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PROFITABILITY AND COMPATIBILITY FACTORS EXPLAINING FACULTY'S POST-ADOPTION BEHAVIORS OF TEACHING AND LEARNING INNOVATIONS IN RESEARCH ONE UNIVERSITIES

A Thesis in

Instructional Systems

by

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ABSTRACT

In recent years, shifts in emphasis in higher education toward learner-centered environments have triggered faculty's interests in initiating teaching and learning innovation and demanding more support from the teaching and learning centers and more funding/grants from the university to facilitate the adoption and continuation of such innovations (Diamond, 1998). However, few studies have systematically examined the continuation of teaching and learning innovations (Ishler, Johnson, & Johnson, 1998; Lane, 2001).

The purpose of this study was to create predictive models to systematically explain the impact of 6 *profitability* factors—Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes and 4 *compatibility* factors—Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation on the *sustaining*, *transferring*, and *diffusing* of a teaching and learning innovation.

From December 2005 to January 2006, a total of 163 faculty participants from a Research I university completed an online survey whose responses were used for data analysis. The results of factor and reliability analysis confirmed that the researcher-designed measurement instrument, *Survey of Post–adoption of Teaching and Learning Course Changes*, was valid for this purpose and responses were reliable.

Six logistic regression models were created based on the three dependent variables to examine whether or not faculty sustained, transferred, and diffused their

innovation—as explained by the 10 predictors. The six models were all significant. Six multiple regression models were then run to further examine the extent to which the changes were sustained, transferred, and diffused as predicted by the 10 predictors. The original diffusing model and the final sustaining, transferring, and diffusing models were all significant.

Predictions to sustain a teaching and learning innovation would be made based on P&T Feedback Received about Course Changes and Influence of Course Changes on P&T. Predictions to transfer a teaching and learning innovation would be made based on P&T Feedback Received about Course Changes, Innovation Philosophy, and Student-Centered Teaching Philosophy. Predictions to diffuse a teaching and learning innovation would be made based on P&T Feedback Received about Course Changes, Teaching Motivation, P&T Focus on Teaching and Research, and Organizational Support.

This study provides a research framework to better explain the sustaining, transferring, and diffusing of an instructional innovation. Moreover, this study bridges the gap between the literature on organizational innovation and instructional innovation as well as prior-, during-, and post-adoption behaviors. This study verifies some of the findings from sustainability research and added to the understanding of factors explain transfer and diffusion.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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Chapter 1

Introduction

Background

Since the 1980s, American colleges and universities have made many efforts to improve teaching and learning on their campuses (Lazerson, Wagener, & Shumanis, 2000). These efforts are reflected in two trends in curricular/course design: 1) a learner-centered approach, often combined with technological advancement related to the Internet (Diamond, 1998); and 2) assessment of student learning (Lazerson et al., 2000). The rationale behind the need for such reform in higher education is to enhance teaching and learning through a variety of instructional innovations such as collaborative learning, cooperative learning, service learning, and technology-based teaching (Lazerson et al., 2000).

A survey by the Higher Education Research Institute (HERI) at the University of California–Los Angeles in 1998 reported approximately a 50% increase in faculty using innovative teaching practices, such as cooperative learning and group projects, and a 15% decrease in the number of faculty who relied heavily on lectures in undergraduate courses (Lazerson et al., 2000). However, the deep-rooted U.S. campus culture in Research I universities emphasizes that "scholarly contributions to teaching and learning are considered add-ons" (Shapiro, 2006, p. 42). Therefore, one has to question how change at the institutional level and the teaching and learning level can be sustained and diffused to

keep U.S. higher education innovative and competitive in the market and of service to the public (Miller, 2006).

Which road will a faculty member choose to take—to be an excellent researcher who does not teach well, to be an excellent teacher who does not conduct or publish research, or to be a person who integrates excellence in both research and teaching? The decision to make changes in one's scholarly teaching may be a daring one for some untenured faculty; to be dedicated to innovative teaching practice requires commitment and perseverance. To give up one's innovative teaching practices because of a lack of support or the existence of other obstacles may be a difficult decision facing some faculty innovators. The challenges that each faculty innovator encounters will vary. Thus, ascertaining factors that influence faculty members' choices to continue or discontinue their innovations may help prepare them for the challenges of continuing their innovations.

Although there is ample literature describing change and innovation in higher education, only a few studies have systematically unfolded the process or captured the scenario from institutionalization to diffusion (Curry, 1992; Levine, 1980). Thus, the present study addresses these concerns: Which factors best explain faculty's sustaining, transferring, or diffusing of teaching and learning innovations—organizational support, collegiality, promotion and tenure, department culture, teaching philosophy, or teaching motivation? This study is expected to provide insights to faculty innovators who wish to handle the challenges of pioneering and find their own strength to continue their innovation. The study additionally is expected to provide insights for university

administrators, such as provosts and deans, as they support high-quality scholarship in teaching and learning.

Problem Statement

Concern about conflicts between quality teaching in course/curricular design and redesign, and research productivity in journal publication has been raised in U.S. higher education in recent years (Shapiro, 2006; Wolverton, 1998). Diamond (1998) reported that:

> National studies sponsored by the National Institute of Education, the Association of American Colleges and Universities, and the Carnegie Foundation for the Advancement of Teaching have all identified significant systemic problems. Their findings point to a need to create orderly, effective change in curricula, set new priorities for faculty, establish systems for evaluating and rewarding success in teaching, and create healthy, vital environments in which students could learn (p. xi).

Thus, shifts in emphasis in higher education toward learner-centered environments have triggered faculty's interest in initiating teaching and learning innovation and created greater demands for assistance from teaching support centers on campuses and for more funding from colleges or universities (Diamond, 1998). Also, the advancement of cutting-edge technology innovations (Martindale & Wiley, 2005) such as online courseware, social software tools, and information learning and organizing tools such as blogs and wikis have opened up opportunities for faculty to integrate technology

into their teaching practice to improve their students' learning. The present study sought to identify factors that led to the successful sustaining, transferring, or diffusing of such teaching and learning innovations, and to provide empirical information to faculty and administrators about potential effects of their investment into curricular design or instructional innovation.

A review of innovation articles led to one general impression: There were more studies about the prior- and during-adoption periods of an innovation than the post-adoption period. The reason that innovation studies addressed the first two periods of adoption more often probably had to do with the length of time it takes to see effects. Longitudinal studies that track pre-, during-, and post-adoption behaviors take many years to complete. The duration of pre- and during-adoption also is shorter. The challenge for conducting post-adoption studies is finding valid cases for study if the innovation was implemented several years ago.

However, few studies have been conducted to examine factors that impact the success or failure of a teaching and learning innovation. Hannan, English, and Silver's (1999) study emphasized the impact of various innovation variables, such as scope, types, innovators' expertise, reasons for innovation, and sources of inspiration and encouragement on teaching and learning innovation in U.K. higher education. Davis, Lawrence, Alexander, and Hussain (1982) examined the impact of an environmental factor, organizational support, on teaching and learning innovation in U.S. higher education. Lane (2001) explored the phenomenon of teaching and learning innovation at a research university in the northeastern U.S. Her case study discussed several themes that had an impact on sustaining teaching and learning innovation. Except for Lane

(2001), previous studies did not systematically determine which factor most affected faculty's sustainability of course innovation. If such answers could be provided, then strategies for coping with obstacles and providing incentives to facilitate the continued use of innovation could be considered and planned.

There are voluminous studies related to organizational innovation because it matches better with the interests of a university's administrators, such as college deans, vice provosts, or presidents. Few studies have been conducted about teaching and learning innovation, especially in the area of higher education. Clarke, Ellett, Bateman, and Rugutt (1996) pointed out that most literature related to innovation and change in higher education seemed to be descriptive and theoretically oriented in nature. Clarke et al. concluded that "only a few studies make explicit reference to systematically obtained data and/or employ theoretical orientations (Dill & Friedman, 1979)" (p. 1). Thus, a study that could make explicit reference to systematically obtained empirical data is needed.

Levine (1980) indicated that profitability and compatibility were two important factors during the post-adoption stage of innovation. The findings from the studies of Rogers and Shoemaker (1971) and Levine (1980) suggested that profitability seemed to be more crucial than compatibility in terms of sustaining *organizational innovation*. Lane (2001) found specific themes that impacted faculty's sustainability in *teaching and learning innovations* from her faculty participants: promotion and tenure; support and collegiality; reward, incentive and recognition; teaching philosophy; student impact; and general education. But how do profitability and compatibility in the post-adoption of an organizational innovation map onto the specific factors for the post-adoption of a teaching and learning innovation in higher education?

Research Assumptions and Studied Variables

This study used the conceptual terms *profitability* and *compatibility* to create a theoretical model and to examine faculty's continuation of teaching and learning innovation. Factors suggested from the previous studies (Bess, 1977; Davis, Lawrence, Alexander, & Hussain, 1982; Deci, Kasser, & Ryan, 1997; Hannan, & Silver, 2000; Lane, 2001; Massy, Wilger, & Colbeck, 1994; Obenchain, Johnson, & Dion, 2002) were mapped on either profitability or compatibility factors based on whether each factor was related to the availability of benefits or fit with the innovation. The resulting theoretical framework for this study is shown in Figure ***1-1*** and includes the factors of organizational support, collegiality, promotion & tenure, department culture, teaching philosophy, and teaching motivation.

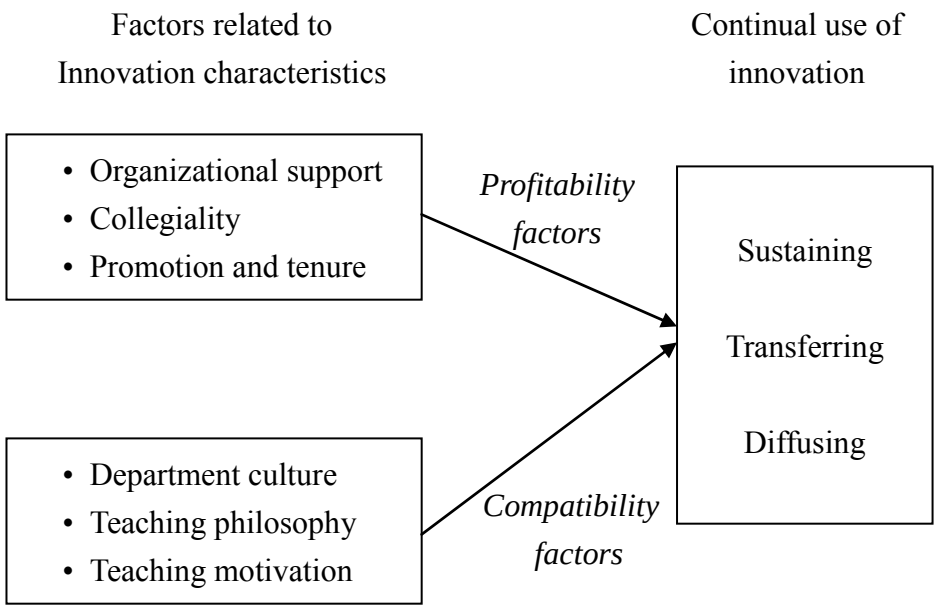

*Figure **1-1***. Theoretical framework for the relationship between the six independent variables and three dependent variables

The six independent variables (i.e., predictor variables, predictors, or factors) were later split into 10 factors after factor analysis. The empirical framework for the relationship between the 10 independent variables and three dependent variables (i.e., outcome variables) is presented in Figure ***1-2***. Three independent variables were expanded to six profitability factors—Organizational Support, Collegiality within the Department, Collegiality above the Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes. Another three independent variables were expanded to four compatibility factors—Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation. The three dependent variables investigated were three post-adoption behaviors of an instructional innovation—sustained or not, transferred or not, and diffused or not. In addition, the three dependent variables were examined in terms of the extent to which such an innovation was sustained, transferred, and diffused.

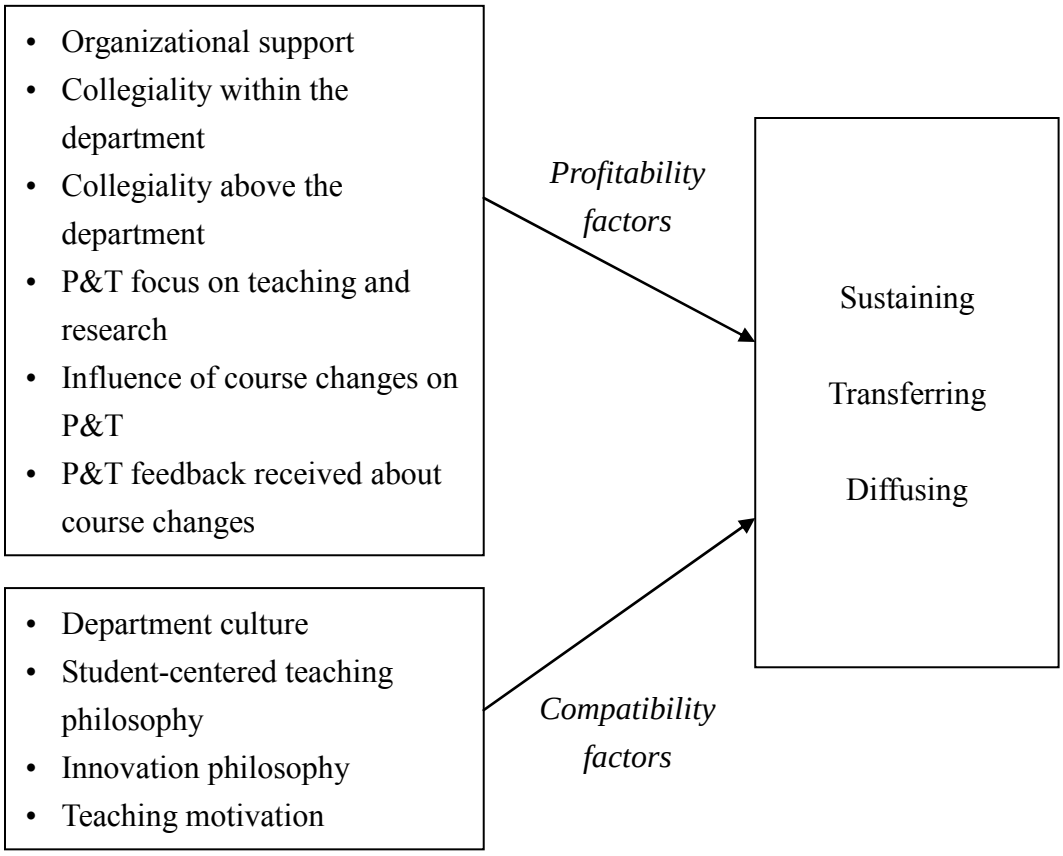

Figure 1-2. Empirical framework for the relationship between the 10 independent variables and three dependent variables

These 10 factors were assumed to be related to the adoption or sustaining of a teaching and learning innovation and were chosen from the literature review and conversations with content experts and faculty innovators. However, it was not yet known whether these factors carried over as predictors of the transferring and diffusing of individual innovation. This led to this study's hypothesis that both profitability and compatibility factors were important to the post-adoption of teaching and learning innovations as measured by faculty's sustaining, transferring, and diffusing of their teaching and learning innovations. If this prediction were found to be supported, then

further explanation about factors that would be more crucial or more related to compatibility or profitability could be provided.

Purpose

The main purpose of this study was to create predictive models to systematically explain the impact of six *profitability* factors—Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes—and four *compatibility* factors—Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation—on the *sustaining, transferring*, and *diffusing* of a teaching and learning innovation. In order to attain this aim, this study investigated: 1) the relationship between predictors—six profitability and four compatibility factors—with faculty's sustaining, transferring, and diffusing of their teaching and learning innovation; 2) whether or not faculty sustained, transferred, and diffused their teaching and learning innovation, as predicted by the 10 predictors; 3) the extent to which all of the predictors contributed to the sustaining, transferring, and diffusing of teaching and learning innovation; and 4) which factors are most influential in the continuation of a teaching and learning innovation.

Research Questions

This study had four primary and three ancillary research questions.

Primary Research Questions

RQ 1: What is the relationship of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered teaching philosophy, Innovation Philosophy, and Teaching Motivation) with the *sustaining, transferring,* and *diffusing* of a teaching and learning innovation?

RQ 2: What are the relative contributions of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation) in explaining/predicting *whether or not faculty sustained* their teaching and learning innovations?

RQ 3: What are the relative contributions of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation) in explaining/predicting *whether or not faculty transferred* their teaching and learning innovations?

RQ 4: What are the relative contributions of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation) in explaining/predicting *whether or not faculty diffused* their teaching and learning innovations?

Ancillary Research Questions

RQ 5: What are the relative contributions of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation) in explaining/predicting the *proportion* of the changes *sustained?*

RQ 6: What are the relative contributions of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation) in explaining/predicting *how many* of the changes were *transferred* for each faculty innovator?

RQ 7: What are the relative contributions of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation) in explaining/predicting the *number of faculty* to whom the changes were *diffused?*

Significance

This study is expected to be a useful reference for faculty interested in continuing a teaching and learning innovation and for university administrators interested in facilitating the continuation of innovation in their institutions. Faculty innovators should consider factors that may affect the continuation/discontinuation of the innovation before they invest a great amount of time and effort in it. The impact of profitability and compatibility factors on continuing or discontinuing an innovation may remind the instructors of the existence/nonexistence of profitability factors such as organizational support and promotion and tenure and compatibility factors such as teaching philosophy and teaching motivation in their scenario. It was also expected that the findings from this study could help instructors perceive potential benefits, rewards, support, and resources available as well as the fit between their personal beliefs and the innovation itself.

Stakeholders in higher education institutions, for example the vice provost for undergraduate education or department chair, may need to reconsider how to provide

optimal teaching and working environments or institutional culture that would encourage faculty's continuing of their teaching and learning innovations. It is also important for the director or course consultants in university-level teaching and learning agencies to determine whether the timing or conditions for initiating a particular course change are appropriate or not.

Furthermore, this study adds to the literature base by testing the findings from previous studies (Lane, 2001; Levine, 1980; Silver, Hannan, & English, 1997). This study also merges their findings to the post-adoption of teaching and learning innovation in higher education. That is, this study generated predictive models that identify and explain some crucial profitability and compatibility factors that impact the sustaining, transferring, and diffusing of a teaching and learning innovation.

Scope

This study represents a snapshot of 165 innovators at several points in the post-adoption period of the innovation process rather than a longitudinal study of several innovators across the stages of prior-, during-, and post-adoption. The investigation was focused primarily on teaching and learning innovations at the undergraduate teaching and learning level.

Definitions of Terms

A brief definition for each term used in this study is provided below.

Innovation

"An innovation is an idea, practice, or object perceived as new by an individual" (Rogers & Shoemaker, 1971, p. 19). An innovation is not necessarily new knowledge but it is definitely something new to the adopter (Rogers & Shoemaker, 1971). In this study, innovation refers to changes made in efforts to cause teaching to work in different and better ways.

Organizational Innovation

Organizational innovation is initiated in a company or an educational institution at the managerial level. In this study, the term describes a top-down innovation (Levine, 1980) advocated by higher education stakeholders.

Teaching and Learning Innovation

Teaching and learning innovation refers to the bottom-up (Levine, 1980) or faculty innovation, that is, an innovation is initiated by faculty innovators themselves. This term is used interchangeably with the terms *instructional innovation, course innovation,* or *course changes.*

Post-Adoption Behaviors of Innovation

Post-adoption behaviors of innovation relate to the last phase of the innovation process and are defined by Levine (1980) as the institutionalization of innovation. Four behaviors are defined below.

Terminating. Terminating refers to when faculty decide not to continue their course innovation. This concept is the opposite of sustaining and therefore was not chosen as the outcome variable in this study.

Sustaining. An innovation is considered to be sustaining if it is continually used after the adoption of that innovation. In this study, sustaining was examined in terms of two aspects: 1) status—whether an innovation was sustained or not sustained; and 2) the proportion of the original course innovation ideas that were preserved in the same course taught by the same instructor in different semesters.

Transferring. When an innovation is used in different contexts or situations, it is considered to be in the category of transferring. In this study, transferring refers to faculty innovators who used the innovation from the original course in another course they teach. Thus, transferring was examined in terms of: 1) status—whether an innovation was transferred or not; and 2) how many of the original course innovation ideas were preserved in different courses taught by the same instructor in follow-up semesters.

Diffusing. When an innovation is passed along to different people through contact or social interaction, it is considered to have been diffused among possible user groups (Rogers & Shoemaker, 1971). In this study, diffusion was examined in terms of: 1)

status—whether an innovation was diffused or not; and 2) faculty's knowledge of the number of people to whom the original innovation ideas were diffused.

Profitability

Profitability refers to the perceived advantages or rewards identified by the innovator or adopter before adopting an innovation (Rogers & Shoemaker, 1971). Profitability is something that may satisfy the needs of the adopters (Levine, 1980). In this study, profitability refers to both the noneconomic benefits and economic return and such as funding or support that impact faculty's continuation/discontinuation of their innovation. Noneconomic benefits were defined by Levine (1980) as the availability of "security, prestige, peer approval, growth, efficiency, and improvement in the quality of life, to name only a few" (p. 18). Organizational Support, Collegiality with and above the Department, and three perspectives related to promotion and tenure—P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes—were the six profitability factors investigated.

Organizational support. Organizational support refers to the overall support or assistance gained from the department, college, or university. Four types of organizational support were examined in this study: financial support, verbal support, technical support, and consultation support. Financial support refers to a grant or funding that faculty received to design, develop, or implement their course changes. Verbal support refers to praise or encouragement faculty received from any authority figures in the university (Hannan, 1998). Technical support refers to computer-related assistance

from university staff (e.g., laboratory assistant or technician). Consultation support (Davis et al., 1982) refers to advice or help from a course consultant, instructional designer, or Web designer about the faculty member's course design or development.

Collegiality. Collegiality refers to an interactive relationship that exists among colleagues (Webb, 1999) as well as mutually supportive relationships among colleagues within the same academic units (Massey et al., 1994). Three types of collegiality examined in this study were: discussion with colleagues about course changes, collaboration with colleagues on one's own course changes, and collaboration with colleagues on colleagues' course changes. In addition, these three types of collegiality were examined at two levels—collegiality at the department level and collegiality above the department level.

Promotion and tenure. The first aspect of promotion and tenure refers to faculty's perception of the weight assigned to the scholarly activity of teaching and research. The other two aspects are related to the influence of the course changes and promotion and tenure feedback received about course changes. Three important concepts captured in this study were: 1) faculty's perception of the weight assigned to teaching and research in the department and above the department (at the college and university levels); 2) positive or negative influence of course changes on P&T at the department and above-department levels; and 3) impact of course changes on student and peer feedback that may later impact faculty's P&T evaluation process.

Compatibility

Compatibility refers to "the degree to which the norms, values, and goals of an innovation are congruent with those of the host" (Levine, 1980, p. 17). In this study, compatibility refers to whether an innovation fits within its external environment or the adopter's teaching beliefs and intrinsic needs. Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation were the four compatibility factors investigated.

Positive department culture. Positive department culture is specific to the context of higher educational institutions. This study adopted the ideas of department culture from the organizational culture model developed by Kabanoff, Waldersee, and Cohen (1995); Obenchain, Johnson, and Don (2002); and Smart and John (1996). The two types of organizational culture examined in this study were: adhocracy and clan culture. An adhocracy type of department culture is associated with the ideas of entrepreneurship, creativity, and adaptability (Kabanoff et al., 1995; Smart & John, 1996). A clan type of department culture is associated with the ideas of cohesiveness, participation, teamwork, and sense of family (Kabanoff et al., 1995; Smart & John, 1996). Three dimensions associated with department culture were adapted from the instrument by Smart and John (1996): department head, department glue, and department climate. In the present study, a department culture which is more adaptable and cohesive was considered as positive.

Teaching philosophy. Teaching philosophy refers to faculty's teaching beliefs in regard to degree of student-centeredness and desirability of innovation practice. The first dimension relates to an instructor's belief about student-centered practice. The ideas are

associated with placing students into two categories: active and independent learners. The second dimension refers to an instructor's belief about: 1) teaching as a refining process; 2) teaching as a trial-and-error process; 3) teaching as a gradual adaptation process; 4) teaching as a continual learning process; and 5) teaching with a variety of instructional methods.

Teaching motivation. When a teacher is highly committed to teaching, s/he is usually committed to playing a significant role in students' educational and personal development. Moreover, three psychological needs related to teaching motivation include: need to enhance autonomy, need to enhance competence, and need to increase relatedness (Deci, Kasser, & Ryan, 1997). The above ideas were adapted from a study performed by the Northwest Regional Educational Laboratory (2001) and incorporated into this study: 1) the need to enhance autonomy was defined as being flexible in selecting one's teaching methods and opportunities to justify one's teaching strategies; 2) the need to enhance competence was defined as valuing students' feedback on course changes and willingness to accept difficult and attainable challenges to make course changes; and 3) the need to increase relatedness was defined as feeling connected to colleagues about their course changes and having opportunities to interact with colleagues with similar research interests.

Limitations

The reader should interpret the results of this study with the following limitations in mind. First, this study uses a self-report measure of post-adoption of course changes.

Self-report measures perception and may not equate with actual behavior. Second, the three types of post-adoption behaviors were measured at a particular point of time; thus, it may not reflect the complete picture of faculty's post-adoption behavior. Third, the findings may be applied only to similar institutions and faculty receiving funding/support from teaching support centers or other units of a university in order to work on their teaching and learning innovations. Fourth, study findings may not apply to university administrators who are interested in implementing a top-down innovation at their institutions because the focus of this study was on the post-adoption of a teaching and learning innovation, most of which is individually initiated.

Chapter 2

Literature Review

In order to answer the questions posed in chapter 1, this study was developed to systematically address the many factors contributing to faculty's post-adoption of teaching and learning innovations. The conceptual framework unfolds gradually through layers of theories of innovation and diffusion, studies about organizational innovation, and studies about teaching and learning innovations. A review of definitions and theories from previous studies then anchors the literature relevant to the current study.

Conceptual Framework

Studies about innovation focus on factors that act to facilitate or inhibit the adoption of innovation. However, the nature of these factors may vary by the context of where an innovation occurs, for instance, whether it is at the organizational or the individual level and whether it is in a corporate or an academic setting. Organizational innovation studies (Levine, 1980; Rogers, 2003; Rogers & Shoemaker, 1971) address the impact of factors as well as themes characterizing the innovation as profitable to or compatible with the success or failure of the innovation results. Studies about teaching and learning innovation (Davis et al., 1982; Lane, 2001; Silver, 1998; Silver, Hannan, & English, 1997) usually address factors or themes impacting innovation results without characterizing them as profitable or compatible.

No known attempt has been made to establish a generic model that maximally accounts for the outcomes with the factors that impact the post-adoption of a teaching and learning innovation. The conceptual model of this study was built upon the literature base of innovation, diffusion, and organizational innovation and extended that theory base to describe the relationships between the impact of profitability and compatibility factors on faculty's sustaining, transferring, and diffusing of their teaching and learning innovation (see Figure ***2-1***).

