that reform. When considering duration of reforms after external funding ends, however, changes made by faculty not directly involved in the reform effort are especially important. The ECSEL example indicates the faculty members' use of practices similar to those advocated by a reform predict adoption of practices actually promoted by the reform effort—whether or not individuals participated directly in the reform. This finding suggests that institutionalization by diffusion depends on factors that directly engage faculty rather than on factors that affect the formal or informal structures surrounding them.

Another interesting difference between regulative, normative, and cognitive institutionalization processes is the amount of evasion opportunity each offers. Individuals comply with regulative processes only to the extent that they believe the rules are right and fair, will be enforced, and that the penalties for disobeying the rules are sufficient deterrent. Few faculty are likely to fear personally the loss of accreditation for their programs. Faculty are not likely to experience direct positive or negative sanctions for teaching externally funded or elective courses. Rather, the predominating research imperative is more likely to leave faculty fearful that time and effort devoted to teaching and curricular innovation will hurt rather than help when they are up for promotion. Thus, regulative institutionalization processes leave individual faculty members a great deal of wiggle room.

Individuals comply with normative processes to the extent that they believe rules are morally right or to the extent they fear social ostracism if they disobey. Academic freedom and tradition have left the teaching practices of most tenured faculty beyond the scrutiny of their peers. Even tenure-seeking faculty have often been told that as long as their research record is good, only really bad teaching can hurt their tenure chances. As a result, although lip service has long been given to the value of "good" teaching, most faculty have no need to concern themselves with social ostracism for their conduct in the classroom. The results of this study provide some evidence that moral persuasion is now having some affect, but normative institutionalization processes still give faculty much room to disregard the latest set of socially acceptable teaching practices.

In contrast, individuals comply with cognitive institutionalization processes because they find it hard to conceive of alternatives. The reform is no longer seen as the new way, or even the best way. It becomes, instead, the only way. The history of American postsecondary education indicates there have been previous shifts in cognitive assumptions about how to teach which kind of content to which students (Stark and Lattuca, 1997; Veysey, 1973). Midway through the nineteenth century, for example, college curricula shifted from an emphasis on using memorization and recitation for training future clergy to using lectures

for educating an economically productive populace. The German university model adapted by many research universities in the late nineteenth century influenced some faculty to provide structured laboratory experiences to future disciplinary scholars. Some reforms in the first half of the twentieth century emphasized liberal education for the well-rounded citizen and included involving students in class discussions.

Since then, curricular reforms have cycled through successive periods of attention to specialization, vocational training, or liberal education, but the primary teaching method has remained lecture (Cuban, 1999). ECSEL reforms, like many current reform efforts in professional fields, reflect a vocational emphasis and attend to teaching methods as well as to the needs of diverse students. Academic leaders, accrediting agencies, and employers are calling for college and university faculty across all disciplines to move from a teacher-centered to a student-centered approach, to emphasize development of students' professional competencies, and to produce graduates ready to work on professional teams to solve real world problems (Barr and Tagg, 1995; Lopez, 1996; Schilder, 1992). It still remains to be seen, however, whether these particular reforms will lead to pervasive changes in faculty teaching practices and sensitivity to the needs of all students.

Acknowledgments. This study was supported by a grant from the Engineering Education and Centers Division of the National Science Foundation to Howard University (Grant No. 634066D) to support the Engineering Coalition of Schools for Excellence in Education and Leadership (ECSEL). The opinions expressed here do not necessarily reflect the opinions or policies of the National Science Foundation, and no official endorsement should be inferred.