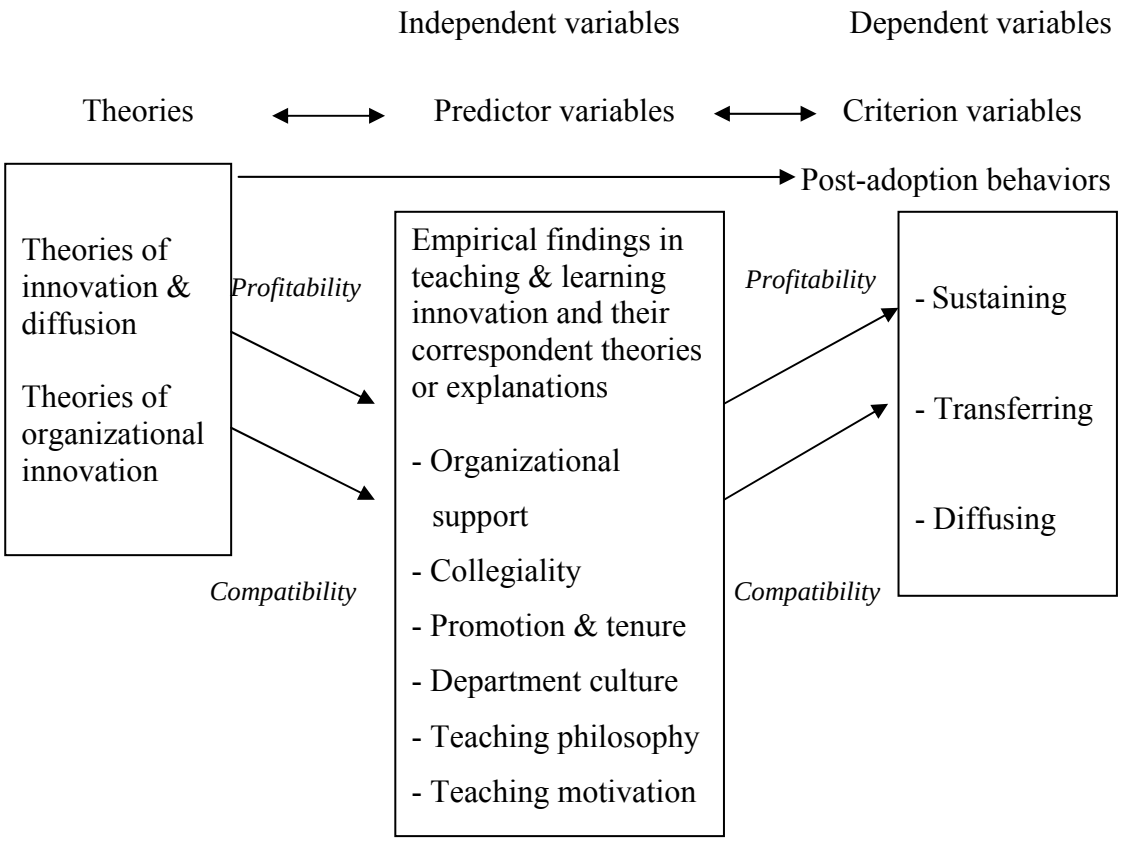

*Figure **2-1.*** Conceptual model

Theories of Innovation and Diffusion

Theories of innovation come from the literature of various disciplines. These theories define the innovation itself (i.e., characteristics, type, and definition) or are related to the innovation processes in which theories of diffusion are embedded. An innovation can occur at an organizational setting or an individual level—the former is known as organizational innovation, while the latter is individual innovation. Teaching and learning innovations are viewed as a type of individual innovation in this study because most of them were initiated by the faculty themselves. Though organizational innovation was initiated at the administrator level, it was assumed that the literature related to innovation processes could be applied to individual innovation, as well. Thus, theories of organizational innovation were included in the framework. The literature review was built on the conceptual framework from the innovation literature, as shown in Figure **2-2**.

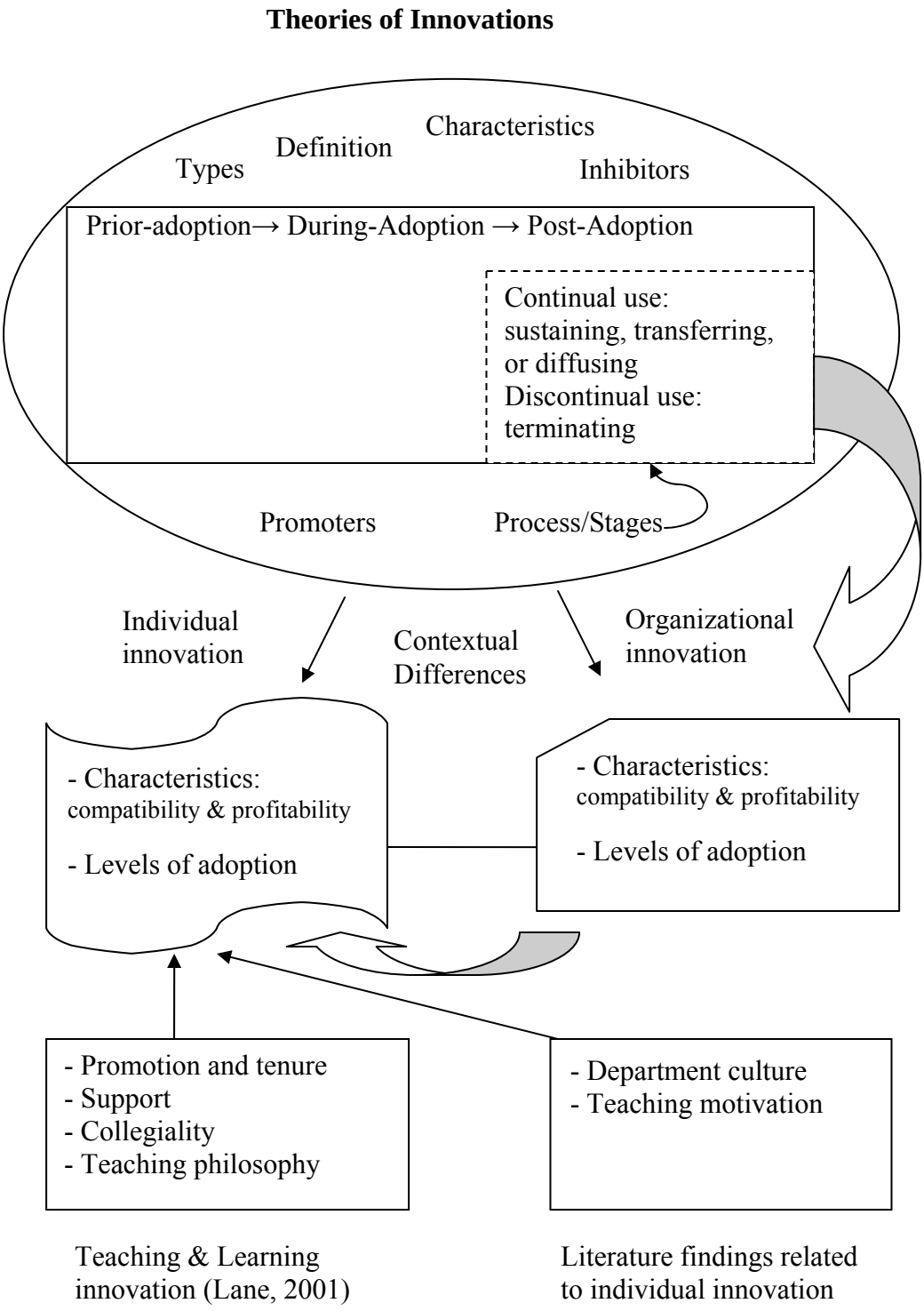

Figure2-2. Conceptual framework

Defining Innovation

Innovation is "a deliberate process (or product), directed towards (but not necessarily achieving) improvement, which may involve originality or adaptation" (Hannan & Silver, 2000, p. 10). The words *innovation* and *change* have been used interchangeably in educational practice since the 1980's (Hannan & Silver, 2000). However, the word *change* is a broader concept than *innovation*. Innovation is associated with improvement, and thus usually implies change for the better (Silver, 1998). In education, innovation is often a synonym for *new technology* (Silver, Hannan, & English, 1997). Innovation does not necessarily include the use of new technology, but the use of new technology implies innovation if the motive is to enable change for the better. Therefore, readers of this study should bear in mind that the term *change* is broader than *innovation,* and innovation is broader than *new technology*.

Levels and Directions of Innovation

Innovation or change can occur at the individual or the social system level. Rogers and Shoemaker (1971) stated that these two levels are interrelated. That is, change in a social system (e.g., adoption of a course management system at the school level) will eventually fall to the individual to adopt that change. Similarly, the accumulated effort of an individual to change may eventually produce a system-level change (e.g., after one faculty member demonstrated the use of a course management system in his/her class, the whole department decided to model this type of technology use). These two processes for change suggest that the direction of change can be bottom-

up or top-down (Levine, 1980). *Bottom-up* change refers to change initiated at the individual level, and therefore is called teaching and learning innovation. *Top-down* change refers to change initiated at the social system level, and therefore is called organization-imposed innovation (Levine, 1980). The innovation process includes both levels of change; therefore, it is important to review both types of innovation studies.

Innovation Process: Adoption and Diffusion

Innovation seems to be inseparable from the concept of adoption. Whenever an innovation is launched, adoption seems to be the expected outcome. That is, people believe, inappropriately, that the adoption of an innovation implies successful implementation of the innovation (Levine, 1980). However, another outcome in the process of adopting an innovation is to discontinue or terminate the use of the innovation, indicating something went wrong with the innovation during adoption.

Surry and Brennan (1998) noted that adoption is "the result of a fairly well defined, orderly process" (p. 3). In some cases the process follows three stages—prior-, during-, and post-adoption (see Figure **2-3**). Rogers (2003) proposed a model with five stages for the innovation-decision process: knowledge, persuasion, decision, implementation, and confirmation. Levine (1980) proposed another one with four stages: 1) recognition of need, 2) planning and formulation of a solution, 3) initiation and implementation of plan, and 4) institutionalization or termination. The first three stages in Rogers' model and the first two stages in Levine's model correspond with the prior-adoption stage. Rogers' stage of implementation and Levine's stage of initiation and

implementation of plan correspond with the during-adoption stage. Finally, the shaded area in Figure 2-3 corresponds to Rogers' confirmation stage and Levine's stage of institutionalization or termination with the two expected outcomes of continuance or discontinuance of an innovation, which are central to this study.

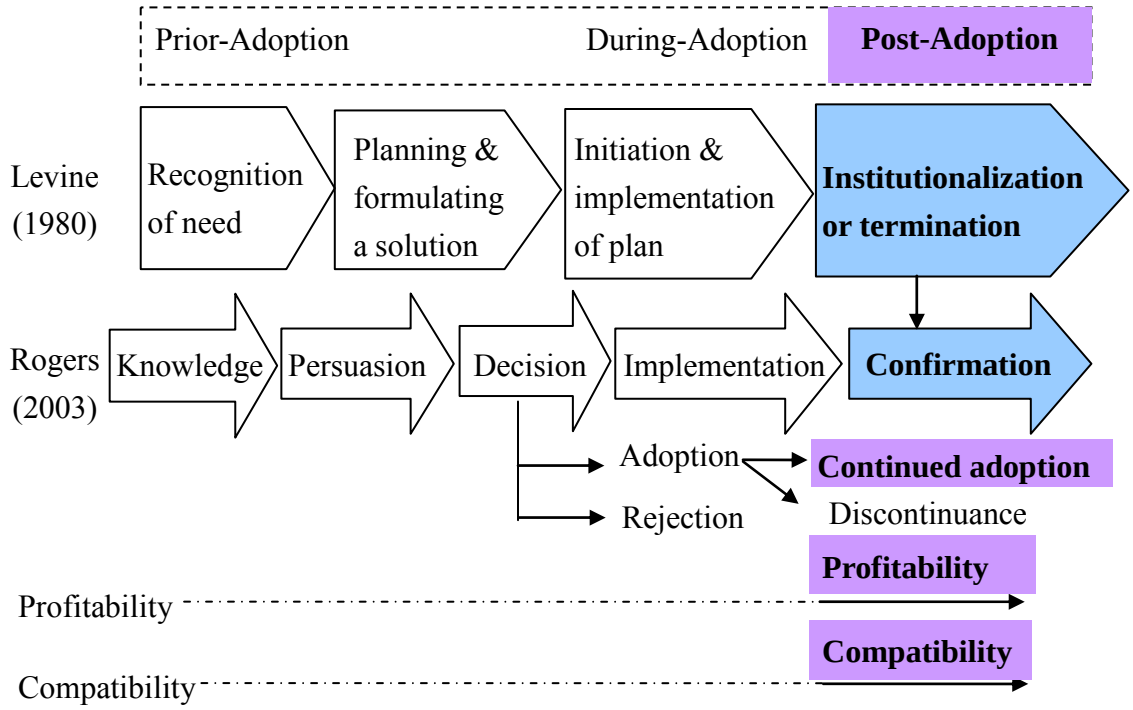

Figure2-3. Comparing Levine (1980) and Rogers' (2003) models of innovation-decision process with the current study.

Rogers (2003) specified three behaviors that may occur during the confirmation stage: "1) recognition of the benefits of using the innovation; 2) integration of the innovation into one's ongoing routine; and 3) promotion of the innovation to others" (p. 199). These three behaviors are related to the outcomes integrated in this study. Recognizing the innovation benefits suggests that the innovation is more likely to be continued by faculty innovators. Integrating the innovation into one's routine teaching is

considered as sustaining or transferring. Finally, the behavior of promoting the innovation implies diffusion.

Surry and Brennan (1998) indicated that the decision to adopt or reject an innovation can be influenced by personal, psychological, social, and technical reasons in all three stages. The four influences are linked with the ideas of profitability and compatibility in this study. That is, the social and technical factors align with profitability and the personal and psychological factors align with compatibility.

The idea of diffusion is associated with the post-adoption stage. Information regarding the chances for the success of an innovation in a specific setting can be found in this literature. Surry and Brennan (1998) indicated that previous studies about diffusion of innovation were conducted at a micro-level, where the innovation occurs on a small scale and its impact is localized, but currently the focus is on a macro-level that examines systemic change. Surry and Brennan's distinction of macro- and micro-level was based on the scope and impact of an innovation studied. Thus, the scope of the innovation in this study is macro because the course changes that faculty used were not confined to a specific type of teaching and learning innovation.

The distinction of macro- and micro-level was extended in the study to refer to the scope of the factors included. This study is considered as a macro-level one because it not only investigated personal factors such as teaching philosophy and teaching motivation but also accommodated environmental or interpersonal factors such as organizational support, collegiality, promotion & tenure, and department culture.

Studies of Organizational Innovation

Studies of organizational innovation tend to investigate adoption characteristics of the innovation as perceived by the intended adopter and the pattern of adoption behaviors in the innovation process. Both characteristics and behaviors of adoption impact the continuation/discontinuation of organizational innovation.

Characteristics of Adoption and Diffusion

Rogers and Shoemaker (1971) proposed five critical characteristics of adoption and diffusion. These emerged from an examination of 1,500 empirical and non-empirical studies of adoption of various innovations. These five characteristics include:

1. Relative advantage, or profitability: "the degree to which an innovation is perceived as being better than the idea it supersedes" (p. 138).
2. Compatibility: "the degree to which an innovation is perceived as consistent with the existing values, past experience, and needs of the receiver" (p. 145).
3. Complexity: "the degree to which an innovation is perceived as relatively difficult to understand and use" (p. 154).
4. Triability: "the degree to which an innovation may be experimented with on a limited basis" (p. 155).
5. Observability, also called communicability: "the degree to which the results of an innovation are visible to others" (p. 155).

Rogers and Shoemaker (1971) found that these five characteristics were all positively related to the rate of innovation adoption. Some characteristics are more

crucial in the prior- and during-adoption stages than in the post-adoption stage. Observability and triability were reported to be more important in the prior- and during-adoption stages and profitability and compatibility more important in the post-adoption stage (Rogers & Shoemaker, 1971).

Levine (1980) suggested a different perspective to examine not only how an innovation is adopted but also how it is sustained from the perspective of an organizational innovation. Levine regrouped the findings from four other models proposed by Hage and Aiken, Mann and Neff, Rogers, and Smelser and summarized four phases for the innovation process: "1) recognizing the need for change; 2) planning and formulating the means of satisfying the need; 3) initiating and implementing the plan; and 4) instituting or terminating the new operating plan" (Levine, 1980, p. 7). Levine noted that the last phase—institutionalization—takes much longer to occur than the first three phases and that the expected outcome of the innovation is to see its institutionalization rather than discontinuation.

Factors Impacting Adoption and Diffusion

Levine (1980) noted that innovation characteristics of profitability and compatibility (Rogers & Shoemaker, 1971) are both critical to the last innovation phase—institutionalization or termination (Levine, 1980). Similarly, Curry (1992) echoed Levine's idea that profitability and compatibility are important factors influencing whether innovations will be institutionalized or terminated. However, previous studies only examined the individual effect of profitability factors and compatibility factors. A

review of the literature yields no study that examined the individual factors and combined the examination of the impact of profitability and compatibility factors from the perspective of teaching and learning innovation.

Using a sample of 115 colleges and universities, Ross (1976) provided another way to look at conditions associated with the continuation of new academic programs,. He hypothesized that institutional innovation is related to three characteristics: *resources* such as size, growth, and dependence on tuition, *pressures to innovate* such as students' ethnic background and faculty's productivity, and *the institutional authority system* such as administrative leadership and decentralization.

In addition to the five characteristics of adoption, Rogers and Shoemaker (1971) proposed other factors that may also impact the behaviors of individuals in an organizational innovation. They include the individual's personality, communication behaviors, attitudes, and the nature of one's social system. Rogers and Shoemaker (1971) stated:

> Not only is the traditionalism-modernism of a social system's norms important in predicting individual diffusion behavior, but also the commitment of the individual to the social system affects his conformity to its norms. (p. 34)

This statement can be related to the current study in that both the values of the university and the faculty's commitment to the university could affect the faculty's post-adoption of innovation. Specifically, the implicit values embedded in the university's promotion and tenure criteria may impact whether or not faculty continue/discontinue his/her innovation, and a faculty member's commitment to the university may impact his/her decision to

continue/discontinue the innovation if such innovation is consistent with the university's goals or mission.

Similarly, Surry and Brennan (1998) addressed the importance of examining the impact of innovation from the social environment perspective. They suggested that more research should be conducted about how an innovation is affected by the social environment, which includes "the practices, habits, goals, hopes, fears, skills, philosophies, and plans of people" (p. 12-13).

The studies reviewed above suggested that factors impacting the post-adoption of an innovation should be examined from the perspective of profitability and compatibility as well as of the individual and his/her social environment. Therefore, teaching philosophy, teaching motivation, department culture, and collegiality factors from previous research were examined in this study.

Behaviors of Adoption and Diffusion

Continuance or discontinuance are the two expected results from the adoption of an innovation in Rogers and Shoemaker's (1971) study. The former is explained in terms of diffusion and the latter in terms of termination. Diffusion is defined as "the process by which innovations spread to the members of a social system" (Rogers & Shoemaker, 1971, p. 12). Termination of an innovation includes: replacement, which is defined as "a decision to cease using an idea in order to adopt a better idea," (p. 116) and disenchantment, defined as "a decision to cease using an idea as a result of dissatisfaction with its performance" (p. 116).

The mechanisms of boundary expansion and boundary contraction are used to explain the post-innovation process for organizational innovation (Curry, 1992; Levine 1980). There are two types of boundary expansions (Levine, 1980): *enclave*— "innovation assumes an isolated position within the organization" (p. 14) and *diffuse*— "innovation's characteristics are allowed to spread through the host organization" (p. 14). When an innovation is continually used regardless of whether the use of such innovation is only within an organization or is spread to other organizations, it is considered as boundary expansion. On the other hand, boundary contraction may lead to the modification or discontinuation of the original innovation. Modification is identified as resocialization and discontinuation as termination (Levine, 1980). Resocialization occurs "when the innovation unit is made to renounce its past deviance and institute the acceptable norms, values, and goals it failed to incorporate previously" (Levine, 1980, p. 15), while termination occurs "when the innovation is eliminated" (Levine, 1980, p. 15).

To sum up, the idea of enclave and diffusion from organizational innovation is similar to the definition for sustaining and diffusion of the current study.

From Organizational Innovation to Teaching and Learning Innovation

In order to better understand factors impacting teaching and learning innovations, ideas about the adoption and diffusion of an organizational innovation (Rogers & Shoemaker, 1971) are matched with those in teaching and learning innovations. Thus, the theories in the adoption and diffusion of innovation are connected to the theories of

innovation in business organizations, higher education institutions, and individual teaching and learning innovation.

Applying Profitability and Compatibility to Factors Impacting Post-Adoption

Both Levine (1980) and Curry (1992) attempted to build a connection between business organizations and higher education institutions. They both concluded that in the post-adoption phase, the institutionalization or termination of an innovation is determined by two important factors: profitability and compatibility (Curry, 1992; Levine, 1980).

Since the scope of this study was framed in the post-adoption phase, it made sense to bring in profitability and compatibility from the context of organizational innovation as a factor to be applied to a teaching and learning innovation. Profitability was measured by gains in material and nonmaterial factors. That is, the degree of relative advantage or profitability of an innovation may be "measured in economic terms but can include factors of social prestige, convenience, and satisfaction" (Rogers & Shoemaker, 1971, p. 22). Profitability aims to measure whether the needs of the adopters are being fulfilled or the status quo is being changed to a better condition (Levine, 1980). It can also be the indicator of consequential rewards or punishments from the adoption of an innovation (Levine, 1980). Compatibility may be reflected in: "1) sociocultural values and beliefs, 2) previously introduced ideas, and 3) client needs for innovation" (Rogers & Shoemaker, 1971, p. 145). Compatibility refers to the fit between the innovation and the organization (Levine, 1980; Rogers & Shoemaker, 1971). If an innovation does not fit well with the values of the social system, it will not be adopted quickly (Rogers & Shoemaker, 1971).

Thus, Rogers and Shoemaker (1971) proposed having pre-adoption of a new value system as the requirement for such case. Furthermore, if the innovation is problem-based learning (PBL) and is less congruent with teacher-centered values in the university, then first adopting student-centered values in the university is more congruent with the PBL innovation. Following that kind of shift in values, the adoption of PBL innovation may take place more quickly.

According to Levine (1980), compatibility is defined as "the degree of congruency of norms, values, and goals of an innovation to its host" (p. 17); profitability is divided into *self-interest profitability,* which "motivates the individuals and the units within the organization to adopt an innovation" (p. 18) and *general profitability,* which "motivates the organization to select or maintain an innovation" (p. 18). Curry (1992) suggested that these two forms of profitability may interact with compatibility. That is, when an innovation is highly compatible, the intended adopters, such as the faculty or staff in an academic unit, will be more satisfied with the innovation advocated. When the innovation is compatible and profitable, the organization is more likely to sustain such an innovation (Curry, 1992).

Therefore, one may ask two important questions. First, do organizational support, collegiality, being promoted, and becoming tenured satisfy faculty's need and facilitate the continuation of a teaching and learning innovation? Further, are the norms of the department culture, faculty's belief in teaching and learning, and teaching motivation congruent with the teaching and learning innovation and do they facilitate its continuation? These questions anchored the main purpose of the study and led to the

examination of the impact of profitability and compatibility factors on the post-adoption behaviors of a teaching and learning innovation.

Based on the definitions of profitability and compatibility in organizational innovation, its sub-dimensions can be mapped onto the context of teaching and learning innovation. The corresponding ideas between these two types of innovations are listed in the second column of Table **2-1**.

Table **2-1**.
Mapping Profitability and Compatibility-Related Factors from Organizational Innovation to Their Corresponding Ideas in Teaching & Learning Innovation

Organizational innovation	Teaching and learning innovation
The degree of economic profitability	Organizational support
Low initial cost	Funding or grant available
Lower perceived risk	Promotion & tenure
Social approval	Collegiality
A decrease in discomfort	Fit into the past practices
A savings in time and effort	Availability of ready-to-use materials
The immediacy of the reward	Salary raise
Sociocultural values and beliefs	Institutional or department culture
Norms, values, and individual beliefs	Teaching philosophy
Client needs for innovation	Commitment to teaching

Applying Behaviors of Post-Adoption

There are two main outcomes after an innovation is adopted—the continuation or discontinuation of the innovation. Dissatisfying experiences with an innovation may lead to its discontinuation (Rogers, 2003). The dissatisfaction may arise because the innovation did not provide enough economic interest or benefits to faculty or because it did not fit within the norms or values of the institution or the individual. The former

illustrates that the innovation was not profitable and the latter that the innovation was not compatible. Both situations could lead to dissatisfaction or termination of an innovation.

The term *diffusion* is frequently used in the context of the continued use of innovation. However, it has broader connotations. In order to capture faculty's post-adoption behaviors more precisely, three continual uses of innovation were extracted from the studies of Curry (1992), Lane (2001), Levine (1980), Markert (1993), and Rogers (2003); that is, sustaining, transferring, and diffusing.

The notion of *enclave* in Levine (1980) and Curry's (1992) boundary expansion is equated with *sustaining* in the current study. The idea of sustainability is suggested by Rogers (2003) as "the degree to which an innovation is continued over time after a diffusion program ends" (p. 217). The sustainability idea is modified in the current study as the extent to which an innovation is continued once it is adopted. Another implication of sustaining was derived from the term *sustainable innovation* from Lane's (2001) study—"continual improvement for the faculty innovators" (p. 87). Lane indicated that the faculty in her study perceived sustainability as a process—once an innovation launches, "it continues to grow and evolve, and eventually diffusing from one course to another" (p. 87). In the current study, sustaining an innovation means the innovation is being continually used in the original course by the same faculty innovator in the subsequent semesters.

The concept of transfer was included in the diffusion of an instructional innovation in Lane's (2001) study when faculty applied their original instructional innovation to their other course(s)—changes from the setting of course A to course B or C. Since the idea of transfer was not clearly defined or emphasized in the previous

literature (Curry, 1992; Levine, 1980; Rogers, 2003; Rogers & Shoemaker, 1971), the definition of transfer is adapted from the idea of technology transfer, which views technology as a narrow concept of innovation.

Johnson, Gatz, and Hicks (1997) define technology transfer in terms of two dimensions: "1) the movement of technology from the site of origin to the site of use; 2) issues concerning the ultimate acceptance and use of the technology by the end user" (p. 36). The first dimension refers to "the development of a technology in one setting which is then transferred for use in another setting" (Markert, 1993, p. 231). Specifically, transfer in this study refers to when faculty use the innovation in other courses they have taught or are teaching now. The second dimension was examined in the current study in terms of whether or not faculty transfer their innovation and the extent to which faculty apply their original innovation to their other courses.

The idea of diffusion from the post-adoption process in organizational innovation is identical to the one used in the current study, that is, when "innovation's characteristics are allowed to spread through the host organization" (Levine, 1980, p. 14). Rogers and Shoemaker (1971) also indicated that diffusion is a social process involving interaction and communication with others. In the current study, diffusion is defined as an ultimate stage of the innovation process, with the innovative idea of the original course passing along to a different instructor. Thus, diffusion refers to the innovation being adopted by other faculty for their courses.

Studies of Teaching and Learning Innovation

Teaching and learning innovation is usually teacher-initiated and occurs in the context of higher education and K-12 education. Most of the literature reviewed in this section, however, involves studies conducted in higher education settings.

Factors Impacting Post-Adoption Behaviors

Davis et al. (1982) examined how organizational support, innovation characteristics, innovator activities, and innovator motivation were related to the outcome of innovation in each stage of the innovation process. They found that, overall, motivation to engage in and activities relating to innovation were perceived as being more important to the success of the innovation than organizational support and innovation characteristics across all stages of the innovation process. However, organizational support was the most important factor reported in the continuation of innovation.

Lane (2001) explored sustainability of teaching and learning innovations at a research university in the eastern U.S. Her findings indicated that after a teaching and learning innovation was institutionalized, the innovation continued to transform into different forms of continuation—transferring and diffusing—among faculty innovators. This evolving idea of a teaching and learning innovation in the post-institutionalization phase (Lane, 2001) differed from some of the previous findings in organizational innovation (Curry, 1992; Levine, 1980) where institutionalization was viewed as the end of the adoption of an innovation.

Many factors that impact the sustained use of innovation may carry dual opposite values—acting as promoters or inhibitors in different innovation cases. The promotion and tenure factor may serve to encourage one faculty member to continue his/her course innovation because the student feedback and peer feedback were positive, but may act to inhibit another faculty member from continuing his/her course innovation because the low scores on student ratings of teaching effectiveness could be attributed by the course innovation. Most of the factors discussed here were assumed to promote rather than inhibit faculty members in continuing their course innovation. Factors impacting individual teaching and learning innovation are summarized in the sections defining profitability and compatibility factors.

Ishler, Johnson, and Johnson (1998) examined the long-term sustainability of the use of collaborative learning. The factors they investigated were the perceived quality of training, personal commitment to using cooperative learning, technical support for using cooperative learning, collegial encouragement and support, and membership in a collegial teaching team. They found that providing technical support and assistance after the training had ended had little impact on the long-term effectiveness of the training (Ishler et al., 1998). Therefore, they suggested training programs should "emphasize membership in collegial teams, supportive relationships with other implementers, and members' commitment to the new practice" (Ishler et al., 1998, p. 280). Their findings suggest that factors related to the ideas of collegiality and teaching motivation (e.g., commitment to the new practice) in the current study may have an impact on the continuation of innovation.

Defining Profitability Factors

Organizational Support

Four types of organizational support were examined in this study: financial support, verbal support, technical support, and consultation support. Organizational support refers to the support gained from the head of the department, dean, or other person in authority, and available resources or funding (Hannan, 1998). Hannan's definition covers the first two dimensions of organizational support: financial support as the grant or funding faculty received to design, develop, or implement their course changes, and verbal support as the praise or encouragement faculty received from any authority figures within the university. Davis et al. (1982) identified the other two dimensions of organizational support: technical support as computer-related assistance from university staff (e.g., a laboratory assistant or technician), and consultative support as advice or help from a course consultant, instructional designer, or Web designer about designing the course innovation materials.

Collegiality

Webb (1999) defined collegial behaviors as "frequent interaction with colleagues, tolerance of differences in colleagues, and generational equity" (p. 1). In addition to those collegial behaviors, Ishler et al. (1998) and Lane (2001) pointed out the importance of good community networking among colleagues, who can help provide innovation support. However, Massy, Wilger, and Colbeck (1994) reported that the main

characteristic in collegiality—mutually supportive relationships among colleagues in academic units—does not occur often in academia. The three types of collegiality examined in this study were: discussion with colleagues about course changes, collaboration with colleagues on one's own course changes, and collaboration with colleagues on their course changes.

Promotion and Tenure

Lane's findings (2001) revealed that promotion and tenure seemed to inhibit junior faculty's initiating or continuing their course innovation because the innovation may have limited their time to work on research. Moreover, course innovation may result in lower scores on student evaluations of their teaching if the innovation had not been successfully adopted in class. This issue is also reflected in Boyer's (1998) report: "[T]oday, at most four-year institutions, the requirements of tenure and promotion continue to focus heavily on research and on articles published in journals, especially those that are refereed. Good teaching is expected, but it is often inadequately assessed" (p. 28).

The main aspects of promotion and tenure center around the three types of scholarly activities—teaching, research, and service. These three areas have been commonly used in most U.S. higher education institutions, but the amount of emphasis on each varies according to the nature of the specific university. The dilemma has always been how to find balance between research excellence and quality teaching (Wolverton, 1998). The statements made by Wolverton (1998) reflected the fact that "teaching is

undervalued and that its status should be elevated, but making it a priority is a formidable task" (p. 67):

> Although teaching excellence may well be an institutional criterion, most research universities find it "difficult to recommend a good teacher for promotion ahead of a good researcher…" (Gibbs, 1995, p. 18). While promotion and tenure from the rank of assistant to associate professor and the granting of tenure may be delayed by poor teaching, teaching excellence rarely influences the tenure decision (Edgerton, 1993). And, even when a university has criteria for teaching quality, it seldom has standards. Since reaching a predetermined level of minimum competency, in many cases, constitutes what tenure and promotion is all about, this causes trouble" (p. 67-68).

Wolverton also pointed out that the faculty review process in U.S. higher education institutions is moving in the direction of balancing research and teaching.

Examining the promotion and tenure criteria established by the university in the current study may help readers better understand the aspects of promotion and tenure investigated in the study. Overall, faculty at the university are expected to provide evidence of three types of scholarly activities (teaching, research, and service). A close look at the promotion and tenure guidelines for faculty in the study resulted in the impression that teaching and learning innovation may be indirectly related to the criteria used to "demonstrate competence in teaching and capacity for growth and improvement" (Policy HR-23 promotion and tenure procedures and regulations, 2006). This criterion listed in the scholarship of teaching section is the only place in which teaching and learning innovation fits within the P&T guidelines.

The investigator's conversations with experts and senior faculty at the university revealed that the following aspects of promotion and tenure may be tied to the topic of this study: 1) faculty's perception of the weight placed on teaching and research by the department and outside the department (at the college and university levels); 2) positive or negative influence of course changes on P&T at the department and above the department levels; and 3) impact of course changes on student feedback and peer feedback that may later affect faculty's P&T evaluation.

Defining Compatibility Factors

Department Culture

The terms *organizational culture* and *institutional culture* are used interchangeably in this section of the literature review. Specifically, institutional culture in this study was defined narrowly as department culture. Institutional culture refers to the institution of higher education and is assumed to be one type of organizational culture; therefore, studies related to organizational culture were later used to examine institutional culture or department culture. Kuh and Whitt **(**as cited in Hall, 1997) defined institutional culture as "the collective, mutually shaping pattern of norms, values, practices, beliefs, and assumptions that guide the behavior of individuals and groups in an institute of higher education and provide a frame of reference within which to interpret the meaning of events and actions on and off campus" (p. 2).

Organizational culture can facilitate or inhibit institutional transformation, but that process depends on "the fit between existing culture and the proposed change" (Keup, Walker, & Astin, 2001, p. 2). Similarly, organizational culture can facilitate or inhibit individual innovation depending on the fit between existing culture and the course change proposed by the faculty. If the goals and values in the department, college, or university align with those innovations of individual faculty, then such instructional innovation could be easily sustained (Bess, 1977).

Kabanoff, Waldersee, and Cohen (1995) did a content analysis to categorize 88 large Australian organizations in one of four value structures: leadership, elite, meritocratic, and collegial. In addition, they investigated the relationship between organizational values and institutional change. Kabanoff et al. found that members in collegial organizations (i.e., clan culture) tended to view change more positively as opposed to those from the other three types of organizations. Collegial organizations tended to advocate the following values: "teamwork, participation, commitment, and high levels of affiliation" (Keup et al., 2001, p. 2). That is, a sense of identifying oneself as part of the organization, involvement and commitment to change, and collaboration among colleagues toward change projects are common characteristics of collegial organizations.

Obenschian, Johnson, and Dion (2002) used a model with four types of organizational culture to predict the frequency of organizational innovation. Obenschian et al. found that clan culture remained the most identified culture for most institutions. The remaining dominant culture types within institutions of higher education were hierarchy (or leadership), market (or elite), and adhocracy (or meritocratic).

Obenschian et al. reported that adhocracy culture was found to be more related to organizational innovation, particularly in the aspects of technical and administrative innovation. Adhocracy culture was found to be affiliated more with the effectiveness of organizational innovation (Hall, 1997). It seems that organizations with adhocracy cultures can provide an environment for the implementation of organizational innovation.

Kabanoff et al. (1995) reported that members from organizations with clan values such as teamwork, participation, commitment, and high levels of affiliation tended to have positive perception of organizational change. The previous findings implied that adhocracy and clan culture were more related to the implementation of an organizational innovation. Two questions remain. Do these two types of cultures facilitate the continuation of an organizational innovation? Do they also facilitate the implementation and continuation of a teaching and learning innovation?

Teaching Philosophy

According to Goodyear and Allchin (1998), teaching philosophy provides information about a teacher's identity, focuses on one's teaching activities, defines one's teaching role in relation to other scholarship activities, and guides one's behavior to act. A clearly articulated teaching philosophy may help a professor become more confident when initiating any change in new course development or course revision (Goodyear & Allchin, 1998). They indicated that instructors' teaching philosophies can be ascertained through an examination of their syllabi, assignments, approaches to teaching and learning, classroom environment, and student-teacher relationship.

Due to the scope of the study, it is not efficient to investigate all five aspects described above. The aspect of teaching philosophy examined in this study was student-teacher relationship. Namely, student-centered teaching philosophy views students as independent and active learners. Hannan and Silver (2000) reported that one of the main reasons that faculty innovators initiated course changes was the need to improve student learning (e.g., giving students more responsibility for their learning), which was assumed to have great impact on the adoption of an innovation.

Another aspect of teaching philosophy, derived from Lane's (2001) study, was *innovation philosophy*. The themes that emerged from this particular type of teaching philosophy were beliefs in: 1) teaching as a refining process; 2) teaching as a trial-and-error process; 3) teaching as a gradual adaptation process; 4) teaching as a continual learning process; and 5) teaching with a variety of instructional methods.

Teaching Motivation

When a teacher loves and enjoys his/her teaching, students not only learn the content taught but also are motivated to learn (Czubaj, 1996). Teachers' commitment to their profession equates with their motivation to teach. According to Bess (1977), "unless faculty members perceive the teaching enterprise as a continuing source of profound satisfaction in life—satisfactions arising out of the fulfillment of deep-seated human needs—they will rarely have the sustained role commitment that is necessary for creativity and excellence in performance" (p. 244). Thus, the intrinsic motivation to teach is a strong indicator of a faculty's desire to sustain course innovation or changes.

The first dimension related to intrinsic teaching motivation involves examining teachers with high vitality. Teaching vitality reveals individual motivation to engage in the teacher role. Vitality has been defined as "an essential, intangible, positive quality of individuals that is synonymous with purposeful production, dedication to beliefs that produce action and sustained commitment" (Sederberg & Clark, 1990, p. 6). Three attributes shared by teachers in elementary and secondary schools who performed with high vitality were identified by Sederberg and Clark (1990): 1) a desperate desire to perform like the teachers who had important influence on one's own intellectual and personal growth; 2) an inner driving force to dedicate to one's teaching; and 3) an intense desire to engage oneself in students' studies and daily lives.

The concept of vitality seems applicable to the study of higher education faculty (Clark, Boyer, & Corcoran, 1985). These three attributes, as held by teachers who perform with high vitality, were assumed to be indicators of a teacher's commitment to teaching. They were refined later in this study into a single concept that reflects one's belief in playing a significant role in students' growth.

The second dimension related to intrinsic teaching motivation is a professor's psychological need for teaching, namely, the need for autonomy, competence, and relatedness (Deci, Kasser, & Ryan, 1997). The three needs are illustrated as follows:

> When people feel autonomous, their behavior is choiceful and congruent with their organismic self (Ryan, 1993). … An expression of humans' need for competence is that they often engage in behaviors to meet optimal challenges, even in the absence of prods, prompts, or pressures. ... Relatedness involves feeling close to and connected with other individuals. (p. 63)

For the purpose of the current study, the concepts from Deci et al. (1997) were defined: 1) being autonomous means one's mind is free without being controlled by the outer world; therefore, it suggests that faculty need autonomy to decide their teaching methods and strategies; 2) being competent means one is able to cope with the challenges confronted and accomplish tasks on demand; therefore, it suggests that faculty are competent in teaching when facing teaching challenges and reacting to students' feedback about their teaching; and 3) being related to others means developing close relationships with individuals or being affiliated to a group or a community; therefore, it suggests that faculty have developed interactive and collaborative relationship with their colleagues and feel connected to their department, college, the university, other academic associations, or a teaching and learning community.

Synthesis of the Literature

A study of the innovation process is more than just noting the continuation or discontinuation of the use of an innovation. Innovation can be closely examined in terms of its directions, stages, characteristics, and degree of adoption or diffusion. By applying these four dimensions to this study, the research focus may investigate how the characteristics of a teaching and learning innovation, such as profitability and compatibility, predict faculty's post-adoption behaviors of sustaining, transferring, or diffusing.

Previous studies investigated some factors that would impact the success or failure of an innovation in general (Davis et al., 1982; Hannan et al., 1999; Levine, 1980).

However, the focus was more on the prior- and during-adoption phases (Davis et al., 1982; Hannan et al., 1999) than on the post-adoption phase (Levine, 1980). These studies attempted to depict the framework for the higher education innovation process from the perspectives of reasons for initiating innovations, innovation activities, innovation characteristics, promoters and inhibitors, innovators' roles, and organizational support. Few studies focused on the post-adoption stage—perhaps because of the time required for this type of study.

The first known scholar to give attention to the post-adoption stage was Levine (1980), who pointed out the importance of investigating the institutionalization of an organizational innovation. Curry (1992) took a similar path to Levine in studying organizational innovation in higher education. The pioneer in teaching and learning innovation is a group in the U.K. (Silver, 1998; Silver et al., 1997) that built a foundation of focusing on teaching and learning innovation from a wide range of perspectives.

Later, more studies shifted their attention to sustainability in teaching and learning innovation (Ishler et al., 1998; Lane, 2001). Their focus was on illustrating some important factors that affect the sustaining of an innovation. No known study provided any exploratory model that systematically examined factors impacting the sustaining, transferring, and diffusing of teaching and learning innovations. This serves as a good rationale for this study.

Since most teaching and learning activities are individually initiated, individual innovators may be somehow isolated from the social environment (Kozma, 1985). However, this type of individual innovation may later become "an internal process of personal or professional development" (Kozma, 1985, p. 309) if the case tends to depend

less on others or on the organization. If innovation is adopted, it is assumed to have some degree of similarity to the previous teaching practices (Kozma, 1985). This assumption provides a sound rationale for the assumption that faculty are more likely to transfer if they have sustained their innovation. Furthermore, Kozma pointed out that fitting with personal needs rather than satisfying organizational needs is the expected outcome of this type of teaching and learning innovation. Personal needs are the key to faculty's motivation for innovation. Did they perceive "the innovation (or the grant or a journal article that might result from it) as justification for a desired promotion" or were they "driven by a highly personal commitment to a particular (although not necessarily articulated) educational philosophy or mission that had implications for instructional methods" (Kozma, 1985, p. 310)? If the answer is that their motivation for innovation was more associated with the former, then profitability factors were assumed to be more crucial to faculty's continuing of their teaching and learning innovation. If the answer is that their motivation for innovation was more associated with the latter, then compatibility factors would be more crucial to their continuation of their innovation.

Many studies related to factors that impact faculty's teaching and learning innovations were reviewed (Davis et al., 1982; Ishler et al., 1998; Lane, 2001; Silver et al., 1997). If a factor relates more to faculty's *extrinsic* needs, such as promotion and tenure, collegiality, and organizational support (funding or verbal support), then the innovation tends to diminish after the outcome is reached or when the extraneous factor is removed. If the factors are related to faculty's *intrinsic* needs, values, or attitudes, such as teaching motivation or teaching philosophy, then the innovation tends to be kept once it is well integrated with the individual. Institutional culture is one extraneous factor—if the

faculty innovator becomes detached from colleagues or the department chair, s/he may care less about innovation—that is considered related to compatibility because the emphasis is the fit between one's innovation and values within the department or institution (Kozma, 1985).

Chapter 3

Method

This study creates predictive models to systematically explain the impact of six profitability factors and four compatibility factors on the *sustaining, transferring*, and *diffusing* of a teaching and learning innovation. The six *profitability* factors are: Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes. The four *compatibility* factors are: Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation

This study took a prediction approach because the research focused on building predictive models for three post-adoption behaviors of instructional innovations. In order to attain the result, this study investigates: 1) the relationship between predictors—six profitability and four compatibility factors—with faculty's sustaining, transferring, and diffusing of their teaching and learning innovation; 2) whether or not faculty sustained, transferred, and diffused their teaching and learning innovation, as predicted by the 10 predictors; 3) the extent to which all of the predictors contributed to the sustaining, transferring, and diffusing of teaching and learning innovation; and 4) which factors are most influential in the continuation of a teaching and learning innovation. The setting is higher education and the research has three major phases: 1) before data collection, 2) data collection, and 3) after data collection

Target Population and Sample

The target population in this study is faculty innovators at large Research I universities whose missions include teaching, research, and public service for many academic disciplines, and who implement course changes in their classes. Since this study examines factors that impact faculty's post-adoption stages of course changes, the only faculty recruited were those who received funding or support to design or redesign their course(s) by conducting course or curricular changes or using technology innovations. Hence, a faculty member who received funding or support not relating to teaching was excluded from the study population.

A convenience sample from a large research one university in the Eastern U.S. was adopted for the study. The participant pool consisted of faculty who received teaching grant/support from one of three teaching and learning centers or one administrative unit between 1996 and 2005. Number of valid cases is 360 after removing faculty who had retired, left the university, or died. A total of 165 out of 360 faculty members agreed to participate and completed the online survey, resulting in a 45.8% response rate (see IRB approval in Appendix A). Among the 165 cases, 95 (58%) participants came from the main campus and 70 (42%) participants from satellite campuses; 106 (64.2%) participants were male and 59 (35.8%) participants were female; 31 (18.7%) participants' academic ranks were instructors, 26 (15.8%) assistant professors, 56 (33.7%) associate professors, 43 (26.1%) professors and 9 (5.5%) other academic ranks such as associate deans, deans, distinguished professors, or emeritus professors who were still teaching at the time they participated in the study.

After data collection, a post-hoc power analysis used G-Power software to obtain an actual power value and critical F value for the multiple regression analysis. The effect size for the original sustaining model was set: medium (f^2 = .15); alpha is .05; predictor number is 10, and sample size is 109 (after deleting the missing cases and filtering out those who did not sustain their course innovation). The results indicated that the actual power is .76, with Lambda = 16.35, and critical F(10, 98) = 1.93. With the same sample size and two predictors, the power for the final sustaining model was enhanced to .96, with F(2, 106) = 3.08 since only two predictors were retained.

For the two transferring models with 95 cases, the power was .68 for the original model with 10 predictors and .96 with one predictor in the final model. For the two diffusing models with 70 cases, the power was .49 with 10 predictors in the original model and .82 with two predictors in the final model. Of the six multiple regression models analyzed, the original transferring and diffusing models were the two models with low power in effect size because they had fewer cases and more predictors. For the other four models, their power of sample size was fairly proper.

Methodology

The research had three stages: before data collection, data collection, and after data collection. The steps and procedures (see Table **3-1**) outline conduction of the study from the literature review to survey design, data collection, and data analysis, and are described in the following sections.

Table **3-1**
Stages for the Study and Procedures Identified

Steps identified	Procedures taken
	Stage I. Before data collection
A. Define research question, identify study population, and choose an appropriate research approach to answer studied questions	Review the literature and discuss with faculty and course consultants on the scope of this topic
B. Design and develop measurement instrument	Review the literature and start survey writing process
C. Logistic operations prior to data collection	Gain approvals from IRB, 3 teaching support centers, and 1 administrative unit
D. Tackle potential technical issues	Update the list, upload the survey online, and test the layout of the survey
E. List the administration procedures for data collection	Set up a timeline and sample chosen for pre-tests and main study
	Stage II. Data collection
E. Pretest 1: Administer a paper survey to two potential participants	Test the clarity of the survey by collecting feedback from 2 faculty
F. Pretest 2: Administer the survey online to a small sample	Detect the administration errors occurred in the pretests and understand the nature of the data and refine items
G. Main study: Administer the survey online to the whole sample	Decide the content and date for invitation e-mail, first reminder, and 2nd reminder Correspond with participants only if participant initiate a question or encounter difficulty
	Stage III. After data collection
H. Consider possible ways for data analysis	Phase I: Data cleaning Phase II: Factor analysis and reliability analysis Phase III: Logistic regression and multiple regression analysis
I. Record the results of data analysis	Report the validity and reliability of measurement instrument used Report the power of the predicting model proposed Write up the results based on the research questions stated

Stage I. Before Data Collection

After identifying the study population, research questions, and research methodology, the focus shifted to the design, development, and description of the measurement instrument, and the procedures for conducting pretests and data collection.

Design and Develop Measurement Instrument

A thorough review of the literature did not lead to identification of an existing survey tailored to this research topic; thus, a measurement instrument was designed to assess the variables in the research questions. In order to demonstrate that the survey adequately represented the construct under investigation, the study followed Hinkin's (1998) validation guidelines through the entire measurement design process. Three types of validity evidence were considered during the development of the instrument: content, construct, and face validity (Hinkin, 1998).

Content Validity: Establishing Representativeness and Relevance

As an important first step, the constructs were operationalized to represent the domains or content to be assessed. Definitions of these constructs helped to establish content validity: The measure was thoroughly representative and relevant to profitability and compatibility measures (Hinkin, 1998). The review of the literature and conversations with faculty and course consultant experts assisted deciding whether or not variables included in this study were relevant and representative for this study. The important, relevant factors were tallied from the literature. The content representativeness

of profitability and compatibility were validated through three expert panels. The details appear later in the sections of Steps 1, 2, and 3.

Construct Validity: Degree of Match between Measurement and Construct

This research took the following steps to "reduce the discrepancy between what a measurement is supposed to measure and appears to measure" (Ebel & Frisbie, 1986, p. 96): 1) provide evidence of content validity through three expert panels, 2) apply item writing skills and have them proofread by a professional editor and a content expert to enhance the clarity of the survey items, and 3) use the results of factor analysis to conform to the conceptual categorization of the sub-concepts within each construct. The details of the steps and results appear later in the sections of Steps 4, 5, and 6.

Face Validity: Balance of the Outlook, Clarity, and Efficiency

Three issues of face validity were considered in this study: the outlook of the measurement instrument, the clarity of language, and the efficiency of survey items to ask relevant and necessary questions (Fink, 2003).

The project title and year were provided as a frame of reference to help the participants recall the course changes they implemented. In addition, techniques to enhance the layout of the instrument included altering section headings, using different font sizes, and highlighting the even rows to distinguish them from the odd rows. To ensure the efficiency and balance of the survey items, the number of constructs used in

the study was reduced from eight to six in the final stage. The details are addressed in the section with Steps 7 and 8.

The three sections related to content-, construct-, and face-validity addressed the main ideas regarding the design of the measurement instrument. Eight steps were followed: 1) conceptualize the structure of the instrument based on the variables investigated, 2) define and operationalize the constructs, 3) consider the scale design, 4) write the initial set of items, 5) ensure representativeness and relevance of the items created, 6) polish items from the suggestions given by the panel experts, 7) decide on the number of items used based on sample size and number of variables, and 8) enhance the clarity of the items. The stages, steps, and techniques used to establish validity evidence from relevant validity issues appear in Table **3-2**.

Table **3-2**
Stages, Steps, Techniques Used in Measurement Development

Steps	Technique used to enhance validity
Stage 1: Before item-writing	
1. Conceptualize the structure of the instrument based on the variables investigated	Analyze the main components from the model to be built
2. Define and operationalize the constructs	Use table of specifications to display the content dimensions for the construct
3. Consider the scale design	Analyze the type of data gathered and quantify the response categories
Stage 2: During item-writing	
4. Write the initial set of items	Follow item-writing guidelines
5. Ensure representativeness and relevance of the created items	Create items from the information obtained from the literature
6. Polish items from the suggestions given by the panel experts	Expert Panels 1 and 2 (verify that the item created is matched with the construct to be measured; reduce vague language)
7. Decide on the number of items based on sample size and number of variables	Be aware of efficiency issue—keep a balance between number of the items and number of constructs investigated
8. Enhance the clarity of the items	a. Find a professional editor to proof-read the items to reduce wording problems b. Expert panel 3: to ensure that the items created match well with the construct they are intended to measure

Step 1. Conceptualize the Structure of the Instrument Based on the Variables Investigated

The structure or main components of the instrument guided its design. After reviewing all of the possible variables suggested in the literature, gathering information from four panel experts allows making a final judgment about which variables are more

relevant to this study. The three criterion variables (or dependent variables) relate to sustaining, transferring, and diffusing. The six predictor variables (or independent variables) are organizational support, collegiality, promotion & tenure (P&T), department culture, teaching philosophy, and teaching motivation. Thus, the structure of the instrument includes four sections: status of the post-adoption of the course changes, compatibility and profitability factors impacting course changes, demographic information, and background information related to course changes.

Step 2. Define and Operationalize the Constructs

To operationalize the constructs, definitions extracted from the literature and then operationalized for each construct, influenced the decision as to whether or not evidence or observable behavior could be measured by each construct. Borrowing from the process of determining the representativeness and relevance of study content (Ebel & Frisbie, 1991), the technique of *table of specifications* assisted perceiving the embedded dimensions in each construct. An example of the format for the table of specifications for the construct, *organizational support,* appears in Table **3-3**.

Table **3-3**
Example of Table of Specification

Type of support	At the department level	Above the department level (college or university)
Encouragement or support from authority figures or academic/educational units	1) Verbal support from the department chair (A1) 2) Financial support (A2) 3) Consultative support (A3) 4) Technical support (A4)	5) Verbal support from the dean or other authority figures (A5) 6) Financial support (A6) 7) Consultative support (A7) 8) Technical support (A8)

Step 3. Consider the Scale Design

Operationaling the constructs established the following response categories: 1) the option of closed-response or open-response, 2) type of response choices, and 3) quantification of those response choices to match the design of the scale measurement (Spector, 1992). The closed-response option was used in this study because it provides objective scores that would better capture the respondent's perception and the surveyor's expectation of the studied questions (Fink, 2002).

The response category, used for the dependent variable of sustaining, which measured the proportion of course changes maintained in the same course; of transferring, which measured how many course changes were applied to the other course taught by the same instructor; and of diffusing, which measured the number of people to whom course changes were diffused. The assigned value used to quantify the scale of proportion of change was from 1 to 5 and the corresponding labels for proportion of change and how many of the changes were: *1) none of them, 2) less than half of them, 3) about half of them, 4) more than half, but not all,* and *5) all of them*. The assigned value for the scale of the number of people to whom the course changes diffused ranged from one to five and the labels for number of people diffused were *none of them, 1 faculty, 2–3 faculty, 4–5 faculty*, and *more than 5 faculty.*

The response category used for the five independent variables was on the scale of *degree of agreement*: organizational support, collegiality, department culture, teaching philosophy, and teaching motivation. The corresponding verbal labels were: *1) strongly disagree, 2) disagree, 3) neutral, 4) agree,* and *5) strongly agree.* The assumption was

that an equal distance exists between the adjacent categories for this 5-point Likert-type scale. An assigned value from the lowest of *1* to the highest of *5* quantifies the scale.