APPENDIX A. Bivariate Relationships between Institutionalization Indicators and Changes in Teaching Content, Method, and Sensitivity to Diverse Students

Items	Use of Design	Use of Groups	Sensitivity to Women	Sensitivity to Minorities
Regulative Indicators				
Years to ABET review		**		
Operating budget funding for ECSEL courses		*		*
ECSEL courses required for graduation as percent of total courses		**		
Faculty rank				

APPENDIX A. Bivariate Relationships between Institutionalization Indicators and Changes in Teaching Content, Method, and Sensitivity to Diverse Students

Items	Use of Design	Use of Groups	Sensitivity to Women	Sensitivity to Minorities
Normative Indicators				
Perceptions of Support for Teaching				
My college of engineering's administration supports teaching			**	**
Sufficient incentives are given for teaching in my college			**	***
My university's administration supports teaching			**	***
Faculty in my college of engineering support teaching	**			
My department chairperson supports teaching				
Cognitive Indicators				
Beliefs About Student Learning				
Graduates of my college understand design process				
Graduates of my college can apply design process				
Students in my college learn teamwork		*		
Graduates of my college understand how groups work				
Graduates of my college are well prepared for the engineering workforce				
Computer-Aided Teaching Practices				
How often used computational tools or software in UG classes	*		**	
How often used computer-aided or machine-aided instruction in UG classes	*			
Student-Centered Teaching Practices				
How often used student presentations in UG classes	***	***		
How often used student evaluation of other students' work in UG classes	**	***		
How often used term/research projects in UG classes	***			
How often used multiple drafts of written work in UG classes	***	**		**
Involvement				
ECSEL involvement	***	***		

*$p < .10$, **$p < .05$, ***$p < .01$.

ENDNOTE

1. There were a total of 1,198 engineering faculty at the seven ECSEL schools. Surveys were sent to all faculty at the smaller schools: CCNY, Howard, and Morgan State. Surveys were mailed to all faculty who had participated in ECSEL and a random sample of 100 non-ECSEL faculty at the large public schools: Penn State, and the Universities of Maryland and Washington. At the request of the institution, surveys were only mailed to faculty who participated in ECSEL at MIT.

REFERENCES

Association of American Colleges (1985). *Integrity in the College Curriculum: A Report.* Washington, DC: Author.

Augustine, N. R. (1996). Rebuilding engineering education. *Chronicle of Higher Education,* May 24, B1–B2.

Barr, R. B., and Tagg, J. (1995). From teaching to learning—a new paradigm for undergraduate education. *Change* (November, December), 13–25.

Braxton, J. M., and Hargens, L. L. (1996). Variation among academic disciplines: Analytics frameworks and research. In J. C. Smart (ed.), *Higher Education: Handbook of Theory and Research,* Vol. 11, pp. 1–46. New York: Agathon Press.

Bringle, R. B., and Hatcher, J. A. (2000). Institutionalization of service learning in higher education. *Journal of Higher Education* 71(3): 273–290.

Cabrera, A. F. (1994). Logistic regression analysis in higher education: an applied perspective. In J. C. Smart (ed.), *Higher Education: Handbook of Theory and Research*, Vol. 10, pp. 225–256. New York: Agathon Press.

Civian, J. T., Arnold, G., Gamson, Z. F., Kanter, S., and London, H. B. (1996). Implementing change. In J. G. Gaff and J. R. Racliff (eds.), *Handbook of the Undergraduate Curriculum: A Comprehensive Guide to Purposes, Structures, Practices, and Change,* pp. 647–660. San Francisco: Jossey-Bass.

Colbeck, C. L. (1999). Assessing institutionalization: Indicators of lasting reform. *Proceedings of the 29th ASEE/IEEE Frontiers in Education Conference*, pp. 13c1: 1–6). Piscataway, NJ: IEEE TAB Products (tab-promo@ieee.org).

Conrad, C. F. (1978). A grounded theory of academic change. *Sociology of Education* 51(2): 110–112.

Cuban, L. (1999). *How Scholars Trumped Teachers: Change Without Reform in University Curriculum, Teaching and Research, 1890–1990.* New York: Teachers College Press.

Curry, B. K. (1992). *Institution Enduring Innovations: Achieving Continuity of Change in Higher Education.* ASHE-ERIC Higher Education Report No. 7. Washington, DC: The George Washington University, School of Education and Human Development.

Dannefer, E. F., Johnston, M. A., and Krackov, S. K. (1998). Communication and the process of educational change. *Academic Medicine* 73(9): S16–S23.