The variable of promotion and tenure (P&T) consisted of three different sets of questions with three types of response categories. The first type of response category was a 5-point Likert-type scale—degree of agreement, ranging: *1) strongly disagree, 2) disagree, 3) neutral, 4) agree,* and *5) strongly agree.* The second type of response category was on a weighted scale assigned to research and teaching. The five corresponding labels were: *1) a great deal more focus on research than teaching, 2) somewhat more focus on research than teaching, 3) equal focus on research and teaching, 4) somewhat more focus on teaching than research,* and *5) a great deal more focus on teaching than research*. The 6th response category, *I don't know*, was added as an optional response but was treated as missing data in the data analysis. The third type of response category was on a scale for judging the influence of the course changes. The five corresponding labels were: *1) contributed very negatively, 2) contributed somewhat negatively, 3) neither negatively nor positively contributed, 4) contributed somewhat positively,* and *5) contributed very positively*. The 6th response category, *I don't know*, was added as an optional response but was treated as missing data in the data analysis.

Step 4. Write the Initial Set of Items

The initial survey items were written so that: 1) each survey item conveyed one single, clear idea (Spector, 1992); 2) no statement was written in double negatives or implicit negatives (Spector, 1992); and 3) sensitive questions such as current status of

post-adoption, participants' academic rank, promotion and tenured status were put at the end of the survey to reduce participants' discomfort when responding (Frary, 2002).

Step 5. Ensure Representativeness and Relevance of the Created Items

In addition to following item writing guidelines, three expert panel sessions helped establish construct validation and provided justification for a precise match between the sub-concepts within a measured construct and its corresponding items. The four sub-concepts in the construct of organizational support were verbal, financial, technical, and consultative support. The experts invited to participate in this panel session were faculty members or content experts who met at least one of the following criteria: 1) had served on the promotion and tenure committee at the department, college, or university level; 2) had experiences with innovative teaching; and 3) was a curricular/course design expert who assisted faculty with their curricular or course changes/innovations. Two experts who participated in the first two panels included: one professor with many years of teaching experience at that university and one program manager from a teaching and learning center at the same university.

During the first panel, the two experts were informed of the validation process and were asked to raise questions regarding the clarity of the constructs defined. The suggestions obtained from this panel were to extend the idea of teaching motivation from a single idea of commitment to teaching to include three psychological needs: autonomy, competence, and relatedness. These needs were reported in the literature of teaching

motivation and were added to the construct of teaching motivation after the first expert panel.

In the second panel, the same experts were asked to rate whether the created items matched the construct they were intended to measure. The materials given to the experts before they reviewed the items were:

1. A rating sheet with three main columns: question item, category identified, and relevance score,
2. Construct materials with descriptions of the origins of the construct, definitions, and how the construct was operationalized, and
3. A table of specifications with a matrix showing how each construct was operationalized.

Thus, the sub-concepts of each concept were classified into different categories. An example of the format used to match sub-concepts of the construct *collegiality* and rating for item relevance to its sub-concept are shown below (Table **3-4**).

Table **3-4**
Sample Rating Sheet for Expert Panel 2 (Construct of Collegiality)

#	Item	Category	Rating
1	I often discussed my course change ideas with colleagues in my program/department.		
Suggestion for change:			
2	I often discussed my course change ideas with colleagues from outside my program/department.		
Suggestion for change:			
3	I collaborated with my program/department colleagues on my course changes.		
Suggestion for change:			
4	I collaborated with colleagues from outside my program/department on my course changes.		
Suggestion for change:			
5	I collaborated with my program/department colleagues on their course changes.		
Suggestion for change:			
6	I collaborated with colleagues from outside my program/department on their course changes.		
Suggestion for change:			

The criteria used to judge the items were based on the principle of consistency of agreement. A 3-point rating scale was used. If the category identified by the experts matched with the item and the rating for relevance was '3' then the item stayed in the survey items' pool. If not, an iterative procedure to revise the items from the feedback of both experts was required until all of the items were judged to be matched and relevant to the category to be measured.

The results from Expert Panel 2 are presented in Table **3-5**. Twenty-five items created for four constructs matched with categories to which they belong and the

percentage of agreement between two experts was 100% for the relevance score of 3. These four constructs were: organizational support (five items), collegiality (five items), promotion & tenure (seven items), and department culture (eight items). The 13 items related to teaching philosophy all matched with the two categories they represented. However, eight items with the percentage of agreement between two experts was 100% for the relevance score of '3' and five items with the relevance score of '2.' Moreover, 12 out of 14 items related to teaching motivation matched with the seven categories they represented and the percentage of agreement between two experts was 100% for the relevance score of '3.' However, two items did not match with the category they were intended to represent by one expert. Overall, 50 out of 52 items matched the category they were supposed to measure and 45 items with 100% of agreement of a relevance score of '3.' Although the results from Expert Panel 2 were satisfactory, some modifications were made later based on recommendation from the two experts. The details appear in Step 6.

Table **3-5**
Results from Expert Panel 2

Variables	Categories	Items matched	% of agreement
Organizational support (5 items)	A1) Verbal support from the department chair A2) Financial support within the department A3) Financial support from the college dean A4) Financial or personnel support from the teaching-support units	5/5 with relevance score of 3	100
Collegiality (5 items)	B1) Frequent interaction with colleagues B2) Tolerance of differences in colleagues B3) Generational equity B4) Supportive community network	5/5 with relevance score of 3	100
Promotion & tenure (7 items)	C1) Demonstration of competence in teaching C2) Demonstration of capacity for growth & improvement C3) Weight assigned to teaching & research by the department C4) Weight assigned to teaching & research by the college C5) Weight assigned to teaching & research by the university	7/7 with relevance score of 3	100
Department culture (8 items)	D1) Weight on evaluating teaching, research, & service by the department D2) Weight on evaluating teaching, research, &service by the college D3) Weight on evaluating teaching, research, & service by the university D4) Weight allocated to teaching, research, & service by faculty D5) Culture type for the department (Clan, Adhocracy, Hierarchy, and Market)	8/8 with relevance score of 3	100
Teaching philosophy (13 items)	E1) Preferred techniques: using a variety of methods for teaching E2) Belief in teaching & learning: the role of teacher, the role of student, and student-teacher relationship	1) 8/13 with relevance score of 3 (100) 2) 5/13 with relevance score of 2 or 3	
Teaching motivation (14 items)	F1) Need for autonomy F2) Need for competence F3) Need for relatedness F4) Identification with teacher role models F5) Previous teaching experiences F6) A real personal concern for both students' achievement & emotional well-being F7) Belief for a life-long learner	1) 12/14 with relevance score of 3 (100) 2) 2/14 did not match the cateogory to be measured	

Step 6. Polish Items from the Suggestions Given by the Panel Experts

The suggestion row in Table 3-4 was another source of feedback from the experts. Items that failed to match their corresponding category and to meet the relevance criteria after the second expert panel were revised again and given to both experts for further discussion. The results from Expert Panel 2 indicated that most of the items matched the sub-concepts proposed; however, some new ideas related to the sub-concepts of the following constructs were recommended for revision. They are detailed below: 1) Split items for consultation and technical support in the category of organizational support; 2) categorize supportive community network in collegiality because the wording of *help each other with course changes* did not specify whether the direction of help was toward one's own course or another's course; and 3) narrow the ideas related to *commitment to teaching* in teaching motivation.

The sub-concepts for the construct of department culture and promotion and tenure went through a major revision during Expert Panel 2. Four sub-concepts relating to department culture focused on *faculty's perception of the weight assigned to teaching, research, and service* as reflected at the department, college, and university levels as well as for themselves. The decision was made to remove *perception of the weight on evaluating teaching, research, and service* because it captured an idea similar to promotion and tenure. Thus, the fifth sub-concept, four types of department culture, was further developed.

The two items, asking whether the course changes faculty made clearly demonstrated to the promotion & tenure evaluation committee that their teaching

competence and capacity for growth and improvement, were deleted because: 1) They did not fully capture the impact of promotion and tenure on the continuation of course innovations; and 2) the words directly borrowed from the promotion and tenure guideline (i.e., demonstration of competence in teaching and capacity for growth and improvement) may be too imposing. Overall, the face-to-face meeting with experts helped establish relevance and clarity of the items requiring revision.

Step 7. Decide on the Number of Items Based on Sample Size and Number of Variables

Survey items were retained based on the criteria of relevance and efficiency. Also, due to the scope of this study, some concepts perceived to overlap with the existing construct were removed from the study. *Practical constraints,* concerning the dimensions of money, time pressure, materials used, and class size, somehow covered the ideas from the constructs of organizational support and promotion and tenure. The construct *teaching efficacy* was not added to the variables for this study because the ideas about interaction with colleagues, teaching competence, and relationship and interaction with students overlapped with collegiality, teaching philosophy, and teaching motivation.

The other concern was balancing the number of constructs investigated with the sample size. Knowing the sample size was to be small, the number of constructs tested was reduced from eight to six. The number of the items matched with the constructs investigated is shown in Table **3-6**.

Table **3-6**

Three Types of Variables, Five Constructs, 22 Categories of Questions, and 63 Items on the Survey

Survey section	Constructs	Categories of questions	Items on the survey (number of items)
		Independent Variables	*47*
Section III.	Profitability factors (20 items)	1) Organizational support	14a-14h (8)
		2) Collegiality	15a-15f (6)
		3) Promotion and tenure	17a1, a2, b1, b2, c1, and c2 (6)
		Practical constraints (removed)	Items related to practical contraints were removed after expert panel 2
	Compatibility factors (27 items)	4) Department culture (institutional culture)	16a-16l (12)
		5) Teaching philosophy	12a-12h (8)
		6) Teaching motivation	13a-13g (7)
		Teaching efficacy (removed)	Items related to teaching efficacy were removed after expert panel 2
		Dependent Variables	*3*
Section II.	States of adoption (3 items)	7) Current sustaining	9
		8) Current transferring	10
		9) Current diffusing	11
		Other Variables	*13*
Section IV.	Demographics (4 items)	10) Academic discipline	18
		11) Current academic rank	19
		12) Current tenure and promotion status	20
			21
		13) Gender	
Section I.	Background information related to course changes (9 items)	14) Reasons to initiate course changes	1
		15) Year of teaching experience	2
		16) Academic rank at that time	3
		17) Tenure and promotion status at that time	4
		18) Course authorship	5
		19) Number of people involved in the course change proposal	5a
		20) Transferring at that time	6
		21) Diffusing at that time	7
		22) Length of time since the semester course change was implemented (# of semesters)	8

Step 8. Enhance the Clarity of the Items

Two techniques, a review of the wording of the items by a professional editor who is a native speaker and a third expert panel were implemented to ensure the clarity of the created survey items. One native speaker of English, an editor of a school magazine, was asked to review the survey items and revise the wording to remove confusion. In addition, a third expert panel was convened to ensure the relevance of the items after the revisions suggested by Expert Panels 1 and 2 and those made by the professional editor.

Since the results from Expert panel 2 were not consistent, an odd number of experts was chosen for a third expert panel to increase the objectivity of the experts' judgments. Two new experts and one from each of the previous panels were invited to participate. The experts involved in the third panel session met at least one of the following criteria: 1) faculty member who served on the promotion and tenure committee at the level of department, college, or university; 2) faculty member who had experiences in innovative teaching; and 3) a course/curricular design expert who helped faculty members with their course innovations.

The results of the third expert panel showed a consistency in matching the items with their corresponding constructs among the three experts. Only one expert had different opinions about items related to collegiality. In addition, the three experts' ratings for relevance of the construct were mostly '3' *more relevant*, while a few had '2' *ambiguous and revision is required*. If only one of the experts chose '2' for the relevance score, then the rating was tolerated. Agreement was 100% for the organizational support (eight items), collegiality (four items), and department culture (nine items). Agreement

for teaching motivation was 98.41%, teaching philosophy, 95.06%, and promotion and tenure, 93.52%. The high agreement percentage of experts for the relevance score for each item and its corresponding construct indicated that the items retained were significantly relevant. After the third expert panel, a professor from the Department of English helped proofread the final version before pre-testing. Appropriateness and accuracy of the use of language and style in the survey were confirmed by that professor.

The Final Measurement Instrument

The survey designed for this study is called Survey of Post-Adoption of Teaching and Learning Course Changes (see Appendix B). The survey consists of four sections (see Table **3-6**). The 63 items constitute 22 question categories. The first section of the survey contains nine question categories with nine items related to background information on course changes. The second section includes three question categories with three items relating to post-adoption states—sustaining, transferring, and diffusing. The third section contains six question categories with 47 items. These 47 items relate to organizational support, collegiality, promotion and tenure, department culture, teaching philosophy, and teaching motivation. The fourth section consists of four categories of demographic questions with four items.

Detailed information related to the variables, definitions, survey items, response categories, scale type, and scoring appear in the following tables. Survey details about organizational support are outlined in Table **3-7**, collegiality in Table **3-8**, promotion and tenure in Table **3-9,** department culture in Table **3-10**, teaching philosophy in Table **3-11**,

and teaching motivation in Table 3-12. Instrument construct information about the three dependent variables is included in Table 3-13.

Table 3-7
Survey Details for Organizational Support

Variable	Organizational support (Davis et al., 1982; Hannan, 2000)
Operationalized definition	1) Financial support from the department or an education development unit 2) Verbal support from the head of the department, or other person in authority 3) Technical support 4) Consultation support
Corresponding items (8 items in total)	14a. Financial support (such as money, software, equipment, etc.) from my program/department was helpful to my course changes. 14b. Financial support (such as money, software, equipment, etc.) from the college or university was helpful to my course changes. 14c. Verbal support from my program/department chair was helpful to my course changes. 14d. Verbal support from the dean or other authority figures at the college or university was helpful to my course changes. 14e. Technical support I received from my program/department was helpful to my course changes. 14f. Technical support from teaching resources available at the college or the university was helpful to my course changes. 14g. Consultation assistance from my program/department was helpful to my course changes. 14h. Consultation assistance from a teaching or learning unit at the college or the university was helpful to my course changes.
Scaling	Closed response (5-point Likert-type scale) 1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly Agree * The number preceding the parenthesis was the score assigned to its equivalent response.
Data type	This type of ordinal data was treated as equal-distanced interval data in this study.
Scoring	Range: 8–40

Note . The four sub-concepts of organizational support were examined in two levels: at the department level and above the department level (college, campus, or university level).

Table **3-8**
Survey Details for Collegiality

Variable	Collegiality (Ishler et al., 1998; Massy et al., 1994; and Webb, 1999)
Operationalized definition	1) Having discussions with colleagues about course changes 2) Having collaboration with colleagues on one's own course 3) Having collaboration with colleagues on their course(s)
Corresponding items (6 items in total)	15a. I often discussed my course change ideas with colleagues in my program/department. 15b. I often discussed my course change ideas with colleagues from outside my program/department. 15c. I collaborated with my program/department colleagues on my course changes. 15d. I collaborated with colleagues from outside my program/department on my course changes. 15e. I collaborated with my program/department colleagues on their course changes. 15f. I collaborated with colleagues from outside my program/department on their course changes.
Scaling	Closed response (5-point Likert-type scale) 1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly Agree * The number preceding the parenthesis was the score assigned to its equivalent response.
Data type	This type of ordinal data was treated as equal-distanced interval data in this study.
Scoring	Range: 6–30

Note . The three sub-concepts of collegiality were examined in two levels: at the department level and above the department level (college, campus, or university level).

Table **3-9**
Survey Details for Promotion & Tenure

Variable	Promotion & tenure (Hannan, 2000; Lane, 2001)		
Operationalized definition	1) Faculty's perception of the weight assigned to teaching and research	2) Influence of course changes on P&T (positive or negative)	3) Impact of P&T feedback received about course changes
Corresponding items (6 items in total)	17a. Using the scale given below, which of the following best describes the focus of the promotion and tenure process overall at the following levels during the time when you made the course changes? 17a1. At the program/department level 17a2. At the college or university level	17b. Using the scale given below, how would you characterize the impact that your course changes had on the tenure and/or promotion evaluation you received at the following levels? 17b1. At the program/department level 17b2. At the college or university level	17c. Using the scale given below, please rate each item based on how well each statement describes the impact of your course changes. 17c1. I believe my course changes had an impact on the student feedback I received about my course. 17c2. I believe my course changes had an impact on the peer feedback I received about my course.
Scaling	Closed response (5-point scale) 1) A great deal more focus on research than teaching 2) Somewhat more focus on research than teaching 3) Equal focus on research and teaching 4) Somewhat more focus on teaching than research 5) A great deal more focus on teaching than research 6) I don't know [counted as missing data]	Closed response (5-point scale) 1) Contributed very negatively 2) Contributed somewhat negatively 3) Neither negatively nor positively contributed 4) Contributed somewhat positively 5) Contributed very positively 6) I don't know [counted as missing data]	Closed response (5-point Likert-type scale) 1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly Agree
Data type	This type of ordinal data was treated as equal-distanced interval data in this study.	This type of ordinal data was treated as equal-distanced interval data in this study.	This type of ordinal data was treated as equal-distanced interval data in this study.
Scoring	Range: 2–10	Range: 2–10	Range: 2–10

Table **3-10**
Survey Details for Department Culture

Variable	Department culture (Hannan, 2000; Kuh & Whitt, 1988; and Obenchain et al., 2002)
Operationalized definition	1) Values and beliefs manifested in the goals and strategies of the organization • Department head/leader • Departmental bonding/department glue • Department climate or general cultural characteristics in the department 2) Types of organizational culture (Obenchain et al., 2002) • Adhocracy: entrepreneurship, creativity, and adaptability (16a, 16e, & 16i) • Clan: cohesiveness, participation, team work, and sense of family (16b, 16f, & 16j)
Corresponding items (6 items in total)	16a. My program/department head was generally considered to be an entrepreneur, an innovator, or a risk-taker. 16e. The glue that held my program/department together was a commitment to innovation and development. There was an emphasis on being first. 16i. My program/department was a place where faculty were innovative and willing to take risks. It was dynamic, adaptable, and creative. 16b. My program/department head was generally considered to be a mentor, facilitator, or a father or mother figure. 16f. The glue that held my program/department together was loyalty and tradition. Commitment to the program/department ran high. 16j. My program/department was a very personal place. It was like an extended family. People seemed to share a lot of themselves.
Scaling	Closed response (5-point Llikert-type scale) 1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly Agree * The number preceding the parenthesis is the score assigned to its equivalent response by the participant.
Data Type	This type of ordinal data is treated as equal-distanced interval data in this study.
Scoring	Range: 6–30

Table **3-11**
Survey Details for Teaching Philosophy

Variable	Teaching philosophy (Goodyear & Allchin, 1998; Lane, 2001)
Operationalized definition	1) Faculty's belief in teaching • Various approaches to teaching (i.e., lectures, class discussions, group projects, guest speakers, etc.) • Students should become independent learners 2) Faculty's belief in learning • Learning occurs when students are actively involved with the learning materials • Students' needs are important 3) Innovation philosophy: teaching as a process of refining, trial-and-error, gradual adaptation, continual learning, and trying of various instructional methods
Corresponding items (7 items in total)	12a. It is preferable to use a variety of methods for effective teaching (i.e., lectures, class discussions, group projects, guest speakers, etc.). 12b. Students should learn to become more independent learners during the learning process. 12c. In order to learn, students should be actively involved with the learning materials. 12d. Teaching is an ongoing process of refining. 12e. Teaching is a process of trying different things and keeping what works. 12f. Teaching is a process of making improvement on your own and relying less on others. 12g. Teaching is a process of making gradual adaptations that evolve over time. 12h. It is important to continue learning things from teaching.
Scaling	Closed response (5-point Likert-type scale) 1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly Agree * The number preceding the parenthesis was the score assigned to its equivalent response.
Data type	This type of ordinal data was treated as equal-distanced interval data in this
Scoring	Range: 8–40

Table **3-12**
Survey Details for Teaching Motivation

Variable	Teaching motivation (Bess, 1977; Deci et al., 1997; Northwest Regional Educational Laboratory, 2001; and Sederberg & Clark, 1990)
Operationalized definition	1) Commitment to teaching • A belief that teachers have a significant impact on students' educational and personal growth 2) Need for autonomy • Flexibility in deciding one's own teaching approach or methods • Opportunities given to understand and discuss the reasons behind one's teaching strategies 3) Need for competence • Confidence gained from feedback relating to successfully carrying out teaching responsibilities • Challenges involves change/improvements which are difficult but attainable 4) Need for relatedness (or need for affiliation) • Experiencing a sense of connecting with department community or colleagues • Opportunities to become acquainted with others who have the same interest of mine (inside or outside the department)
Corresponding items (7 items in total)	13a. A major reason for being a teacher was that I believed I played a significant role in my students' growth. 13b. It was important to me to have the flexibility to determine the classroom methods I would like to use. 13c. I enjoyed being able to justify to others the reasons behind the teaching strategies I used. 13d. I valued the feedback from my students about the changes I made in my teaching. 13e. I was willing to accept difficult but attainable challenges to change my course. 13f. When making course changes, it was important to feel connected to my colleagues in the program/department. 13g. It was important to me to have opportunities to interact with other colleagues with similar research interests.
Scaling	Closed response (5-point Likert-type scale) 1) Strongly disagree 2) Disagree 3) Neutral 4) Agree 5) Strongly Agree * The number preceding the parenthesis was the score assigned to its equivalent response.
Data type	This type of ordinal data was treated as equal-distanced interval data in this study.
Scoring	Range: 7–35

Table **3-13**
Survey Details for Sustaining, Transferring and Diffusing

Variables	Sustaining	Transferring	Diffusing
Operationalized definition	When faculty continued to use the original innovation ideas in the same course. In this study, sustaining was examined in terms of the status & the amount of the change ideas were preserved in the same course but taught in different semesters.	When faculty used the original innovation in other course(s) they taught or are teaching now. In this study, transferring was examined in terms of the status & how many of the changes were applied to different courses taught by the same instructor.	When faculty disseminated their course innovation ideas to other faculty and those ideas were adopted by other faculty in their course. In this study, diffusion was examined in terms of the status amd the number of faculty to whom the changes were diffused.
Corresponding items	9. Thinking of the changes you made in your class, what proportion of them have you continued to use in subsequent versions of that course?	10. How many of the changes have you used in your other courses?	11. How many other faculty members have utilized the ideas that originated from your course or project?
Scaling	Closed response: Percentage of changes sustained 1) None of them 2) Less than half of them 3) About half of them 4) More than half but not all 5) All of them	Closed response: Percentage of changes transferred 1) None of them 2) Less than half of them 3) About half of them 4) More than half but not all 5) All of them	Closed response: Number of new hosts that the original course innovation ideas were spread to 1) None 2) 1 faculty 3) 2-3 faculty 4) 4-5 faculty 5) More than 5 faculty 6) Some, but I don't know how many
Data type	This type of ordinal data was first treated as ordinal data for logistic regression analysis and then later treated as interval data for multiple regressional analysis.	This type of ordinal data was first treated as ordinal data for logistic regression analysis and then later treated as interval data for multiple regressional analysis.	This type of ordinal data was first treated as ordinal data for logistic regression analysis and then later treated as interval data for multiple regressional analysis.
Scoring	Range: 1–5	Range: 1–5	Range: 1–5

Logistic Operations Prior to Data Collection

IRB (Institutional Review Board) Approval and Revisions

Since this study involved faculty participants completing an online survey, IRB approval was obtained in March 2005 and renewed in March 2006. The content of the invitation e-mail, first reminder e-mail, and second reminder e-mail are included in Appendices C, D, and E, respectively.

Approval of Use from Different Units

The original list of potential participants was obtained from a program manager and two directors from the university's three learning-support units and one administrative unit.

Update and Validation of the Database

The database of potential participants matched with innovation grants was updated and validated to avoid sending recruitment e-mail to faculty who were not eligible to participate in the study. Faculty who were retired or no longer assuming teaching responsibilities at the university were removed from the database. Also, only one entry was included when a faculty member received multiple awards and the selected entry was the earliest project that faculty innovators had worked on and contained detailed information. When a choice existed between collaborative or individual projects,

an individual project was chosen to represent the innovation. The filtered database included 360 entries. Information about the study population from each source is listed in Table 3-14.

Table 3-14
Study Population and Their Distribution among the Four Funding/Support Sources

Source	Teaching and learning center A	Teaching and learning center B	Teaching and learning center C	Administrative unit A	Total
Nature of funding/support	Curricular or course changes	Curricular or course changes	Integrating technology into teaching	Integrating technology into teaching	
Timeline	1997-2002	1995-2004	prior to 1997-2001	2003-2004	
Number of participants	175	85	69	31	360
Instructors	38	12	3	12	65
Others	137	73	66	19	295
# for pilot test	15	7	6	2	30
# for data collection	160	78	63	29	330

Stage II: Data Collection

The data were collected in three stages. The purpose of data collection in Stage I was to pre-test the survey with a few participants to gather feedback and comments on the clarity of instructions, survey items, and response categories. The purpose of Stage II was to test the data collection procedures with a small sample and to understand the nature of the data. The purpose of Stage III was to administer the survey to the target population.

Pretests of Measurement Instrument

After writing the Survey of Post-Adoption of Teaching and Learning Course Changes, the survey items were pre-tested to ensure face-validity and to reduce errors resulting from inappropriate procedures. Thus, the feedback served as the basis for revising the measurement instrument and refining the administrative procedures for the main study.

Ensure Content and Format Clarity with Two Participants

In the first pre-test, an instructor and an associate professor were asked to give verbal feedback in individual, face-to-face meetings. These two faculty members were given hard copies of the survey items and asked to comment on the clarity of the instructions, survey items, and response categories. Two revisions were made based on the suggestions they provided: 1) Senior lecturer/instructor was added as a response category to the question asking about faculty's academic rank, and 2) the section heading of promotion and tenure was changed to *division of scholarly activities* to reduce potential feelings of intimidation and increase the likelihood of response.

Pretest with a Small Sample

A stratified random sample was selected for the second pre-test based on the participant's academic rank as instructors vs. non-instructors and the source of funding/support. Thirty faculty members receiving funding/support to revise their

curriculum or course or to integrate technology in their teaching were selected. An invitation e-mail, containing URL to access the online informed consent form and online survey, was sent to invite them to participate. A reminder e-mail was sent seven days after the invitation e-mail.

Seven out of 30 faculty members responded to the survey. Previous research indicated that an expected response survey rate is 30–50% (Dillman, 2000); thus, the estimated number of respondents for the pilot test was 9–15. Two strategies were used to increase the response rate: 1) personalized e-mail message to include the funding/support source, year, and project title for each potential participant, and 2) indication that the study is sponsored by one of the university's teaching and learning centers and accomplished by gaining permission from the university's other teaching and learning centers or an administrative units outside its main campus.

This was a small-scale pilot study for the survey; however, due to the small amount of data obtained, frequency analysis was the only statistical method used to aid understanding the nature of the data. In addition, lessons learned from these two pre-tests served as the basis for refining the survey items and data collection procedures.

Refine the Instrument Based on the Results Obtained from the Pre-tests

Some technology problems with the online survey were solved after the second pre-test. Confusions regarding terms relating to the person in charge of the academic unit to which faculty member belonged, found in the sections on collegiality and department culture, were clarified. The term *department head* worked for faculty members from the

university's main campus but did not sound right to those faculty who were from the university's satellite campuses. The adequate term for department head at the university's satellite campuses should be DAA (director of academic affairs) or CAO (chief academic officer) and the term *department* culture was changed to *campus* culture. The strategy devised to prevent confusion when addressing these terms was to deliver two versions of the survey to faculty at the two types of campus locations. The two versions were equivalent, with the only differences of terms for department head or DAA/CAO and department culture or campus culture.

To understand the nature of the data obtained from the seven cases, two issues were discussed. First, participants tended to choose the response of *not applicable* or *I don't know*. Four out of seven participants offered more than one such response, leading to missing data issues. The solution was to remove the option of *not applicable* from the response categories to avoid missing data. The second issue was that participants responded to some items for which their responses were not required. The three questions related to P&T focused on teaching and research, influence of course changes on P&T, and organizational support. They consisted of four levels of questions for participants from the main campus and satellite campuses. These four questions were: 1) at the level of program/department/division, 2) at the campus level, 3) at the college level, and 4) at the university level. This caused some problems with data validity since faculty from the main campus were supposed to skip the question related to *at the campus level*. However, they still responded to this type of question. Faculty from the satellite campuses were supposed to skip the question related to *at the college level*. Nevertheless, they still responded to this type of question. Moreover, having these four types of questions related

to a single idea did not seem to be very efficient. Thus, a solution was to have two versions of the same survey to distinguish terms for the main campus and its satellite campuses and to merge college with university for faculty from the main campus, and merge campus with university for faculty from the satellite campuses.

Other changes were made to refine the survey and avoid respondents' frustrations. First, an introductory paragraph about content of the study was provided to help participants recall their course change experiences. Some participants might have had difficulty recalling the information asked because it might have been up to 10 years since the adoption of course innovation. However, previous research also indicated that if the experience was meaningful to the individual, such recall problems may be reduced (Dillman, 2000). Second, technical instructions were added to encourage the participants to complete the survey in one sitting (i.e., You cannot save or return to the survey later) with a single successful attempt (i.e., Once you complete all of the questions, please hit the *Submit Survey* button) and to reduce administrative errors (Dillman, 2000).

Data Collection Procedures for the Main Study

The goal of data collection was to ensure that the measurement instrument was valid and reliable, and then to test the research hypotheses and refine predictive models. The administration procedures for data collection were successfully completed through an online survey using 165 faculty respondents during December 2005 to January 2006.

The procedures for administering the online survey were as follows: First, an invitation contained an URL to access the online informed consent form, and an online

survey was sent via email on December 1, 2005. The first reminder and second reminder e-mails were sent on January 5 and 23, 2006, respectively. The second reminder informed participants that the deadline to participate in the online survey was at the end of January 2006. The survey data were automatically coded and generated using Perseus (survey software) after the deadline.

Stage III: After Data Collection

The data analysis in this study had two stages. The purpose of the data analysis in Stage I focused on discovering whether or not the survey items used were valid and reliable. The purpose of the data analysis in Stage II was to test the hypotheses in the proposed models.

Factor analysis was conducted to determine whether or not the survey items were measuring the construct they purport to measure. Reliability analysis was conducted to provide evidence of the internal consistency of items measured within the same factor. Finally, logistic regression and multiple regression analyses were conducted to provide answers to the primary and ancillary research questions proposed for the study. Moreover, all inferential statistic test results were deemed to be .05 or less.

Data Analysis Techniques

The data were analyzed using the Statistical Package for the Social Sciences (SPSS, version 13.0). Two preliminary steps were taken prior to the statistical analysis: 1)

data coding, scaling, and cleaning; and 2) diagnostic procedures to check assumptions of normality, linearity, and homoscedasticity.

Data Coding, Scoring, and Cleaning

Nine out of ten independent variables used a scale of agreement from *strongly disagree* to *strongly agree*. Thus, the response categories for the independent variables were coded from 1 (lowest) to 5 (highest). The variable promotion and tenure had six items with three different scales—scale of agreement, scale of shifting the emphasis from more research to more teaching, and a scale of judging the influence of the course changes from negative to positive.

For the scale of agreement, each response was assigned a corresponding score from 1 to 5. The score coded for each participant in each item was added together with the scores from the rest of the items within the same factor. The summed score of these items in the same factor was used as an indicator of the range of variation in each factor. However, due to the different number of items in each factor, mean scores and standard deviations were used as indicators for descriptive analysis. Similar procedures were applied to the other two scales for the four items within the promotion and tenure variable. The two scales used were: scale for faculty's focus on teaching, from the lowest, *a great deal more focus on research than teaching* to the highest, *a great deal more focus on teaching than research*, and the scale for the impact of promotion and tenure, from the lowest, *contributed very negatively* to the highest, *contributed very negatively*.

Some issues occurred while filtering the data set, and the following guidelines were implemented. First, only system missing data were treated (i.e., skip answers with the symbol of a period appeared in the coded data set) because they were not useful data for the study. Second, response category with *I don't know* or *some, but I don't know how many* in item 11 was treated as missing data. The only exception was that a response category of *this type of support was not available* for the variable of organizational support was merged with the *strongly disagree* option, and coded as '1' in the data set. When a person chose *strongly disagree*, two possible interpretations for such a response were plausible: 1) They did receive financial support from their program/department; however, the support was not helpful, and 2) they did not receive any financial support from their program/department, and thus, they strongly disagreed with this statement. The option of *this type of support was not available* depicted the scenario for the second possibility; thus, this response in this option was merged with *strongly disagree*. After filtering the data, steps were taken to check the multivariate assumptions.

Diagnostics Procedures: Normality, Linearity, and Homoscedasticity

The diagnostic procedure for the dataset in logistic regression was mainly to check whether the normality assumption in the 10 predictors had been met. However, the diagnostic procedures for checking whether the dataset met the assumptions of multiple regression analysis undertaken for both the 10 factors and three outcome variables were: normality, linearity, and homoscedasticity.

Before running logistic regression analysis, the assumptions for normality were conducted for the 10 predictors with the 165 cases in the dataset: Organizational Support (OS), Collegiality within Department (COL1), Collegiality above Department (COL2), P&T Focus on Teaching and Research (PT1), Influence of Course Change on P&T (PT2), and P&T Feedback Received about Course Changes (PT3), Positive Department Culture (DC), Student-centered Teaching Philosophy (TP1), Innovation Philosophy (TP2), Teaching Motivation (TM). Seven of 10 variables fit in a normal distribution curve—the exceptions were the variables PT1, TP1 and TP2. Histograms, boxplots, and skewness values were used to check whether the normality assumption was being met.

For the 165 cases, the histograms for the 10 predictor variables fit in a normal distribution curve, with the exception of the variables PT1, TP1 and TP2. However, their skewness values were all in the range of -1.5 to +1.5. Boxplots indicated that case 17 was extremely under the boundary of the PT3 and TP1; case 103 was extremely under the boundary of the TP2 and TM. Six outliers were present; however, case 17 and 103 were the two extreme outliers because they contributed to the departure of the data set from normality. The existence of these two outliers may "bias the mean and inflate the standard deviation" (Field, 2005, p. 67); thus, the decision was to remove these two outliers from further data analysis at this point. Once the outliers were removed, the same procedure for checking normality was used for the 163 cases. The skewness values for the 10 predictors were all in the range of -1.5 to +1.5. Boxplots indicated that no extreme outliers detected except the predictor PT3. The histograms for the 10 predictors fit in a normal distribution curve, with the exception of the predictors PT1, TP1 and TP2. The

decision was to keep the dataset with 163 cases. Thus, caution is necessary when interpreting the results of logistic regression with PT3 as a significant predictor.

Before running multiple regression analysis, the assumptions of normality, linearity, and homoscedasticity were conducted for the 10 predictors along with the three outcome variables. Histograms, boxplots, and skewness values were used to check whether or not the normality assumption was being met, the curve estimation for checking the linearity assumption, and the regression plots of *RESID against *PRED for checking the homoscedasticity assumption of the error terms. The guidelines (Field, 2005) used to check the assumptions were: 1) skewness value above +1.96 or below -1.96 are problematic and the range used in this study was from -1.5 to +1.5 (George & Mallory, 2001); 2) histograms display more symmetrical and normal-like distributions; 3) boxplots show symmetrical and less skewed distributions; 4) difference between the *r*-squared for linear fit as compared to the nonlinear fit should be fairly small and this can be verified from the curve fit program; and 5) the plots of *ZRESD in X-axis and *ZPRED in Y-axis from the multiple regression in SPSS display a random error pattern rather than a systematic error pattern.

The results of checking normality for the 109 sustaining cases, 95 transferring, and 70 diffusing cases were satisfactory. Their skewness values for the 10 predictors and three outcome variables were all in the range of -1.5 to +1.5, and boxplots indicated no extreme outliers. The histograms for all of the 10 predictors displayed a normal distribution, except for the variables PT1, TP1 and TP2. The histograms for the three outcome variables displayed a normal distribution, except the sustaining variable was negatively skewed. As for linearity, the graphs of curve estimation for the 109 sustaining

cases and 70 diffusing cases indicated that the curve fit for all of the 10 predictors met the linearity assumption. For the 95 transferring cases, all of the 10 predictors met the linearity assumption, except for COL1. Finally, the plots of *ZRESD in X-axis and *ZPRED in Y-axis from the multiple regression were used to check whether the assumption of homoscedasticity in the error terms had been met. These plots for each of the predictors and the first dependent variable (sustaining) displayed a random error pattern rather than a systematic error pattern. The same procedures were completed for the second and the third dependent variables and the plots all displayed a random error pattern. Therefore, the homoscedasticity assumption for the error terms in the multiple regression was met for all of the sustaining, transferring, and diffusing cases. In addition, autocorrelation used to test *whether adjacent residuals are uncorrelated* was examined using the Durbin–Watson statistics (Field, 2005). Field suggested a conservative safe range for the value of the Durbin–Watson test: less than 1 or greater than 3. The value for Durbin–Watson statistics used in this study was set in the acceptable range of Field's guideline which is between 1.5 and 2.5.

Overall, the assumptions for normality, linearity, and homoscedasticity met most of the criteria suggested in Field's (2005) guidelines. Even the results indicated that some variables slightly deviated from normality (PT1, TP1, and TP2) and linearity assumptions (OS, PT3, TM, and COL) in some instances, but they were acceptable to proceed to multiple regression analysis because these tests were robust, meaning that the *n* was not in a very small sample (Sirkin, 2006).

Justification for Using the Likert Scale as Interval Data

Does justification exist for treating the Likert-type scale as interval data? The answer may vary from person to person, but it depends on the position held by the individual researcher. Based on the literature review, empirical tests and diagnostic test results from data in this study followed the common practice of treating an *interval-like* ordinal scale as interval data. The literature review and diagnostic results are summarized below.

Conceptual Difference between Scale Type and Statistics Methods

If the belief is that "measurement is a process of assigning numbers to objects in such a way that interesting qualitative empirical relations among the objects are reflected in the numbers themselves as well as in important properties of the number system" (Michell, 1986, p. 398), then making a strict distinction between scale-type and statistical methods is the act of such conduct. The opposite view is that the distinction between the scale-type and statistical methods is not absolute—it is relative to how the scale-type was designed for use in a certain context and how the research questions were approached (Michell, 1986). Most measurements in social science yield scales that are somewhere between ordinal and interval scales. Treating almost, but not exactly, intervally measured variables as ordinal data, the possible interpretation of the difference between two scores (i.e., the power of running parametric tests) may lose the middle ground (Labovitz, 1967). Thus, if the data do not deviate too far from the assumption of the parametric test, perhaps using parametric tests with this sort of *interval-like* ordinal data will allow

meaningful research questions to be asked and more meaningful interpretations to be generated.

Common Practices in Data Analysis for Likert-type Ordinal Scale

It may be problematic to analyze ordinal scales with few categories (two, three, or four) using nonparametric statistical tests. Less problematic is treating ordinal scales with many categories (five or more) as interval data and using parametric statistical tests. Although Likert-type scales are technically ordinal scales, more and more researchers (Field, 2005; Tabachnick & Fidell, 2007) treat them as continuous variables and use parametric statistical tests in the data analysis. That is, when five or more categories are present, there is relatively little harm in doing this (Johnson & Creech, 1983; Zumbo & Zimmerman, 1983), especially when using the composite score from the items combined. When two or more Likert or ordinal items are combined, the number of possible values for the composite variable begins to increase beyond five categories; thus, encountering less harm in doing so (Baker, Hardyk, & Petrinovich, 1966; Labovitz, 1967).

A recent review of literature on assuming interval data with ordinal scale items demonstrated that "for many statistical tests, rather severe departures (from intervalness) do not affect Type I and Type II errors dramatically" (Jaccard & Wan, 1996, p. 4).

Evidence from Diagnostic Tests

The act of treating interval-like ordinal data as interval data not only has support in the literature, but also has evidence from the diagnostics-test results from the data set obtained in the study. For the variables treated as interval-type data, the study examined the assumptions of normality using several strategies, including calculating skewness values, using boxplots (also called box-whisker diagrams), and examining histograms. Field's (2005) guideline for interpreting skewness value was used—all of the independent variables were found to be fairly or acceptably normal. Moreover, the following two diagnostics procedures under multiple regression analysis were conducted: 1) plotting the residuals against each dependent variable for any systematic error pattern, and 2) checking curve estimation for any indication of quadratic pattern. The results suggest that the data met the assumptions of normality and linearity in a multiple regression analysis.

Approach Taken in This Research

As reflected in this discussion, the first assumption, as suggested by Labovitz (1967), was that although in reality having a true interval scale is rare, in practical, a common belief is to regard the differences between categories A and B, B and C, C and D, etc. as equal.

By assigning the scale-type in the predictor variables as a continuum scale of agreement—a 5-point Likert-scale of strongly disagree, disagree, neutral, agree, and strongly agree—assumed that the relation between these response categories would not

just be ordinal but also approach interval. That is, the distance was assumed to be equal among each adjacent response. Similar assumptions were extended to the other two scales used for promotion and tenure, namely, degree of focus on teaching and research (see items 17a1 & 17a2) and degree of impact of promotion and tenure (see items 17b1 & 17b2). Moreover, evidence from the diagnostic tests suggested that the distributions of the 10 predictors were fairly normal. Thus, this research treated those *interval-like* ordinal scales as interval data and analyzed the data by taking advantage of having interval data for the predictors. Moreover, justification for using the Likert scale as interval data was a prerequisite for the analysis of both instrumentational statistics and inferential statistics.

Factor Analysis

Factor analysis was used to analyze the correlation between the items within each independent variable in order to aid discovery of simple patterns in the variables studied and to test theories about the underlying processes (Tabachnick & Fidell, 2007). Since survey items in the study were developed from their corresponding latent constructs and were validated by the five experts in three panel sessions, analysis used was confirmatory factor analysis (Field, 2005). Items that were assumed to measure the first latent construct were all entered into the variable column and then those items were analyzed using *principal axis factoring* with a *varimax* rotation in SPSS. Then, another set of items, related to the second construct, were analyzed using the same method. Finally, the remaining items were analyzed following the same procedures. The criteria established for retaining items for each factor in this study were based on the guidelines suggested by

Tabachnick and Fidell (2007): 1) factor loadings of .32 or higher, and 2) the avoidance of cross loadings of .10 or less—the difference for the factor loadings of the same item across different factors should be at least .10.

The results of the factor analysis assisted testing whether or not those items included in the survey belonged to a factor or latent construct and measured what they purported to measure. Partially confirmation of a hypothesized factor structure occurred by asking if the theoretical number of factors adequately fit the data (Tabachnick & Fidell, 2007). Thus, re-evaluation of the meaningfulness of the factors, derived from factor analysis, was a crucial step. Items that passed the criteria were judged based on whether or not their clustering with other items was conceptually or logically sound. Items that failed to form a category that explained common variance with other items and that had no strong theoretical basis were removed from the measurement instrument. Finally, items that did not meet the criteria but which remained in the instrument required justification for solution.

After ensuring completion of the first step of data analysis—the scores for the survey instrument were valid, the next step was to proceed to the reliability analysis to judge whether the scale used consistently reflected the construct it was supposed to measure.

Reliability Analysis

Reliability analysis was conducted to measure the internal consistency of the Survey of Post-Adoption of Teaching and Learning Course Changes. Separate reliability

analyses were conducted for all subscales of the measurement instrument. The reliability of each factor was judged based on the following two values: α (Cronbach's alpha or called as coefficient alpha) for the set of items and item-total correlation for each item. Field (2005) suggested the criteria set for coefficient alpha should be .70 or higher and item-total correlation .30 or higher. Nunnaly (1978) also indicated that .70 was an acceptable reliability coefficient but lower thresholds, ranging between .50 and .60, were sometimes used in the literature in the early stages of research. Thus, the decisions were: a set of items with $\alpha > .70$ remained in the set of the items, and those with $.50 < \alpha < .70$ were kept only if they were theoretically sound or newly developed.

Logistic Regression

Binary logistic regression analysis was conducted to predict the sustaining, transferring, and diffusing of a teaching and learning innovation with two dichotomies, sustained/not sustained, transferred/not transferred, and diffused/not diffused, from the 10 predictors: Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Change on P&T, P&T Feedback Received about Course Changes, Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation.

The measure of log-likelihood from the observed and predicted values was used to assess the fit of the logistic regression model (Field, 2005). The larger the value of the log-likelihood, the greater the number of unexplained observations in the model. The *Hosmer-Lemeshow* goodness-of-fit statistic was also used to assess how well the chosen

model fit the data. The classification of cases was a method used to assess the success of a model by evaluating its ability to predict correctly the three outcome variables in the study—sustaining, transferring, and diffusing (Tabachinick & Fidell, 2007).

Two important indicators for logistic regression models in the SPSS output were: the value of exp b, as *Exp (B)* and the coefficient, *B.* The former served as an indicator of the change in odds resulting from a unit change in the target predictor variable, and the latter as natural logs of the odds ratios for the same predictor variable.

The step followed in completing the binary logistic regression analysis for this study involved merging the response categories for the criterion variables into two types of outcomes. In the sustaining cases, the outcome *did not sustain course change* was coded as '0' and the one *sustained course change regardless the degree of sustaining* was coded as '1.' Thus, the response category of *none of them* in the dependent variable of sustaining was coded as '0' and the rest of the response categories were coded as '1.' The contrast in the outcome variables for the transfer cases was transferred vs. not transferred and diffused vs. not diffused in the diffusion cases. The response categories in the transfer cases were coded the same way as in the sustaining model. In the diffusion cases, *none of the people to whom the changes were diffused* was coded as '0' and the other responses related to *the number of people to whom the changes were diffused* were coded as '1.' The response category of *some, but I don't know how many* in the diffusion cases was treated as missing or valid data. This instance was treated as missing data since later these cases were used in the follow-up multiple regression analysis.

Multiple Regression

In this study, multiple regression analysis was used as a follow-up procedure to further explore the prediction of models for each outcome variable. In order to attain the primary goal of investigating the relationship between each outcome variable (or DV) and several predictor variables (IVs) proposed in the study, the following steps suggested by Tabachnick and Fidell (2007) were conducted in the regression analysis: 1) determine the strength of the relationship between the DV and IVs, 2) assess the importance of each of the IVs to the relationship, and 3) investigate the relationship between a DV and some IVs with the effect of other IVs statistically eliminated.

The values of R, R^2, and adjusted R^2 were used to assess the goodness-of-fit of the multiple regression model(s). Multiple R indicated how well the model predicted the observed data because it represented the correlation between the observed values of Y and the values of Y predicted by the multiple regression models. R-squared (R^2) represented the amount of variation in the outcome variable, accounted for by the predictor variables entered in the model. Adjusted R^2 indicated how well the model could be generalized; this value should be the same, or very close to, the value of R^2 (Field, 2005).

The steps followed in accomplishing multiple regression analysis involved using SPSS to select cases for the three models. Among the 163 cases in the data set, only those cases in which the response for the innovation sustained was larger than one were used. That is, '0' signified those who did not sustain their course innovation; thus, the 25 identified cases were eliminated from the analysis. The same procedures were completed

for transfer and diffusion models. Using the same 10 predictors in the logistic regression analysis, the final cases used in the sustaining model were 109; transferring model, 95; and diffusion model, 70.

Summary

In chapter 3, methods followed in the design and development of the measurement instrument, *Survey of Post–Adoption of Teaching and Learning Course Changes,* were described. Then, the focus shifted to the implementation and analysis of instrument use in creating predictive models for the sustaining, transferring, and diffusing of an instructional innovation. A total of 163 faculty from a Research I university completed the online survey from December 2005 to January 2006.

The research was conducted in three stages: before data collection, data collection, and after data collection. The steps and procedures followed in the survey design, data collection, and data analysis were from the literature and suggestions from different experts. Content-, construct-, and face-validity were the main guidelines used in designing and developing the survey. Eight steps were implemented before data collection: 1) conceptualize the structure of the instrument based on the variables investigated, 2) define and operationalize the constructs, 3) consider the scale design, 4) write the initial set of items, 5) ensure representativeness and relevance of the items created, 6) polish items from the suggestions given by the panel experts, 7) decide on the number of items based on sample size and number of variables, and 8) enhance the clarity

of the items. Procedures for applying logistic operations and two pre-tests were followed to reduce measurement error during data collection.

After data collection, two data analysis techniques were implemented. First, data coding, scoring, and filtering were described and the diagnostic procedures of checking the multivariate assumptions of normality, linearity, and homoscedasticity were conducted. In addition, justification for using Likert-type scale as interval data was provided before completing instrumentational and inferential statistics.

The results of factor analysis and reliability analysis indicated that the instrument used was valid and the scores obtained were reliable. The 10 predictors used in the inferential statistics were: Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, influence of course changes on P&T, P&T Feedback Received about Course Changes, Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation.

Binary logistic regression was used to explain the predicting power of each model in terms of whether or not faculty sustained, transferred, and diffused their instructional innovations, as predicted by the 10 predictors. Multiple regression analysis were used as an in-depth examining tool to explore further the predicting power of the 10 predictors on the sustaining, transferring, and diffusing models for those cases that were sustained, transferred, and diffused. Moreover, a final model with significant predictors retained was provided to maximize the parsimonious principle for predictive models.

Chapter 4

Results

This study investigates the relationship between profitability- and compatibility-related factors on faculty's post-adoption of teaching and learning innovations. Specifically, this study creates predictive models to systematically explain the impact of six *profitability* factors and four *compatibility* factors on the sustaining, transferring, and diffusing of a teaching and learning innovation. The six profitability factors are Organizational Support, Collegiality within Department, Collegiality above Department, Promotion and Tenure (P&T) Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes. The four compatibility factors are Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation. The purpose of creating these predictive models is to measure how much of the variance within each dependent variable (i.e., sustaining, transferring, and diffusing) could be accounted for by the 10 independent variables.

Pearson's correlation was used to investigate the relationship between the 10 predictors (six profitability and four compatibility factors) with faculty's sustaining, transferring, and diffusing of their teaching and learning innovation. Binary logistic regression analysis was used to examine whether or not faculty sustained, transferred, and diffused their teaching and learning innovation, and whether the activity could be predicted by the 10 identified predictors. Multiple regression analysis was conducted to

account for the extent to which all of the predictors contributed to the sustaining, transferring, and diffusing of a teaching and learning innovation. Moreover, the significance of individual predictors was reported based on the results from both logistic and multiple regression models.

Descriptive Statistics

Demographics

During the study, 165 faculty participated in an online survey; two outliers were removed from the data analysis. Among the 163 respondents, 93 (57%) were from the university's main campus and 70 (43%) were from satellite campuses; 104 (63.8%) were male and 59 (36.2%) were female. The distributions by discipline area for these respondents were: 34 (20.9%) from Science; 31 (19%) from Liberal Arts; 27 (16.6%) from Engineering; 17 (10.4%) from Health and Human Development; 15 (9.2%) from Arts and Architecture; 8 (4.9%) from Earth and Mineral Sciences; 8 (4.9%) from Information Sciences and Technology; 8 (4.9%) from Agricultural Sciences; 5 (3.1%) from Education; 4 (2.5%) from Communications; 2 (1.2%) from Business; and 4 (2.4%) from other fields.

As for their current academic rank, 31 (19%) are instructors; 26 (16%), assistant professors; 55 (33.7%), associate professors; 42 (25.8%), professors; and 9 (5.5%), other academic ranks such as associate deans, deans, distinguished professors, or emeritus professors who are still teaching.

Background Information on Participants' Course Changes

When asked about the main reason for initiating a course change, the faculty innovators' top three reasons were: 1) the need to improve student learning in my course (45.5%), 2) in response to knowledge of a new way to present the course (19.6%), and 3) adaptation of new technologies (15.3%). These three reasons suggested that respondents' main motive was to improve their students' learning.

The academic ranks for these faculty members at the time they implemented their course changes were: 55 (33.7%), assistant professors; 45 (27.6%), associate professors; 33 (20.3%), lecturers and instructors; 26, (16%), professors; and 4 (2.5%), other academic ranks.

In term of years of teaching experience, 48 (29.5%) faculty participants had six or fewer years of teaching experience, and 115 (71.5%) had seven or more years of teaching experience. Only 12 (7.4%) had less than three years of teaching experience, and 68 (41.7%) had taught more than 12 years at the time they implemented their course changes. This result indicates that those who are more likely to implement course changes were at the academic rank of associate professor or above (about 80%). In particular, most faculty participants received tenure or were promoted during the time they implemented their course changes. In addition, faculty members with more than six years of teaching experience were more likely to implement course changes than those with less than six years of teaching experience.

As for the originality of course authorship, 90 (54.5%) faculty participants reported that they were the only instructor who taught the course and proposed the course

changes without collaborating with other faculty. Also, when asked the question "Prior to spring 2006, how many semesters have you taught the course since the changes were implemented?", 110 (66.9%) participants said they had taught the same course for more than two semesters; 38 (23.3%) participants, for one to two semesters; and 16 (9.8%) participants, never taught that course again.

Status of Participants' Course Changes

One of the main inquiries in the study was to determine the impact of 10 predictors on the post-adoption of a teaching and learning innovation. A review of the frequency analysis for the three dependent variables, sustaining, transferring, and diffusing, is presented in Table **4-1**. The two questions relating to *sustaining now* and *transferring now* were measured in terms of the proportion of the changes sustained and how many of the changes were transferred; the questions relating to *diffusing now* were measured by the number of faculty to whom the changes were diffused.