DiMaggio, P., and Powell, W. W. (1983). The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. *American Sociological Review* 48(2): 147–160.

Engineering Workforce Commission (1997). Engineering degrees, 1996: numbers of women, minority graduates reach all time highs. *Engineers* 3(1): 3–8.

Fairweather, J. S., Colbeck, C. L., Paulson, K., Campbell, S. E., Bjorklund, S., and Malewski, E. (1996). *ECSEL: Year 6 Evaluation Report.* University Park: Center for the Study of Higher Education, The Pennsylvania State University.

Goodman, P. S., and Associates (Eds.) (1982). *Change in Organizations.* San Francisco: Jossey-Bass.
Hanushek, E. A., and Jackson, J. E. (1977). *Statistical Methods for Social Scientists.* New York: Academic Press.
Kanter, R. M. (1983). *The Change Masters: Innovations for Productivity in the American Corporation.* New York: Simon & Schuster.
Lattuca, L. R., and Stark, J. S. (1994). Will disciplinary perspectives impede curricular reform? *Journal of Higher Education* 65(4): 401–426.
Levine, A. (1980). *Why Innovation Fails.* Albany: State University of New York Press.
Lopez, C. L. (1996). *Opportunities for Improvement: Advice from Consultant-Evaluators on Programs to Assess Student Learning*. Chicago: North Central Accreditation Commission on Institutions of Higher Education.
March, J. G. (1994). *A Primer on Decision Making: How Decisions Happen.* New York: Free Press.
Meyer, J. W., and Rowan, B. (1977). Institutionalized organizations: formal structure as myth and ceremony. *American Journal of Sociology*, 83(2): 340–363.
Moore, D. S., and McCabe, G. P. (1989). *Introduction to the Practice of Statistics.* New York: W. H. Freeman and Company.
Moskalski, N. M. (2000). *Personal and organizational factors that enhance or constrain faculty implementation of team activities in their classes*. Unpublished doctoral dissertation, The Pennsylvania State University.
Palomar Community College District (1999). District priorities for institutionalization project. Palomar Community College District, San Marcos, CA (ED431490)
Powers, J. B. (2000). The use of institutional incentive grants for strategic change in higher education. *Review of Higher Education* 23(3): 281–298.
Ratcliff, J. L. (1997). What is curriculum and what should it be? In J. G. Gaff and J. R. Ratcliff (eds.), *Handbook of the Undergraduate Curriculum: A Comprehensive Guide to Purposes, Structures, Practices, and Change,* pp. 5–29. San Francisco: Jossey-Bass.
Reichart, M., and Absher, M. (1997). Taking another look at educating African American engineers: the importance of retention. *Journal of Engineering Education* 86(3): 241–253.
Rogers, E. M. (1983). *Diffusion of Innovations* (3rd ed.). New York: Free Press.
Scott, W. R. (1995). *Institutions and Organizations.* Thousand Oaks, CA: Sage Publications.
Schilder, J. (1992). Work teams boost productivity. *Personnel Journal* 71(1): 67–71.
Stark, J. S., and Lattuca, L. R. (1997). *Shaping the College Curriculum: Academic Plans in Action.* Needham Heights, MA: Allyn & Bacon.
Stark, J. S., and Lowther, M. A. (1989). Exploring common ground in liberal and professional education. In R. A. Armour and B. Fuhrmann (eds.), *Integrating Liberal Learning and Professional Education, New Directions for Teaching and Learning No. 40*, pp. 7–20. San Francisco: Jossey-Bass.
Toombs, W., and Tierney, W. (1991). *Meeting the Mandate: Renewing the College and Departmental Curriculum.* ASHE-ERIC Higher Education Report No. 6. Washington, DC: The George Washington University, School of Education and Human Development.
Veysey, L. (1973). Stability and experiment in the American undergraduate curriculum. In C. Keysen (ed.), *Content and Context*, pp. 1–63. New York: McGraw-Hill.

Received September 26, 2000.