Table **4-1**
Descriptive Statistics of Status of Faculty's Course Changes (n = 163)

Status of participants' course changes	n	Mean	Standard deviation
Sustaining now	158	3.66	1.41
Transferring now	160	2.61	1.33
Diffusing now	159	3.26	1.84

Note . Responses were coded using a 5-point scale.
Sustaining now was coded as follows: 1 as none of the changes sustained; 2 as less than half of the changes sustained; 3 as about half of the changes sustained; 4 as more than half the changes sustained, but not all; and 5 as all of the changes sustained.
Transferring now was coded as follows: 1 as none of the changes transferred; 2 as less than half of the changes transferred; 3 as about half of the changes transferred; 4 as more than half the changes transferred, but not all; and 5 as all of the changs transferred.
Diffusing now was coded as follows: 1 as none of the faculty; 2 as one faculty; 3 as two to three faculty; 4 as four to five faculty; and 5 as more than five faculty.

Among the mean scores for faculty's status relating to course changes, the mean score of the variable *sustaining now* suggests that, on average, faculty either sustained *about half of their innovation* or *more than half, but not all of their innovation*. However, faculty tended to make less transfer of their course innovation because the mean of transfer is 2.6, between *less than half of the innovation* and *about half of the innovation*. Moreover, on average, faculty tended to diffuse their innovation to two to three or four to five faculty members.

The results suggested that faculty made more sustaining efforts than transferring and diffusing efforts. However, a surprising result was that the mean score for *transferring now* was lower than that for *diffusing now*. The original assumption was that somehow faculty should first sustain their course changes and then later transfer that idea to their other courses. Ultimately, when they were more confident in making course

changes, they could diffuse their course change ideas to other faculty. Perhaps in reality the difference between transferring and diffusing was not completely a sequential relationship. Both could occur at the same time, or one could take place prior to the other. Whether the mean for these three dependent variables reflected the real scenario relating to faculty's post-adoption of their course changes may be answered from the results of the inferential statistics provided in a later section.

Impact of Profitability Factors

The results relating to faculty's perceptions of the impact of the six profitability factors on their course changes are presented in Table 4-2. Two factors—P&T Focus on Teaching and Research, and Influence of Course Change on P&T—used the scale for focus laid more on teaching or research and the scale of P&T impact as positive or negative, respectively. The other four profitability factors used a 5-point Likert scale of agreement. A mean score for a factor higher than 3 suggests that faculty participants agreed more that the factor played a certain role during their innovation process. Three of the profitability factors had means higher than 3: Organizational Support (mean = 3.30), Collegiality within Department (mean = 3.33), and P&T Feedback Received about Course Changes (mean = 3.72). Collegiality above Department is a factor with a mean lower than 3 (mean = 2.84).

Were support and encouragement from authority figures or resources helpful during the time faculty implemented their course changes? Results relating to the types and levels of organizational support indicated that the following were perceived as more

helpful to faculty: verbal support at the department level (mean = 3.65), financial support above the department level (mean = 3.91), and technical support above the department (mean = 3.43). Consultation support at the department level (mean = 2.68) seemed to be least helpful to faculty's continuation of course changes.

Which of the collegial activities existed during the time faculty implemented their course changes? When participants were asked whether they had had discussions about course changes with department colleagues, the mean was 3.71. Moreover, they also reported collaborations with department colleagues on the participants' own course changes (mean = 3.27) and collaborations with department colleagues on the colleagues' course changes (mean = 3.01).

Table **4-2**
Descriptive Statistics for Profitability Factors

Description of factor represented	n	Mean	SD
Factor 1: Organizational support	160	3.30	1.34
Financial support at the department level	162	3.31	1.46
Verbal support at the department level	163	3.65	1.26
Technical support at the department level	163	3.24	1.35
Consultation support at the department level	163	2.68	1.30
Financial support above the department level	163	3.91	1.30
Verbal support above the department level	162	2.94	1.38
Technical support above the department level	162	3.43	1.33
Consultation support above the department level	163	3.20	1.37
Factor 2: Collegiality within the department	161	3.33	0.91
Discussed course changes with colleagues within the department	162	3.71	0.98
Collaborated with department colleagues on my course changes	162	3.27	1.20
Collaborated with department colleagues on their course changes	161	3.01	1.14
Factor 3: Collegiality above the department	160	2.84	1.14
Discussed course changes with colleagues from outside the department	161	3.01	1.12
Collaborated with colleagues from outside the department on my course changes	162	2.90	1.17
Collaborated with colleagues from outside the department on their course changes	161	2.60	1.13
Factor 4: P&T focus on teaching and research	158	1.93	1.14
Focus more on teaching and research within the department	160	2.19	1.28
Focus more on teaching and research above the department	158	1.67	0.99
Factor 5: Influence of course changes on P&T	152	2.85	1.32
Impact of course changes on P&T at department level	154	3.01	1.31
Impact of course changes on P&T above the department level	152	2.68	1.32
Factor 6: P&T feedback received about course changes	157	3.72	0.88
Impact of course changes on the student feedback received	158	4.09	0.79
Impact of course changes on the peer feedback received	157	3.35	0.97

Note . Differences in *n* are because the number of missing entries varied by item. Responses were coded using a 5-point Likert scale (1: strongly disagree and 5: strongly agree).

What were faculty's perceptions of the various aspects of P&T during the time they implemented their course changes? In terms of the weight assigned to teaching and research, the results shown in Table **4-2** indicate that faculty perceived less focus was assigned to teaching than research at both the department level (mean = 2.19) and at the college or university level (mean = 1.67). As for the impact of course changes on the type of student feedback they received as part of the P&T criteria, the results indicated that faculty perceived the impact from the student feedback they received (mean = 4.09) to be greater than the impact of peer feedback they received (mean = 3.35). Furthermore, faculty perceived that the impact of their course changes on the P&T process was greater at the department level (mean = 3.01) than at the college or university level (mean = 2.68).

Impact of Compatibility Factors

The results relating to faculty's perceptions of the impact of the four compatibility factors on their course changes are presented in Table **4-3**. The four compatibility factors used a 5-point Likert scale of agreement. Their mean scores are: Positive Department Culture (mean = 3.05), Student-centered Teaching Philosophy (mean = 4.69), Innovation Philosophy (mean = 4.48), and Teaching Motivation (mean = 4.04). The relatively high mean scores for the factors of Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation suggest that faculty participants perceived them as playing an important role in their innovation process.

Table **4-3**
Descriptive Statistics for Compatibility Factors

Description of factor represented	n	Mean	SD
Factor 7: Positive department culture	159	3.05	1.13
Department head (Adhocracy culture type)	163	3.06	1.16
Department head (Clan culture type)	163	3.01	1.15
Department glue (Adhocracy culture type)	160	2.86	1.01
Department glue (Clan culture type)	161	3.03	1.07
Department climate (Adhocracy culture type)	163	3.28	1.15
Department climate (Clan culture type)	163	3.07	1.21
Factor 8: Student-centered teaching philosophy	162	4.69	0.52
Belief in viewing students as independent learners	163	4.66	0.56
Belief in viewing students as active learners	162	4.72	0.49
Factor 9: Innovation philosophy	157	4.48	0.64
Teaching with a variety of instructional methods	161	4.60	0.65
Teaching as a refining process	163	4.75	0.45
Teaching as a trial-and-error process and keeping what works	161	4.45	0.66
Teaching as a gradual adaptation process over time	161	3.91	0.93
Teaching as a continual learning process	163	4.69	0.51
Factor 10: Teaching motivation	158	4.04	0.64
Teaching commitment: Commitment to play a significant role in students' growth	163	4.21	0.70
Needs for autonomy: Having flexibility in teaching methods	161	4.57	0.61
Needs for autonomy: Justifications of teaching strategies	163	3.81	0.87
Needs for competence: Valuing students' feedback on course changes	162	4.35	0.67
Needs for competence: Accepting difficult but attainable challenges to change course	162	4.25	0.61
Needs for relatedness: Feeling connected to department colleagues	162	3.33	0.10
Needs for relatedness: Having opportunity to interact with colleagues with similar research interests	162	3.75	0.91

Note. Differences in *n* are because the number of missing entries varied by item. Responses were coded using a 5-point Likert scale (1: strongly disagree and 5: strongly agree).

What was the department culture like during the time faculty implemented their course changes? Departments aligning with the adhocracy culture advocate the ideas of entrepreneurship, creativity, and adaptability, whereas departments inclined toward a clan culture emphasize the ideas of cohesiveness, participation, teamwork, and sense of a shared family. The results revealed that for both types of department cultures (1 = adhocracy; 2 = clan), descriptively, faculty perceived that department climate (mean1 = 3.28; mean2 = 3.07) had a greater impact on their course changes than the department head (mean1 = 3.06; mean2 = 3.01) or department glue/cohesion (mean1 = 2.86; mean2 = 3.03) during the time they implemented course changes.

What kind of teaching philosophy did faculty follow while implementing their course changes? Two types of philosophy tabulated in Table 4-3 are: Student-centered Teaching Philosophy and Innovation Philosophy. The mean scores for the two items related to Student-centered Teaching Philosophy were both high (4.66 and 4.72). This suggests that faculty who implemented their course changes tended to hold a student-centered teaching philosophy. Moreover, Innovation Philosophy seemed to be prevalent during the time faculty implemented course changes. This was reflected in the higher mean scores for the following three items: 1) teaching as a refining process (mean = 4.75); 2) teaching as a continual learning process (mean = 4.69); and 3) teaching with a variety of instructional methods (mean = 4.60).

What kind of teaching motivation guided faculty during their implementation of course changes? Mean scores are tabulated for the seven items in Table 4-3. The mean scores related to teaching commitment (mean = 4.21), needs for autonomy (4.57 and

3.81, respectively), and needs for competence (4.35 and 4.25, respectively) are higher than those related to needs for relatedness (3.33 and 3.75, respectively).

Factor Analysis and Reliability Analysis

The results of factor analysis and reliability analysis indicated that overall the validity and reliability of the measurement instrument was acceptable for a newly developed instrument. Originally, there were three *profitability* factors (organizational support, collegiality, and promotion and tenure) and three *compatibility* factors (department culture, teaching philosophy, and teaching motivation). The factor analysis and reliability analysis resulted in six *profitability* factors derived from the original three profitability factors and four *compatibility* factors derived from the original three compatibility factors. The six resulting *profitability* factors were: Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes. The four resulting *compatibility* factors were: Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation.

Validity and Reliability of Profitability Factors

The results of factor analysis and reliability analysis for the profitability factors appear in Table **4-4**.

Table **4-4**
Results of Factor Analysis and Reliability Analysis for Profitability Factors

Description of factors represented	Factor 1	Factor 2	Factor 3
Organizational support (Cronbach's alpha = .72)			
14e. Technical support within department	.67	.07	na
14g. Consultation support within department	.67	.21	na
14a. Financial support within department	.54	.11	na
14d. Verbal support above department	.50	.24	na
14c. Verbal support within department	.50	.04	na
14h. Consultation support above department	-.01	.79	na
14f. Technical support above department	.17	.51	na
14b. Financial support above department	.33	.35	na
Collegiality above the department (Cronbach's alpha = .76)			
15f. Collaborated with colleagues from outside the department on their course changes	.89	.15	na
15d. Collaborated with colleagues from outside the department on my course changes	.66	.11	na
15b. Discussed course changes with colleagues from outside the department	.58	.10	na
Collegiality within the department (Cronbach's alpha = .75)			
15c. Collaborated with department colleagues on my course changes	-.04	.95	na
15a. Discussed course changes with department colleagues	.14	.62	na
15e. Collaborated with department colleagues on their course changes	.28	.55	na
Influence of course changes on P&T (Cronbach's alpha = .82)			
17b1. Impact of course changes on P&T at the department level	.83	.12	.07
17b2. Impact of course changes on P&T above the department level	.83	-.04	.04
P&T focus on teaching and research (Cronbach's alpha = .73)			
17a1. Focus on teaching and research within the department	.01	.87	-.13
17a2. Focus on teaching and research above the department	.06	.69	.07
P&T Feedback received about course changes (Cronbach's alpha = .59)			
17c1. Impact of course changes on the student feedback received	.01	-.04	.65
17c2. Impact of course changes on the peer feedback received	.08	.02	.64

All 20 items relating to profitability factors passed the first criterion (factor loading > .32) and second criterion (no cross loading) for factor analysis except item 14b, which belonged to the sub-concept *financial support above department*. Item 14b had a cross-factor loading problem because its loading was .35 on Factor 2 (Organizational

Support above Department) and .33 on Factor 1 (Organizational Support within Department). It was decided to retain item 14b within the set of items measuring the factor Organizational Support above Department because it was conceptually categorized there. This solution did not accord with one of the criteria set for the factor analysis—the difference for the factor loadings of the same item across different factors should be at least .10. However, the final decision to group all of the 8 items (14a–14h) as the factor Organizational Support resolves the issue of cross loading since this item had only one loading within the grouped factor Organizational Support.

Further, the factor analysis results logically matched the conceptual analysis of these profitability items except for one item, 14d (*verbal support above department*). Mathematically, this item loaded similarly on Factor 1 (Organizational Support within Department) and Factor 2 (Organizational Support above Department) and loaded toward Factor 1. In looking conceptually and logically at the item, it belongs to Factor 2; however, leaving it with Factor 2 did not fit with the results of the factor analysis.

After holding discussions with experts and evaluating the importance of the effects of items 14d and 14b, the investigator decided to retain 14b and 14d under a latent construct—organizational support. This resolution merged the two levels of organizational support (within department vs. above department); the coefficient alpha for these eight items increased to .72.

The results from the factor analysis for the two factors derived from collegiality matched the conceptual classification of the two proposed levels of collegiality. The six items for Collegiality within Department and Collegiality above Department all passed the two criteria for factor analysis; their coefficient alphas were .75 and .76, respectively.

The results from the factor analysis for the three factors derived from promotion and tenure matched the conceptual classification of the three sub-concepts proposed. However, there were only two items for each factor. The general rule is to have at least three items per factor (Marsh, Hau, & Grayson, 1998); the respective alpha values for reliability analysis were very good for the first two factors: P&T Focus on Teaching and Research ($\alpha = .73$) and Influence of Course Changes on P&T ($\alpha = .82$), except for P&T Feedback Received about Course Changes ($\alpha = .59$). The reliability coefficient for P&T Feedback Received about Course Changes is relatively low in comparison with the criterion ($\alpha = .70$). Since these two items were newly developed and the Cronbach's alpha may be affected by the length of the scale, it is acceptable to have somewhat lower standards of reliability in this case. Also, Nunnally (1978) mentioned that a coefficient alpha from .50 to .60 is tolerable in the early stages of research. Since this study was an early investigation of the effect of promotion and tenure on post-adoption of course innovation, it was decided to retain the three factors: P&T Feedback Received about Course Changes, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes. The rationale is that the six items related to the three factors all captured important aspects related to the impact of promotion and tenure on the post-adoption of an instructional innovation.

Validity and Reliability of Compatibility Factors

The results for factor analysis and reliability analysis for compatibility factors are presented in Table 4-5. Originally, there were 12 items for the construct of department culture, eight items for teaching philosophy, and seven items for teaching motivation.

Table **4-5**
Results of Factor Analysis and Reliability Analysis for Compatibility Factors

Description of factor represented	Factor 1	Factor 2	Factor 3
Department culture (Cronbach's alpha for the first 6 items = .83)			
16i. Department climate (Adhocracy culture type)	.72	-.19	na
16b. Department head (Clan culture type)	.67	-.20	na
16j. Department climate (Clan culture type)	.67	-.08	na
16a. Department head (Adhocracy culture type)	.65	-.32	na
16f. Department glue (Clan culture type)	.63	.11	na
16e. Department glue (Adhocracy culture type)	.61	-.19	na
16g. Department glue (Market culture type)	.58	.39	na
16d. Department head (Hierarchy culture type)	.46	-.12	na
16c. Department head (Market culture type)	.45	.08	na
16l. Department climate (Hierarchy culture type)	-.29	.74	na
16h. Department glue (Hierarchy culture type)	.12	.67	na
16j. Department climate (Market culture type)	-.12	.48	na
Innovation philosophy (Cronbach's alpha = .70)			
12e. Teaching as a trial-and-error process and keeping what works	.72	.07	na
12d. Teaching as a refining process	.71	.27	na
12h. Teaching as a continual learning process	.62	.27	na
12g. Teaching as a gradual adaptation process over time	.45	.09	na
12a.Teaching with a variety of instructional methods	.39	.25	na
Student-centered teaching philosophy (Cronbach's alpha = .71)			
12c. Belief in viewing students as active learners	.21	.83	na
12b. Belief in viewing students as independent learners	.15	.62	na
Teaching motivation (Cronbach's alpha = .69)			
13e. Accepting difficult but attainable challenges to change course	.69	.03	na
13b. Having flexibility in teaching methods	.51	-.03	na
13c. Justifications of teaching strategies	.50	.39	na
13a. Commitment to play a significant role in students' growth	.49	.25	na
13d. Valuing students' feedback on course changes	.44	.17	na
13f. Feeling connected to department colleagues	.06	.80	na
13g. Having opportunity to interact with colleagues with similar research interests	.12	.66	na

However, eight items were removed from the compatibility factors either because they failed to meet the first or second criterion for factor analysis or because they did not group well with the other items to form a meaningful factor. Overall, the 20 items related to compatibility factors all met the first criterion for factor analysis and had a factor loading larger than .32. In addition, none of the 20 items cross-loaded and thus met the second criterion as well.

The 12 items for the construct department culture were reduced to six items (Items 16i, 16b, 16j, 16a, 16f, and 16e) because only the grouping of these six items within the first factor identified was much more meaningful than the second factor in explaining faculty's continuation/discontinuation of their innovations. The results from the factor analysis indicated that among the nine items identified in the first factor, six items were related to clan culture and adhocracy culture. Thus, it was decided to delete the other three items (Items 16g, 16d, and 16c) relating to the idea of market or hierarchy culture and label the first factor as Positive Department Culture because these two types of culture were believed (Kabanoff et al., 1995; Obenschian et al., 2002) to facilitate the continuation of innovation . Furthermore, the results of the reliability analysis ($\alpha = .83$) confirmed that the scores for the six items used to measure the predictor Positive Department Culture were reliable.

Three factors relating to teaching philosophy were identified from the factor analysis. The third factor only contained one item (item 12f), which was conceptually related to Innovation Philosophy and had a factor loading of .20. Since it does not make sense to have one item within one factor, and the factor loading for item 12f was low, the options were to regroup it with other factors or delete this item. Grouping it together with

the other items to form another factor did not generate a meaningful category; therefore, the decision was to remove item 12f from the factor Innovation Philosophy. For the other seven items retained, all had a factor loading above .32 and no cross-loading problem. Two factors related to the construct teaching philosophy were derived from the factor analysis and the results met conceptual classification. The reliability scores for both factors in Student-centered Teaching Philosophy (α = .71) and Innovation Philosophy (α = .70) were fairly good. The factor Student-centered Teaching Philosophy contained only two items, which had responses that were intercorrelated to the extent that they appeared to measure the single factor Student-centered Teaching Philosophy. Since this instrument was newly developed, the decision was to retain this factor after consulting two statistical experts. The rule of thumb is that a factor should contain at least 3 items (Marsh et al. 1998). However, the factor Student-centered Teaching Philosophy only contained two items. Thus, the reader should be cautious while interpreting the results of this factor.

Two factors identified from the construct teaching motivation did not make sense because this categorization dissected two items that were supposed to measure the concepts of *need for competence* into two different factors. Therefore, it was decided to include the six items with three psychological needs and one item related to *commitment to teaching motivation* in the original construct proposed. In doing so, the reliability of the scores with this solution increased from .67 to .69. Although putting the two items related to need for competence with the other five items together did not increase alpha value much, it was closer to .70. In doing so, it kept the integrity for the construct teaching motivation because these two items belong to one of the three sub-concepts for teaching motivation.

Summary of Factor Analysis and Reliability Analysis

Overall, the reliability for the 10 predictors was fairly good because their Cronbach's alpha values were close to or higher than .70, except for the factor P&T Feedback Received about Course Changes. Their alpha values were as follows: Positive Department Culture (α = .83), Influence of Course Changes on P&T (α = .82), Collegiality above Department (α = .76), Collegiality within Department (α = .75), P&T Focus on Teaching and Research (α = .73), Organizational Support (α = .72), Innovation Philosophy (α = .70), Teaching Motivation (α = .69), and P&T Feedback Received about Course Changes (α = .59). Nunnally (1978) mentioned that a coefficient alpha from .50 to .60 is tolerable in the early stages of research. The reliability level was still adequate for those two factors with alpha lower than .70 since these items were newly developed for the measurement instrument. Thus, having two predictors with Cronbach's alpha of less than .70 was deemed acceptable. This suggests that the self-designed measurement instrument had good validity for factors impacting faculty's post-adoption and yielded reliable scores. Therefore, data collected from the instrument was used for logistic regression and multiple regression analysis in the inferential statistics.

Inferential Statistics

Three types of analysis were conducted to answer the seven research questions: correlation, binary logistic regression, and multiple regression. Research Question 1 asked about the relationships between the 10 predictor variables and the three outcome variables. Research Questions 2 to 4 investigated whether or not course innovations were

sustained, transferred, or diffused; thus, these questions fit the assumptions for using logistic regression. Research Questions 5 and 6 related to the extent of the changes sustained and transferred, whereas Research Question 7 related to the number of people to whom the changes diffused. The nature of Research Questions 5 to 7 was more tailored to the assumptions of multiple regression analysis. The 10 predictor variables used in both logistic regression and multiple regression analysis were: Organizational Support, Collegiality within Department, Collegiality above Department, P&T focus on Teaching and Research, Influence of Course Changes on P&T, P&T Feedback Received about Course Changes, Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation. The three criterion variables examined were: sustaining, transferring, and diffusing.

Results for Primary Research Questions

Relationship between Profitability and Compatibility Factors with Faculty's Post-adoption Behaviors

RQ 1: What is the relationship of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered teaching philosophy, Innovation Philosophy, and Teaching Motivation) with the *sustaining, transferring,* and *diffusing* of a teaching and learning innovation?

The results from the correlation matrix for all of the 10 predictor and three outcome variables, sustaining, transferring, and diffusing, appear in Table **4-6**. The predictors of P&T Feedback Received about Course Changes, Organizational Support, and Collegiality above Department were significantly and positively correlated to all of the three outcome variables (sustaining, transferring, and diffusing). Teaching Motivation was significantly and positively correlated to transferring and diffusing. Positive Department Culture and Innovation Philosophy were significantly and positively correlated to the outcome variable of transferring. Collegiality within Department was significantly and positively related to diffusing. The three predictors—P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and Student-centered Teaching Philosophy—predominantly correlate with the three outcome variables of sustaining, transferring, and diffusing in a negative manner. However, these negative correlations were significant.

Table **4-6**
Pearson Correlations for the 10 Predictors and Three Dependent Variables

	Pearson correlations												
	OS	COL1	COL2	PT1	PT2	PT3	DC	TP1	TP2	TM	DV1	DV2	DV3
OS	1												
COL1	.35**	1											
COL2	.12	.26*	1										
PT1	.01	–.01	–.08	1									
PT2	–.07	–.06	.21*	.08	1								
PT3	.31**	.14	.29**	-.03	.09	1							
DC	.33**	.29**	.001	.11	–.04	.25**	1						
TP1	–.03	.02	.07	–.23**	.13	.06	–.03	1					
TP2	.05	–.01	.05	–.19*	.01	.18*	–.01	.37**	1				
TM	.16*	.31**	.26**	–.01	–.02	.36**	.16*	.17*	.44**	1			
DV1	.18*	.06	.16*	–.01	–.02	.23**	.04	–.08	.12	.14	1		
DV2	.25**	.12	.25**	–.05	–.01	.39**	.16*	.03	.21**	.18*	.32**	1	
DV3	.29**	.34**	.32**	.02	.06	.35**	.15	–.04	.16	.34**	.36**	.45**	1

Note . OS = Organizational Support; COL1 = Collegiality within Department; COL2 = Collegiality above Department; PT1 = P&T Focus on Teaching and Research; PT2 = Influence of Course Changes on P&T; PT3 = P&T Feedback Received about Course Changes; DC = Positive Department Culture, TP1 = Student-centered Teaching Philosophy; TP2 = Innovation Philosophy; TM = Teaching Motivation; DV1 = sustaining; DV2 = transferring; DV3 = diffusing.
*$p < .05$. **$p < .01$.

Predicting Innovations Sustained or Not from Profitability and Compatibility Factors

RQ 2: What are the relative contributions of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about

Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation) in explaining/predicting *whether or not faculty sustained* their teaching and learning innovations?

Profitability factor P&T Feedback Received about Course Changes and compatibility factor Innovation Philosophy were the two important factors in predicting whether or not faculty *sustained* their course innovations.

There were 38 missing cases from the original 163, thus only 125 cases were analyzed. The results from the binary logistic regression analysis indicated that the overall sustaining model was significant at .048 according to the model chi-square statistic. The Nagelkerke *r*-squared calculated for the sustaining model was .257; this means that 25.7% of variance related to faculty's sustaining of course innovation was explained by the 10 predictors stated in Table 4-7. Information relating to *b*, exp (*b*), *p*-value, and model fit for the sustaining model is presented in Table 4-7. However, the results need to be interpreted cautiously because one of the indicators for the model fit—the Hosmer-Lemeshow goodness-of-fit statistic ($p = .004$)—indicated that the chosen model did not seem to fit the data very well.

Table **4-7**

Summary of Binary Logistic Regression for 10 Predictors Explaining Faculty's Sustaining of Course Changes (n = 125)

	Original model			Final model		
Predictor variables	b	Exp(*b*)	p	b	Exp(*b*)	p
0 = not sustained 1 = sustained			Profitability factors			
Organizational support	.35	1.42	.42			
Collegiality (within the department)	-.03	.97	.95			
Collegiality (above the department)	-.24	.79	.54			
P&T focus on teaching and research	.22	1.24	.51			
Influence of course changes on P&T	.11	1.12	.69			
P&T feedback received about course changes	1.04	2.83	.02*	1.03	2.81	.005**
			Compatibility factors			
Positive department culture	.42	1.52	.34			
Student-centered teaching philosophy	-1.16	.31	.17			
Innovation philosophy	1.88	6.55	.03*			
Teaching motivation	-1.43	.24	.12			
Constant	-1.03	.36	.83	-1.70	.18	.18
Goodness-of-fit test	Model $X^2 = 18.455$ with 10d.f., $p = .048$; Nagelkerke r-squared = .257			Model $X^2 = 8.444$ with 1d.f., $p = .004$; Nagelkerke r-squared = .122		

Note. *$p < .05$. **$p < .01$.

When controlling for the effect of the other eight factors, P&T Feedback Received about Course Changes and Innovation Philosophy were the two significant factors predicting whether or not faculty *sustained* their course innovations ($p = .02$ and .03, respectively). The result verifies the proportionate change in odds or exp (*b*). The

odds ratios for significant factors in the sustaining model were: Innovation Philosophy (6.55) and P&T Feedback Received about Course Changes (2.83).

With regard to *profitability* factors, in the tier of course innovation *sustained vs. not sustained*, the odds of sustaining course innovation were 2.83 times more likely with a one-unit increase in P&T Feedback Received about Course Changes. That is, faculty with a one point higher rating on P&T Feedback Received about Course Changes were 2.83 times more likely to sustain their instructional innovation than those with a rating one point lower on this factor.

With regard to *compatibility* factors, in the tier of course innovation *sustained vs. not sustained*, the odds of sustaining course innovation were 6.55 times more likely with a one-unit increase in Innovation Philosophy (viewing teaching as a process involving trial and error, refining, and continuing learning). This means that faculty with one point higher on the rating for Innovation Philosophy were 6.55 times more likely to sustain their instructional innovation than those with one point lower on the rating for Innovation Philosophy.

These results suggest that the likelihood of faculty's sustaining their course changes was significantly increased by the impact of feedback faculty received about course changes and by having a refining and improving innovation philosophy.

In order to present a parsimonious (or final) model for whether or not faculty sustained their course innovation, a Backward: Wald method was used. After exploring all of the possibly important variables, a final model with a few significant factors that account for the maximum sustaining variance is presented. The Hosmer-Lemeshow goodness-of-fit statistic (p = .021) indicated that the chosen model did not fit the data

very well. The result for the final model is presented in Table 4-7. The only profitability factor retained in the final model was P&T Feedback Received about Course Changes (p = .005), which explained 12.2% of the sustaining variance. The odds of sustaining course innovation were 2.81 times more likely with a one-unit increase in P&T Feedback Received about Course Changes from peers and students. Namely, faculty with a one point higher rating on P&T Feedback Received about Course Changes were 2.81 times more likely to sustain their instructional innovation than those with a rating one point lower on this factor.

Information regarding the predictive accuracy of the original and final models is shown from the classification tables obtained from SPSS results (Table **4-8**).

Table **4-8**
Classification Tables for the Original and Final Sustaining Model (n = 125)

	Original model			Final model		
	Predicted			Predicted		
Observed	0 (did not sustain)	1 (sustained)	Percentage correct	0 (did not sustain)	1 (sustained)	Percentage correct
0 (did not sustain)	4	12	25	1	15	6.3
1 (sustained)	0	109	100	0	109	100
Overall percentage			90.4			88

The original sustaining model correctly classified 90.4% of the sample included in the analysis for the logistic regression, whereas the final model classified 88% of the sample included. Specifically, in the original model, of those who sustained their course innovations, 100% of the sustaining cases were correctly classified by the model; of those who did not sustain their course innovations, 25% were correctly classified. In the final model, of those who sustained their course innovations, 100% were correctly classified

by the model; of those who did not sustain their course innovations, 6.3% were correctly classified. This equation works best for those who have sustained their innovations and works rather poorly for those who did not sustain. Moreover, the predictor P&T Feedback Received about Course Changes works best for those who have sustained their innovations and works rather poorly for those who did not sustain.

Predicting Innovations Transferred or Not from Profitability and Compatibility Factors

RQ 3: What are the relative contributions of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation) in explaining/predicting *whether or not faculty transferred* their teaching and learning innovations?

Innovation Philosophy and Student-centered Teaching Philosophy (compatibility factors) and P&T Feedback Received about Course Changes (a profitability factor) were three important factors predicting whether or not faculty *transferred* their course innovations.

Among the 163 cases, 37 cases were missing, thus only 126 cases were analyzed. According to the model chi-square statistic, the overall transferring model was statistically significant ($p < .001$). The Nagelkerke r-squared indicated that 35.9% of variance related to faculty's status in transferring their course innovation (transferred vs.

not transferred) was accounted for by the 10 predictors. The information for *b*, exp (*b*), *p*-value, and model fit for the transfer model is presented in Table **4-9**. In addition, one of the indicators for the model fitting tests—the Hosmer-Lemeshow goodness-of-fit statistic ($p = .519$)—indicated that the chosen model fit the data well.

Table **4-9**
Summary of Binary Logistic Regression for 10 Predictors Explaining Faculty's Transferring of Course Changes (n=126)

	Original model			Final model		
Predictor variables	b	Exp(*b*)	p	b	Exp(*b*)	p
0 = not transferred 1 = transferred			Profitability factors			
Organizational support	.45	1.56	.21			
Collegiality (within the department)	-.21	.82	.52			
Collegiality (above the department)	.43	1.54	.17			
P&T focus on teaching and research	.48	1.62	.09			
Influence of course changes on P&T	.16	1.17	.47			
P&T feedback received about course changes	1.27	3.56	.004**	1.29	3.64	.001**
			Compatibility factors			
Positive department culture	.21	1.23	.57			
Student-centered teaching philosophy	-1.24	.29	.07	-1.31	.27	.04*
Innovation philosophy	2.03	7.63	.004**	1.55	4.71	.006**
Teaching motivation	-.69	.50	.33			
Constant	-7.67	.00	.06	-4.11	.02	.21
Goodness-of-fit test	Model $X^2 = 34.764$ with 10d.f., $p < .001$; Nagelkerke r-squared = .359			Model $X^2 = 27.053$ with 3d.f., $p < .001$; Nagelkerke r-squared = .287		

Note. $*p < .05$. $**p < .01$.

Both Innovation Philosophy (a compatibility factor) and P&T Feedback Received about Course Changes (a profitability factor) were statistically significant at .004. The odds of *innovation transferred or not* were 7.63 times more likely with a one-unit increase in Innovation Philosophy—viewing teaching as a process of trial-and-error, refining, and continuing learning. This means that faculty with one point higher on the rating for Innovation Philosophy were 7.63 times more likely to transfer their instructional innovation than those with a lower rating on Innovation Philosophy. The odds of *innovation transferred or not* were 3.56 times more likely with a one-unit increase in P&T Feedback Received about Course Changes. In other words, faculty with one point higher on the rating for P&T Feedback Received about Course Changes were 3.56 times more likely to transfer their instructional innovation than those with one point lower on their rating.

The Backward: Wald method in SPSS was used to explore a parsimonious (or final) model on the question of whether or not faculty transferred their instructional innovation. The Hosmer-Lemeshow goodness-of-fit statistic ($p = .704$) indicated that the chosen model fit the data quite well. The results for the final model appear in Table 4-9. Three predictors retained in the final model ($p < .001$) explained 28.7% of the transferring variance. The only profitability factor retained in the final model was P&T Feedback Received about Course Changes ($p = .001$). Examining the odds of P&T Feedback Received about Course Changes, faculty innovators were 3.64 times more likely to transfer their course innovations with one-unit increase on this factor as opposed to those with one-unit decrease on this factor. Two compatibility factors were significant in predicting faculty's transferring status of course innovation (transferred vs. no

transferred): Innovation Philosophy (p = .006) and Student-centered Teaching Philosophy (p = .04). The odds of *innovation transferred or not* were 4.71 times more likely with a one-unit increase in Innovation Philosophy (viewing teaching as a process of trial-and-error, refining, and continuing learning). The odds of transferring were 0.27 times more likely with a one-unit increase in Student-centered Teaching Philosophy; that is, the odds of not transferring one's instructional innovation were 3.70 times more likely with a one-unit increase in Student-centered Teaching Philosophy.

The predictive accuracy of the original and final model is shown in the classification tables from the original and final transferring model (Table **4-10**).

Table **4-10**
Classification Tables for the Original and Final Transferring Model (n = 126)

	Original model			Final model		
	Predicted			Predicted		
Observed	0 (did not transfer)	1 (transferred)	Percentage correct	0 (did not transfer)	1 (transferred)	Percentage correct
0 (did not transfer)	14	17	45.2	8	23	25.8
1 (transferred)	8	87	91.6	5	90	94.7
Overall percentage			80.2			77.8

Overall, the original model correctly classified 80.2% of the transferring cases included in the analysis for the logistic regression, whereas the final model classified 77.8% of the transferring cases included. Specifically, in the original model, of those who transferred their course innovations, 91.6% were correctly classified by the model; of those who did not transfer their course innovations, 45.2% were correctly classified. In the final model, of those who transferred their course innovations, 94.7% were correctly classified by the model; of those who did not transfer their course innovations, 25.8%

were correctly classified. This equation works best for those who have transferred their innovations and works poorly for those who did not transfer. Moreover, the three predictors—P&T Feedback Received about Course Changes, Student-centered Teaching Philosophy, and Innovation Philosophy—work best for those who had transferred their innovations and work rather poorly for those who did not transfer.

Predicting Innovations Diffused or Not from Profitability and Compatibility Factors

RQ 4: What are the relative contributions of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation) in explaining/predicting *whether or not faculty diffused* their teaching and learning innovations?

Organizational Support, P&T Focus on Teaching and Research, and P&T Feedback Received about Course Changes were three important profitability factors predicting whether or not faculty *diffused* their course innovations to others.

Among the 163 cases, 62 cases were missing, thus only 101 cases were analyzed. The overall diffusion model was significant at .005, according to the chi-square statistic. The Nagelkerke *r*-squared indicated that 31.5% of the diffusion variance—diffused or not—was explained with the 10 predictors proposed. The information for *b*, exp *(b)*, *p*-value, and model fit for the diffusion model is presented in Table **4-11**. Also, one of the

indicators for the model fitting tests—the Hosmer-Lemeshow goodness-of-fit statistic (p = .299)—indicated that the chosen model fit the data well.

Table **4-11**
Summary of Binary Logistic Regression for 10 Predictors Explaining Faculty's Diffusing of Course Changes (n = 101)

	Original model			Final model		
Predictor variables	b	Exp(*b*)	p	b	Exp(*b*)	p
0 = not diffused 1 = diffused			Profitability factors			
Organizational support	.96	2.63	.03*	.86	2.36	.02*
Collegiality (within the department)	.12	1.13	.72			
Collegiality (above the department)	.23	1.26	.46			
P&T focus on teaching and research	.74	2.09	.03*	.79	2.21	.01**
Influence of course changes on P&T	.30	1.35	.18			
P&T feedback received about course changes	.64	1.90	.14	.88	2.42	.02*
			Compatibility factors			
Positive department culture	-.10	.91	.80			
Student-centered teaching philosophy	-.54	.58	.41			
Innovation philosophy	.20	1.22	.76			
Teaching motivation	.15	1.26	.83			
Constant	-6.51	.001	.12	-6.62	.001	.001
Goodness-of-fit test	Model $X^2 = 25.473$ with 10d.f., $p = .005$; Nagelkerke r-squared = .315			Model $X^2 = 20.768$ with 3d.f., $p < .001$; Nagelkerke r-squared = .262		

*Note. *p < .05. **p < .01.*

Among the 10 predictors, two profitability factors were significant: Organizational Support (p = .03) and P&T Focus on Teaching and Research (p = .03). Among the profitability factors, the odds of innovation *diffused to others or not* were 2.63 times more likely with a one-unit increase in *organizational support received was helpful.* This means that faculty with one point higher on the rating for Organizational Support were 2.63 times more likely to diffuse their innovation than those with one point lower on their rating for Organizational Support. The odds were 2.09 times more likely with a one-unit increase in P&T Focus on Teaching and Research; faculty with one point higher on the rating on P&T focus more on teaching than research were 2.09 times more likely to diffuse their instructional innovation to others than those with one point lower rating.

Using a Backward: Wald method in SPSS, the final model for whether or not faculty diffused their course innovation to others was statistically significant ($p < .001$). The Nagelkerke *r*-squared indicated that 26.2% of the diffusion variance—diffused or not—was explained with the three predictors retained in the model. Also, the Hosmer-Lemeshow goodness-of-fit statistic ($p = .192$) indicated that the chosen model fit the data quite well. The results for the final model appear in Table 4-11. The three profitability factors retained in the final model were all significant: Organizational Support ($p = .02$), P&T Focus on Teaching and Research ($p = .01$), and P&T Feedback Received about Course Changes ($p = .02$).

The odds of *innovation diffused or not* were 2.36 times more likely with a rating one point higher for Organizational Support than with a rating one point lower on Organizational Support; the odds of diffusing were 2.21 times more likely with a one-unit

increase in P&T Focus on Teaching and Research; and finally, the odds were 2.42 times more likely with a one-unit increase in P&T Feedback Received about Course Changes.

The predictive accuracy of the original and final models is shown in the classification tables from the original and final diffusing model (see Table **4-12**). Overall, both the original and final diffusing model correctly classified 74.3% of the diffusing cases included. Specifically, in the original model, of those who diffused their course innovations, 88.6% were correctly classified by the model; of those who did not diffuse their course innovations, 41.9% were correctly classified. In the final model, of those who diffused their course innovations, 92.9% were correctly classified by the model; of those who did not diffuse their course innovations, 41.9% were correctly classified. This equation works best for those who have diffused their innovations and works poorly for those who did not diffuse them. Moreover, the three predictors—Organizational Support, P&T Focus on Teaching and Research, and P&T Feedback Received about Course Changes—work best for those who had diffused their innovations and work poorly for those who did not diffuse them.

Table **4-12**
Classification Tables for the Original and Final Diffusing Models (n = 101)

	Original model			Final model		
	Predicted			Predicted		
Observed	0 (did not diffuse)	1 (diffused)	Percentage correct	0 (did not diffuse)	1 (diffused)	Percentage correct
0 (did not diffuse)	13	18	41.9	13	18	41.9
1 (diffused)	8	62	88.6	5	65	92.9
Overall percentage			74.3			77.2

Results for Ancillary Research Questions

The results of the binary logistic regression provided answers to primary Research Questions 2 to 4. However, one of the concerns in using binary logistic regression analysis was that the specificity of information in the dependent variables was missing due to the collapse of multiple categories into binary categories. Therefore, multiple regression analysis was considered to further explore the extent of innovation that was sustained, transferred, or diffused, and this approach provided answers for Research Questions 5 to 7.

The major assumption in conducting the multiple regression analysis was that the three dependent variables were all in interval scales. These variables were ordinal data but treated as interval-like data. Thus, diagnostic procedures were conducted to check whether the assumptions of normality, linearity, and homoscedasticity were met for the three dependent variables and the 10 independent variables since the number of cases was reduced in the multiple regression models. The tests conducted for the three assumptions were: 1) normality: skewness, histograms, and boxplots, 2) linearity: curve estimation between the *r*-squared difference for the linear and quadratic models, and 3) homoscedasticity of the error terms—plots of *ZRESID against *PRED. The cases that did not sustain, transfer, or diffuse their instructional innovation were removed from the data set for the multiple regression analysis. As described in chapter 3, the assumptions of normality, linearity, and homoscedasticity for the reduced cases met most of the criteria suggested in Field's guidelines (2005). Therefore, a multiple regression was run.

Predicting the Proportion of Changes Sustained from Profitability and Compatibility Factors

RQ 5: What are the relative contributions of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation) in explaining/predicting the *proportion* of the changes *sustained?*

Two profitability factors—Influence of Course Changes on P&T and P&T Feedback Received about Course Changes—were significant in predicting the extent of an instructional innovation sustained by faculty.

Among the 125 cases, 16 cases did not sustain their innovations; thus, 109 cases were analyzed to examine the extent to which an innovation was sustained. The overall model for those who had sustained their course innovation did not reach statistical significance ($p = .227$) in predicting the proportion of course changes faculty sustained. Information about *B* (unstandardized regression coefficient), beta *ß* (standardized regression coefficient), and *p*-value in the original and final sustaining models appear in Table **4-13**.

Table **4-13**
Results of Multiple Regression on Those Who Sustained Their Course Changes (n = 109)

	Original model			Final model		
Predictor variables	*B*	β	p	*B*	β	p
			Profitability factors			
Organizational support	.16	.11	.28			
Collegiality (within the department)	-.03	-.03	.83			
Collegiality (above the department)	.13	.12	.27			
P&T focus on teaching and research	.02	.02	.85			
Influence of course changes on P&T	-.19	-.23	.03*	-.17	-.20	.04*
P&T feedback received about course changes	.30	.18	.10	.39	.24	.01**
			Compatibility factors			
Positive department culture	-.18	-.13	.21			
Student-centered teaching philosophy	-.14	-.06	.56			
Innovation philosophy	.10	.05	.70			
Teaching motivation	.07	.03	.81			
Constant	3.08		.05	3.09		.000
Note. *$p < .05$. **$p < .01$.	Multiple R = .345 R-squared = .119 Adjusted R-squared = .029 p = .227			Multiple R = .285 R-squared = .081 *Adjusted* R-squared = .064 p = .011		

When controlling for the effect of the rest of the predictors, Influence of Course Changes on P&T was the only significant factor in predicting faculty's sustaining of course changes (p = .03), but negatively. That is, for each unit increase in the score for *faculty's perception that their course change had a positive influence on the promotion*

and tenure process, there was a .19 unit decrease in faculty's sustaining of their course changes.

A Backward method was used to explore which predictors were more efficient in predicting this outcome variable (i.e., the proportion of changes sustained). The result for the final model in Table 4-13 revealed that the overall model was significant at .011 and accounted for 8.1% of the variance regarding faculty's sustaining of their course changes. Of the two profitability factors retained in the final model, both Influence of Course Changes on P&T and P&T Feedback Received about Course Changes were statistically significant (p = .04 and .01, respectively). This finding was consistent with the one from the original sustaining model that Influence of Course Changes on P&T was negatively related to the proportion of changes faculty sustained, except that the factor P&T Feedback Received about Course Changes was found to be significant in the final model.

Predicting How Many of the Changes Transferred from Profitability and Compatibility Factors

RQ 6: What are the relative contributions of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation) in explaining/predicting *how many* of the changes were *transferred* for each faculty innovator?

The profitability factor P&T Feedback Received about Course Changes and the compatibility factor Positive Department Culture were two important factors predicting the degree of innovation transferred.

Among the 126 cases, 31 cases did not transfer their innovations; thus, 95 cases were analyzed to examine the extent of an innovation was transferred. Overall, the original model was not significant (p = .053) in predicting how many of their course changes faculty transferred to another or to different courses they were teaching; 18.6% of variance related to the proportion of changes transferred to faculty's other courses was explained by the 10 predictors. The information related to *B* (unstandardized regression coefficient), beta *ß* (standardized regression coefficient), and *p*-value for the original and final transferring model is included in Table **4-14**. When controlling for the effect of the rest of the predictors, P&T Feedback Received about Course Changes and Positive Department Culture were found to be statistically significant in predicting how many of course changes faculty transferred (p = .01 and .03, respectively).

Table **4-14**
Results of Multiple Regression on Those Who Transferred Their Course Changes (n = 95)

	Original model			Final model		
Predictor variables	*B*	β	p	*B*	β	p
			Profitability factors			
Organizational support	-.03	-.02	.83			
Collegiality (within the department)	-.13	-.11	.34			
Collegiality (above the department)	.12	.10	.38			
P&T focus on teaching and research	-.06	-.06	.57			
Influence of course changes on P&T	-.10	-.12	.28			
P&T feedback received about course changes	.52	.30	.01**	.53	.31	.002**
			Compatibility factors			
Positive department culture	.34	.25	.03*			
Student-centered teaching philosophy	.07	.03	.78			
Innovation philosophy	.28	.11	.37			
Teaching motivation	-.28	-.12	.34			
Constant	.28		.87	1.11		.10
Note. *$p < .05$. **$p < .01$.	Multiple $R = .431$ R-squared = .186 Adjusted R-squared = .089 $p = .053$			Multiple $R = .312$ R-squared = .097 Adjusted R-squared = .088 $p = .002$		

A Backward method was used to explore which predictor variables were more efficient in predicting how many of the changes transferred. The results for the final model are presented in Table **4-14**. Overall, the final model was significant at .002 and accounted for 8.8% of the variance regarding how many of course changes faculty

transferred. The only significant predictor was the profitability factor P&T Feedback Received about Course Changes (p = .002).

Predicting the Number of Faculty to Whom the Changes Diffused from Profitability and Compatibility Factors

RQ 7: What are the relative contributions of *profitability factors* (Organizational Support, Collegiality within Department, Collegiality above Department, P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and P&T Feedback Received about Course Changes) and *compatibility factors* (Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation) in explaining/predicting the *number of faculty* to whom the changes were *diffused?*

The profitability factor P&T Feedback Received about Course Changes and the compatibility factor Teaching Motivation were two important factors predicting the number of people to whom the changes were diffused.

Among the 101 cases, 31 cases did not diffuse their innovations; thus, 70 cases were analyzed to examine the number of people of an innovation to whom an innovation was diffused. Overall, the diffusing model was statistically significant (p = .002) in predicting the number of people to whom faculty diffused their course change ideas, and 36.5% of the diffusing variance was explained by the 10 predictors. The information related to *B* (unstandardized regression coefficient), beta *ß* (standardized regression coefficient), and *p*-value for both diffusing models is included in Table **4-15**.

Table **4-15**
Results of Multiple Regression on Those Who Diffused Their Course Changes (n = 70)

	Original model			Final model		
Predictor variables	*B*	β	p	*B*	β	p
			Profitability factors			
Organizational support	.22	.15	.27			
Collegiality (within the department)	.08	.07	.57			
Collegiality (above the department)	.10	.10	.41			
P&T focus on teaching and research	-.01	-.01	.91			
Influence of course changes on P&T	-.09	-.12	.31			
P&T feedback received about course changes	.45	.28	.02*	.44	.27	.01**
			Compatibility factors			
Positive department culture	-.15	-.12	.34			
Student-centered teaching philosophy	-.31	-.16	.18			
Innovation philosophy	.19	.09	.51			
Teaching motivation	.88	.39	.005**	.99	.44	<.001**
Constant	-2.11		.19	-2.56		.02
Note . * $p < .05$. ** $p < .01$.	Multiple $R = .604$ R-squared = .365 Adjusted R-squared = .257 $p = .002$			Multiple $R = .544$ R-squared = .296 Adjusted R-squared = .275 $p < .001$		

When controlling for the effect of the rest of the variables, Teaching Motivation ($p = .02$) and P&T Feedback Received about Course Changes ($p = .005$) were found to be statistically significant in predicting the extent to which an instructional innovation was diffused (i.e., measured by the number of faculty to whom the changes were diffused).

Specifically, the beta for Teaching Motivation indicated that for a one-unit increase in Teaching Motivation, there is a .88 unit increase in the number of people to whom an innovation was diffused; for a one-unit increase in P&T Feedback Received about Course Changes from peers and students, there is a .45 unit increase in the number of faculty to whom the changes were diffused.

A Backward method was used to explore which predictors were more efficient in predicting the extent of an instructional innovation's diffusion. The results for the final model are presented in Table 4-15. Overall, the final model with two predictors retained was significant ($p < .001$) and accounted for 29.6% of the variance in the number of faculty to whom changes were diffused. The compatibility factor Teaching Motivation ($p < .001$) and the profitability factor P&T Feedback Received about Course Changes ($p = .01$) were found to be statistically significant in predicting the number of faculty to whom the changes were diffused. Teaching Motivation seemed to be a stronger predictor than P&T Feedback Received about Course Changes in terms of predicting the extent to which an innovation was diffused. For a one-unit increase in Teaching Motivation, there was a .99 unit increase in the number of people to whom changes were diffused; for a one-unit increase in P&T Feedback Received about Course Changes, there was a .44 unit increase in the number of people to whom the changes were diffused.

Summary

Overall, the relationships between profitability and compatibility factors on faculty's post-adoption behaviors of sustaining, transferring, and diffusing, as revealed

through a Pearson-correlation analysis, were not exactly the same as those revealed through the multiple regression. The results of the binary logistic regression and multiple regression analysis in terms of sustaining, transferring, and diffusing in the original and final models are summarized in Table **4-16**. A summary of the results from the Pearson's correlation, logistic regression, and multiple regression analysis is presented in the following sections. A predictor described as significant in this study means that its *p*-value was statistically significant at .05 or less.

Table **4-16**

Summary of Pearson's Correlations between IVs and DVs, Binary Logistic, and Multiple Regression Results on the Sustaining, Transferring, and Diffusing Models

	Pearson's correlations			DV1				DV2				DV3			
Outcome variables	DV1	DV2	DV3	Sustained or not		Extent of sustaining		Transferred or not		Extent of transferring		Diffused or not		Extent of diffusing	
n				125		109		126		95		101		70	
Model				Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final
				p	*p*	*p*	*p*	*p*	*p*	*p*	*p*	*p*	*p*	*p*	*p*
Predictor variables								Profitability factors							
OS	.18*	.25**	.29**	ns		ns		ns		ns		.03*	.02*	ns	
COL1	.06	.12	.34**	ns		ns		ns		ns		ns		ns	
COL2	.16*	.25**	.32**	ns		ns		ns		ns		ns		ns	
PT1	-.01	-.05	.02	ns		ns		ns		ns		.03*	.01**	ns	
PT2	-.02	-.01	.06	ns		.03*	.04*	ns		ns		ns		ns	
PT3	.23**	.39**	.35**	.02*	.005**	ns	.01**	.004**	.001**	.01**	.002**	ns	.02*	.02*	.01**
								Compatibility factors							
DC	.04	.16*	.15	ns		ns		ns		.03*		ns		ns	
TP1	-.08	.03	-.04	ns		ns		ns	.04*	ns		ns		ns	
TP2	.12	.21**	.16	.03*		ns		.004**	.006**	ns		ns		ns	
TM	.14	.18*	.34**	ns		ns		ns		ns		ns		.005**	.001**
Constant	na	na	na	ns		ns		ns		ns		ns		ns	

Note . OS = OrganizationalSupport; COL1 = Collegiality within Department; COL2 = Collegiality above Department; PT1 = P&T Focus on Teaching and Research; PT2 = Influence of Course Changes on P&T; PT3 = P&T Feedback Received about Course Changes; DC = Positive Department Culture, TP1 = Student-centered Teaching Philosophy; TP2 = Innovation Philosophy; TM = Teaching Motivation; DV1 = sustaining; DV2 = transferring; DV3 = diffusing.
*$p < .05$. **$p < .01$.

As suggested in the Pearson's correlation, the profitability factor P&T Feedback Received about Course Changes was in a medium correlation with the three outcome variables (r = .23** with sustaining, r = .39** with transferring, and r = .35** with diffusing, respectively). The results of the logistic regression analysis indicated that the factor P&T Feedback Received about Course Changes was significant in predicting whether or not faculty sustained and transferred their course innovations but not significant in predicting the status of diffusing (diffused or not diffused) in the original model with the 10 predictors. Moreover, this predictor was significant in predicting the extent to which innovations were transferred and diffused in both the original and final multiple regression models. In terms of predicting the proportion of the changes sustained, it was only significant in the final model with another predictor (Influence of Course Changes on P&T) but not in the original model with 10 predictors in the model.

The profitability factor Organizational Support was not highly correlated with any of the three outcomes variables—sustaining, transferring, and diffusing—as its bivariate r values suggested (r = .18*, .25**, and .29**, respectively). However, it was significant in terms of predicting whether or not faculty diffused their instructional innovations in both the original and final diffusing models.

The compatibility factor Teaching Motivation was in a low to medium correlation with transferring (r = .18*) and diffusing (r = .34**). It was only significant in terms of predicting the number of people to whom the changes were diffused in both the original and final diffusing models, and it matched with the correlation results (r = .34**).

The results of the Pearson's correlation only suggested that the compatibility factor Innovation Philosophy was in fairly low correlation with transferring (r = .21**) .

This predictor indeed was a strong predictor in terms of predicting whether or not faculty transferred their instructional innovation in both the original and final models. Moreover, Innovation Philosophy was also found to be significant along with the predictor P&T Feedback Received about Course Changes in predicting whether or not faculty sustained their instructional innovations.

The compatibility factor Positive Department Culture displayed a low significance correlation (r = .16*) with transferring. The regression analysis suggested that it was not a very good predictor in terms of predicting whether or not faculty transferred their instructional innovations but was a good one in predicting how many of the changes were transferred when controlling for the effect of the rest of the variables in the original transferring model.

The profitability factor Collegiality above Department did not turn out to be as strong a predictor of sustaining, transferring, and diffusing as suggested from Pearson's correlation. This factor had a low to medium correlation with the three outcome variables (r = .16*, r = .25**, and r = .32**). The factor Collegiality within Department was assumed to have some predicting power for diffusing since its Pearson's r was .34**; its impact on sustaining or transferring was based on conceptual understanding from the previous literature. However, this factor turned out to be a poor predictor in terms of predicting faculty's sustaining, transferring, and diffusing of their instructional innovation.

Moreover, in the Pearson analysis, three out of 10 factors did not demonstrate any significant correlation with sustaining, transferring, or diffusing. They were: P&T Focus on Teaching and Research, Influence of Course Changes on P&T, and Student-centered

Teaching Philosophy. Though these three factors did not show any significant correlation with sustaining, transferring, or diffusing at the bivariate dimension, they turned out to be significant predictors for the outcome variables. The factor P&T Focus on Teaching and Research was found to be a significant predictor of whether or not faculty diffused their instructional innovations to others regardless of the original or final diffusing logistic regression model. The factor Influence of Course Changes on P&T was an interesting predictor in predicting the proportion of the changes sustained because it was negatively correlated with sustaining. As suggested by the Pearson's correlation, this factor was found to be negatively correlated with sustaining and transferring but did not reach statistical significance. Finally, the compatibility factor Student-centered Teaching Philosophy only demonstrated its power along with two other factors, P&T Feedback Received about Course Changes and Innovation Philosophy, in terms of predicting whether or not faculty transferred their instructional innovations in the final model.

Overall, the 10 predictors proposed in the study played different roles in terms of their influence on sustaining, transferring, and diffusing. The effect of the two factors related to collegiality diminished when controlling for the effect of the other factors. The differences in the results summarized above reflect the nature of using correlation and regression analysis. The bivariate *r*-values obtained in the correlation analysis provided the overall relationships among variables, whereas in a multiple regression analysis, a partial relationship between the individual predictor and outcome variable was examined when controlling for all of the other predictors in the original model. Thus, some less important factor may come and go in the original regression model; those more

significant predictors retained were all statistically significant in the final model. An in-depth examination of the results is presented in the discussion sections of chapter 5.

Chapter 5

Discussion

Introduction

This study creates predictive models to systematically explain the impact of profitability and compatibility factors on faculty's sustaining, transferring, and diffusing of a teaching and learning innovation. The six profitability factors are: Organizational Support, Collegiality within the Department, Collegiality above the Department, Promotion and Tenure (P&T) Focus on Teaching and Research, Influence of Course Changes on Promotion and Tenure, and Promotion and Tenure Feedback Received about Course Changes. The four compatibility factors were: Positive Department Culture, Student-centered Teaching Philosophy, Innovation Philosophy, and Teaching Motivation. Faculty's behaviors related to post-adoption of teaching and learning innovations were examined by: 1) the relationship between predictors—six profitability and four compatibility factors—with faculty's sustaining, transferring, and diffusing of their teaching and learning innovation; 2) whether or not faculty sustained, transferred, or diffused their teaching and learning innovation; 3) the extent to which all of the predictors contributed to the sustaining, transferring, and diffusing of teaching and learning innovation; and 4) which factors are most influential in the continuation of a teaching and learning innovation. A summary of results is presented in Table **4-16**.

Discussion of Findings

Relationship between Profitability and Compatibility Factors with Post-Adoption of a Teaching and Learning Innovation (RQ1)

Seven out of 10 predictors were significantly and positively correlated with at least one of the three outcome variables: sustaining, transferring, and diffusing (see Table **4-16)**: Organizational Support, Collegiality within the Department, Collegiality above the Department, Influence of Course Changes on P&T, P&T Feedback Received about Course Changes, Positive Department Culture, Innovation Philosophy, and Teaching Motivation.

Correlation of P&T Feedback Received about Course Changes, Organizational Support, and Collegiality above Department with Sustaining, Transferring, and Diffusing

The significant correlation between P&T Feedback Received about Course Changes and sustaining, transferring, and diffusing may support the findings of Massey et al. (1994). They made two assumptions about course-change feedback received during the promotion and tenure process: 1) faculty who are more open to peer evaluation of teaching would be more likely to enhance their teaching skills before the P&T evaluation; 2) faculty who are more open to student evaluation of teaching would be more likely to make changes on their course during the semester. Thus, their findings suggested that there was a correlation between P&T Feedback Received about Course Changes and implementation of course changes. Thus, it is not surprising for the current study to make

the statement that faculty who perceived that their course changes made an impact on the feedback they received from peers and students would be more likely to make changes in their courses and may be more willing to continue their course changes.

The significant correlation between Organizational Support and sustaining, transferring, and diffusing of a teaching and learning innovation could be explained by the findings of Hannan (2000) and Davis et al. (1982). Hannan noted that teaching and learning innovation is most likely to take place when "the innovator has encouragement or support from the head of the department, dean or other person in authority … resources are available through the department … and an education development unit" (p. 4). Hannan's findings suggested that organizational support is highly correlated with the implementation of an innovation and that it makes sense to assume that organizational support is highly related to the continuation of innovation. Moreover, Davis et al. (1982) found that two aspects of organizational support—technical support and consultative assistance—were perceived by the innovators as important to their continuation of innovation and it corroborates this finding.

No previous findings seemed to clearly address the notion that collegiality above the department level and diffusing are highly related; however, this finding could be inferred from the findings by Hannan (2000) that one of the conditions to facilitate the occurrence of a teaching and learning innovation is when "colleagues and people in authority show an interest in disseminating the outcomes of innovation" (p. 4). That is, if such collegiality does exist, then a teaching and learning innovation might be more likely to take place and then to be continued.

Correlation of Teaching Motivation with Transferring and Diffusing

The significant correlation between Teaching Motivation and transferring and diffusing may be inferred from the statement by Bess (1977) that "unless faculty members perceive the teaching enterprise as a continuing source of profound satisfaction in life—satisfactions arising out of the fulfillment of deep-seated human needs—they will rarely have the sustained role commitment that is necessary for creativity and excellence in performance" (p. 244). This suggested that if faculty really enjoyed their teaching, they were more likely to continue their innovation in the same course or apply the innovation to other courses they taught. The significant correlation between Teaching Motivation and diffusion may be interpreted to suggest that once a faculty innovator perceived and experienced his/her teaching as a source of life pleasure and enjoyment, s/he would be more likely to diffuse the innovation to others.

Moreover, the significant correlation between Teaching Motivation and faculty's transferring and diffusing of their course changes in this study could be examined in terms of a professor's psychological need for teaching (Deci et al., 1997). The finding of the current study suggests that faculty who transferred or diffused their innovation display the following characteristics: 1) had flexibility in choosing their teaching methods and enjoyed explaining to others about their teaching strategies; 2) valued students' feedback about course changes and were wiling to accept challenges while making changes; and 3) felt connected to their department colleagues and interacted more with other colleagues on similar research.

Correlation of Innovation Philosophy and Department Culture with Transferring

Innovation Philosophy is found to be significantly related to faculty's transfer of teaching and learning innovation. The first notion of innovation philosophy suggested that those faculty innovators liked to try a variety of teaching methods. Thus, there were increased chances for faculty innovators to continue trying various teaching methods to their original course or use different teaching method to their other courses. The rest of the notions of innovation philosophy adapted from Lane's (2001) study were assumed to be highly related to faculty's sustaining of their course innovation: viewing teaching as a refining process; trial-and-error process and keeping what works; gradual adaptation process; and continual learning process. It is not surprising to see a correlation between Innovation Philosophy and transferring because these faculty innovators would tend to try any innovation ideas they have in one course and refine them to make sure those ideas work for that course. They may later apply these ideas to other courses they teach because their beliefs in teaching as gradual adaptation and continuous learning process are going to drive them to do so.

No known literature could corroborate the findings that department culture is significantly related to faculty's transfer of teaching and learning innovation. However, examining the notions of department culture suggested in this study may reveal the correlation. The clan and adhocracy type of department culture were labeled as Positive Department Culture in the current study. The characteristics of this type of culture are: 1) department head was generally considered to be an innovator, risk-taker, mentor, or a facilitator; 2) department glue represented members' commitment to innovation or

displayed their loyalty; and 3) department climate was adaptable or sharing. The correlation between transfer and these ideas could be explained by reasoning that there were increased chances for faculty innovators to apply their course innovation from the original course to other courses they taught if: 1) their department head tended to be an innovator or mentor to them; 2) department colleagues were committed to innovation or had loyalty to their department; and 3) their department was a place that was adaptable or sharing.

Correlation of Collegiality within Department with Diffusion

The significant correlation between collegiality at the department level and diffusion can be explained through the findings of Massey et al. (1994). They described collegiality within a department as faculty "meeting informally with their colleagues in the hall, in the department lounge, or over lunch to share their latest research findings" (p. 18) and they noted that "faculty in the departments that support teaching talk with each other frequently—in formal department meetings, in curriculum review sessions, in the corridors, and by the copying and coffee machines" (p. 14). These descriptions suggest that more formal or informal interaction with departmental colleagues increases the chance of sharing teaching ideas or course changes with one's colleagues. Therefore, it makes sense to conclude that collegiality at the department level is highly related to the diffusion of one's instructional innovation to other faculty.

Regression Models Predicting Sustaining, Transferring, and Diffusing (RQ2–7)

In the original and final logistic regression models, determining whether or not faculty will sustain, transfer, and diffuse their teaching and learning innovation, all six were significant at .05. In the original multiple regression models determining the extent to which a teaching and learning innovation will be sustained, transferred, and diffused by faculty, only the original diffusing model was found to be significant at .05. However, the final models of sustaining, transferring, and diffusing were all significant.

Factors Explaining/Predicting Sustaining (RQ2 and 5)

Factors explaining sustaining were examined at two levels. First, the emphasis was on which predictors were influential in predicting whether or not faculty sustained their innovation. Second, if faculty sustained their innovation, then which factors were influential in predicting the extent to which the changes were sustained? The details can be found in the results for the final sustaining models using binary logistic regression and multiple regression. Two significant factors from the final model are discussed: Influence of Course Changes on P&T and P&T Feedback Received about Course Changes.

P&T Feedback Received about Course Changes Predicting Whether or Not Faculty Engaged in Sustaining Behavior (RQ2)

In terms of predicting whether or not faculty sustained their instructional innovations, the impact of course changes on the peer/student feedback faculty received

was a significant predictor related to profitability. This suggested that if faculty perceived that their course changes had an impact on the student feedback they received, then they were more likely to sustain their course innovations. The assumption of this study made in chapter 2 supported this idea that instructional innovations could be associated with the content of teaching as a scholarly activity, which is one of the P&T criteria. Thus, engaging in instructional innovations may help satisfy faculty's wish to be promoted or receive tenure.

The literature suggested that, overall, faculty tend to value students' feedback more when it comes to judging their level of skills in the teaching role (Blackburn, Boberg, O'Connell, & Pellino, 1980). This tendency is corroborated in one of the findings in Lane's (2001) study that innovations may impact faculty's SRTEs (student ratings of teaching effectiveness) and their promotion and tenure. Also another faculty innovator revealed that the feedback he received from other faculty members had an impact on his sustaining course innovations (Lane, 2001). The findings of the current study suggest that both P&T feedback from students and peers about course changes could affect one's sustaining of course innovation.

P&T Feedback Received about Course Changes and Influence of Course Changes on P&T Predicting the Proportion of Changes Sustained (RQ5)

P&T Feedback Received about Course Changes was found to be a significant predictor of the proportion of the changes sustained. It was not difficult to explain this result—the P&T feedback from peers and students on one's instructional innovation provides a baseline for modifying the innovation implemented. By varying the proportion

of the changes faculty may sustain, an innovation may be fine-tuned to its best condition for learning.

The second profitability factor, Influence of Course Changes on P&T, was a significant predictor in explaining the proportion of changes sustained by faculty innovators, in a negative manner. That is, as an innovation contributes positively to P&T evaluation, the proportion of such innovation sustained by the faculty innovator would become less; as an innovation contributes negatively to P&T evaluation, the proportion of such innovation sustained by the faculty innovator would become more.

This finding was a little puzzling when first confronted. No known literature seems to be related to this finding. However, it is suspected that this finding may reflect the post-adoption behaviors of two groups of faculty innovators: faculty innovators who cared less about the promotion and tenure evaluation because they already have their job security, and untenured faculty with a risk-taking approach. There were two possible outcomes for these two groups of people: 1) they tended to sustain less of their innovation because they cared less about the promotion and tenure evaluation and were eager to try out various instructional innovations because they might be tired of using the same type of innovation; and 2) they tended to sustain more regardless of the negative contribution of their course changes to P&T evaluation because they were risk-takers and wanted to fine-tune the innovation they implemented in their course.

Perhaps a case depicted in Lane's (2001) study may provide some hints that help explain the first part of the puzzle. A faculty innovator mentioned that one issue affected the sustainability of his innovation: "the feeling of being burned out" (Lane, 2001, p. 73). When an innovation was in place for a while, the adopter might lose motivation to

maintain such innovation and this could result in decreasing use of such innovation when the novelty was diminished. Thinking more deeply about the difference between using the same lecture notes for 10 years and sustaining an entire instructional innovation for 10 years may explain this surprising finding. Creativity and change may fade out after an innovation has been stabilized—when it is no longer an innovation. That is, after several years of using the same innovative teaching strategies, faculty may become tired of their *innovative-turned-routine* teaching strategies and thus decide to decrease or shift the proportions of use for such innovation and may incline to adopt a new one in their original course.

To unfold the second part of the puzzle, faculty innovators who tended to sustain more of their innovation with regard to a negative contribution of their changes to P&T evaluation. It is suspected that these faculty innovators could afford high risk to their job security as long as they could continue their innovation in the original course they teach. They could be faculty innovators who made high commitment to innovation and were focused on continually fine-tuning their innovation to its best condition.

Factors in Explaining/Predicting Transfer (RQ3 and 6)

Factors predicting transfer were examined at two levels. First, the emphasis was on which predictors were influential in predicting whether or not faculty transferred their innovation. Second, if faculty transferred their innovation, then which factors were influential in predicting the extent of the changes transferred? The details can be found in the results of the two final transferring models using binary logistic regression and

multiple regression analysis. Three significant factors are discussed: P&T Feedback Received about Course Changes, Innovation Philosophy, and Student-centered Teaching Philosophy.

P&T Feedback Received about Course Changes, Innovation Philosophy, and Student-Centered Teaching Philosophy and Their Predictions about Faculty Transfer (RQ3)

P&T Feedback Received about Course Changes was found to be a significant predictor of whether or not faculty transferred their course changes. One explanation is that peer review and student evaluation about course changes played an important role in faculty's P&T evaluation. When faculty decided to transfer their course innovations, they had to pay attention to feedback about whether their transferring of course innovation was satisfactory to the people around them, especially to students and peers (Lane, 2001).

Innovation Philosophy, a compatibility factor, was found to be a significant predictor of whether or not faculty transferred their innovation. This finding extended Lane's (2001) finding that innovation philosophy is not only crucial to faculty's sustaining of an innovation but also to their transfer of an innovation. The main idea of innovation philosophy is continual improvement—"once the innovation begins, it continues to grow and evolve, eventually diffusing from one course to another" (Lane, 2001, p. 87). The idea of evolving and gradual changes allows faculty to keep using the same innovation within the original course they taught. Moreover, the following notions of innovation philosophy—trying various instructional methods and viewing teaching as a refining process; trial-and-error process and keeping what works; gradual adaptation process; and continual learning process—seem to explain whether or not faculty

transferred their innovation. It would be difficult to believe that faculty who had such beliefs would just want to sustain but not to transfer their instructional innovation to their other courses if such innovation was also congruent with their teaching philosophy and teaching style (Lane, 2001).

The third significant predictor explaining whether or not faculty transferred innovation was Student-centered Teaching Philosophy. Acknowledging that students may construct their own knowledge and to create a facilitative learning environment allowing students to be actively involved in learning was found to have a negative impact on faculty's transfer of their course innovation from one course to another. This finding did not align with the research assumption that Student-centered Teaching Philosophy would be a predictor of faculty's continuation of innovation. One possible explanation is that due to the nature of the innovation in the course, it might not have fit well with other courses being taught by the faculty. If this type of student-centered teaching philosophy is carried to other courses faculty are teaching, problems may arise, especially when the courses were previously taught by other faculty members using a very different teaching method.

P&T Feedback Received about Course Changes and Prediction about How Many Changes Transferred (RQ6)

P&T Feedback Received about Course Changes was found to be a significant factor explaining the proportion of the changes faculty transferred to their other courses. However, no known studies have investigated this aspect. The speculation for this finding is that the P&T feedback faculty received about course changes from their peers and

students could help faculty to fine-tune the innovation by varying the proportion of changes transferred to their other courses.

A frequency analysis of transfer (n = 119) with the two items related to this factor was used to reveal the specificity of the proportions of the changes were transferred. It was found that 88% of faculty innovators perceived that their course changes had an impact on the student feedback they received (mean = 4.19), and 52% perceived that their course changes had an impact on the peer feedback they received (mean = 3.5). Among the 119 transferring cases, 41 (34.5%) reported their transfer proportions were *less than half of them*, 38 (31.9%) *about half of them,* and 20 (16.8%) *more than half, but not all* and *all of them*. A higher rating on this factor suggested that faculty perceived that there was an impact of course changes on the peer and student feedback they received; however, this tendency did not completely reflect the proportion of the changes they transferred to their other courses—the transfer proportions did not exceed half of them.

Factors in Explaining/Predicting Diffusion (RQ4 and 7)

Factors predicting diffusion were examined at two levels. First, the emphasis was on which predictors were influential in predicting whether or not faculty diffused their innovation. Second, if faculty diffused their innovation, then which factors were influential in predicting how many other faculty members the innovation was diffused to? The details of the findings can be found in the results of the two final diffusing models for binary logistic regression and multiple regression analysis. Four significant factors are

discussed: P&T Focus on Teaching and Research, P&T Feedback Received about Course Changes, Organizational Support, and Teaching Motivation.

P&T Focus on Teaching and Research, P&T Feedback Received about Course Changes, and Organizational Support and Predictions about Faculty Diffusion (RQ4)

P&T Focus on Teaching and Research, a profitability factor, was found to be a significant predictor of whether or not faculty diffused their course innovations to others. Though no known literature supports this particular finding, the finding seems to be consistent with the previous finding that faculty's perception of the weight assigned to teaching and research impacts their *adoption* of innovation (Hannan & Silver, 2000). In the current study, faculty's perception of the weight assigned to teaching and research impacts their *diffusion* of innovation; in particular, faculty who perceived more weight on teaching than research would be more likely to diffuse their innovation than those who perceived more weight on research than teaching.

The frequency analysis of diffusion (n = 163) with the mean scores for the two items related to this factor indicated that: 1) 38 faculty (23.3%) did not diffuse their innovation, and the rest of them diffused their innovation; 2) faculty perceived a greater focus on research than on teaching, especially at the level of college or university than at the level of department. The analysis suggests that even though faculty who perceived more weight assigned to research than to teaching, 131 (74.4%) of them still diffused their innovation to other faculty. The finding is different from the conclusion made by Hannan and Silver (2000) that innovation is more likely to be hampered by the low value placed on teaching culture, when compared with research, on U.K. campuses. Their

finding did not directly suggest whether this factor hampered the diffusion of an innovation; however, the finding in the current study seemed to provide a counter point that faculty diffuse their innovation regardless of their perception of less emphasis on the scholarship of teaching. The possible explanation could be that this group of faculty innovators were not only adopters of innovation but advocates of innovation (i.e., to diffuse their innovation to others).

The second profitability factor, P&T Feedback Received about Course Changes, was found to be a significant predictor of whether or not faculty diffused their course innovations to others. Though no known literature supports this particular finding, the finding is consistent with the findings of whether or not faculty sustained or transferred their innovation. Thus, this finding completes the notion that P&T Feedback Received about Course Changes serves as a sufficient condition for whether or not faculty continued their teaching and learning innovation. Namely, this factor could be used to explain whether or not faculty sustain, transfer, or diffuse their innovation.

Hannan and Silver (2000) pointed out that both colleagues and students can promote and inhibit an innovation in various degrees. Colleagues' response may vary from positive reaction to resistance and opposition, and students' reaction from positive acceptance and enjoyment of a new pedagogy to complaining about and resenting it. Perhaps, this is the reason why these faculty innovators were concerned about this factor—their course changes were affected by student and peer feedback regardless of whether they decided to sustain, transfer, or diffuse their course innovations. Moreover, this factor was assumed to have a direct impact on their SRTEs (student ratings of teaching effectiveness) and peer evaluation in their promotion and tenure process.

The third profitability factor, Organizational Support, was found to be a significant predictor of whether or not faculty diffused their course innovations to others. Financial, verbal, consultative, and technical support received at the department and college/university levels was a significant predictor of whether or not faculty diffused innovation ideas to other faculty.

Though no known literature showed that organizational support explained whether or not faculty diffused their innovation, previous findings indicated overall organizational support impacts on the sustaining of teaching and learning innovation. The three findings were: 1) technical support was helpful in the long-term sustainability of a collaborative learning effort (Ishler et al., 1998); 2) organizational support was rated as the most important factor by faculty in the continuation stage of an innovation (Davis et al., 1982); and 3) support within the institution can be sources of inspiration and encouragement, which implies that organizational support may inspire the adoption of an innovation and the further use of such an innovation (transferred or diffused) might occur as a result of the encouragement (Hannan et al., 1999). Thus, the finding in this study again adds to the previous finding that Organizational Support is not only a predictor for sustaining but also diffusion. A frequency analysis of diffusion (n = 159) with the mean scores for the eight items related to this factor indicated that financial support above the department level (mean = 3.91) and verbal support within the department (3.65) were the two aspects of organizational support that may have more impact on faculty's diffusion of their innovation than other aspects.

Diffusion of an instructional innovation is assumed to require more time or more resources or support to take place than sustaining or transferring an innovation. Thus, the

positive impact of course changes on the student and peer feedback faculty received, P&T focus on teaching more than research, and availability of organizational support are factors that impact the likelihood of diffusion of innovation to others.

Teaching Motivation and P&T Feedback Received about Course Changes and Predictions about the Number of People to Whom the Changes were Diffused (RQ7)

The compatibility factor Teaching Motivation was found to be a significant predictor of the number of people to whom the changes were diffused. Previous studies suggested that teaching motivation was crucial to faculty's commitment to teaching (Clark et al., 1985) or to sustaining their innovation (Bess, 1977). No known literature has yet suggested that teaching motivation would have an impact on one's diffusion of innovation.

The construct of teaching motivation proposed in this study was based on the notion of *intrinsic motivation*. That is, faculty perceived teaching as a professional commitment and a source of gaining satisfaction for their intrinsic psychological needs. As Bess (1977) suggested, teaching motivation could be a source for performance excellence and might lead to a long-term commitment such as sustaining, transferring, or diffusing. The study of Stetar and Finkelstein (1997) noted that faculty's sustaining of their teaching effort could be enhanced by three psychological needs (i.e., needs for autonomy, competence, and relatedness). Adding to the previous finding, this study discovered that teaching motivation can lead to one's diffusion of innovation. Perhaps being driven to achieve teaching excellence not only made faculty innovators enthusiastic about enhancing student learning but also spreading innovation to others.

Teaching motivation can be examined from the aspects of three inherent psychological needs—autonomy, competence, and relatedness (Deci et al., 1997), but how does teaching motivation explain the diffusion of innovation? Deci et al. indicated that when faculty feel autonomous, competent, and affiliated, faculty are more likely to transform their experience in vigorous and energetic ways. Translating the ideas of Deci et al. into this finding, faculty were more likely to diffuse their innovation to others when they: 1) were able to decide their teaching methods and justified teaching strategies from the course changes they made; 2) were comfortable in accepting challenges and confident in receiving students' feedback as a result from the course changes they made; and 3) were able to fit well in the department community with their changes ideas and tended to share research interests with colleagues from outside the department. These behaviors portray faculty innovators as individuals who experience great satisfaction concerning their own conduct and have good interactions with others, and these qualities may lead to faculty's diffusion of innovation to various people.

When support or encouragement comes from peers or authority figures in the university, it not only enhances faculty's intrinsic motivation but also extrinsic motivation and both types of motivation may lead to the diffusion of innovation. Thus, the profitability factor P&T Feedback Received about Course Changes is also a significant predictor of the number of people to whom the changes were diffused. This finding again confirmed the observation that both peer feedback and student evaluation could promote an innovation in various degrees (Hannan & Silver, 2000). However, how can this factor explain the number of people to whom the innovations were diffused?

No known literature supports this finding; however, a frequency analysis with the two items related to this factor shows that 101 faculty members (83.5%) agreed or strongly agreed that their course changes had an impact on the students' feedback they received (mean = 4.14), and 60 faculty members (49.5%) agreed or strongly agreed that their course changes had an impact on the peer feedback they received (mean = 3.5). This information reveals that faculty innovators believed strongly that course changes impacted student feedback more than peer feedback, and this is reflected in their diffusion behaviors.

Among the 121 diffusing cases, 23 faculty innovators (19.9%) reported that they diffused the innovation to one faculty, 39 (32.2%) to *two to three faculty*, 11 (9.1%) to *four to five faculty*, and 14 (11.6%) to *more than five faculty*. Thirty-four of them (28.1%) diffused their innovation to more than one faculty, but they could not recall the exact number. This information reveals that about 50% of them diffused their innovation to more than one faculty and about 20% diffused their innovation to more than four faculty.

Summary of the Findings

The study findings indicated that seven out of 10 factors were found to be significant predictors of sustaining, transferring, or diffusing of an instructional innovation. They were: 1) P&T Feedback Received about Course Changes; 2) Innovation Philosophy; 3) Teaching Motivation; 4) P&T Focus on Teaching and Research; 5) Organizational Support, 6) Influence of Course Changes on P&T; and 7) Student-centered Teaching Philosophy.

Interestingly, among the seven significant predictors, four were profitability factors and three were related to the different aspects of promotion and tenure. The other three were related to the fit between innovation and the individual's environment, philosophy, or motivation and they were counted as compatibility factors. Four out of seven factors were related to diffusing; three to transferring; and two to sustaining.

Implications

Implications for Instructional Design

Five implications for instructional design can be drawn from this study. First, when advocating the continuation of an instructional innovation, the instructional designer (or course/curricular consultant) should be aware of three factors related to promotion and tenure—P&T Feedback Received about Course Changes, P&T Focus on Teaching and Research, and Influence of Course Changes on P&T. Faculty members' promotion and tenure status should be known before giving advice about the extent of possible changes to the course. For instance, if the faculty rank is assistant professor, it may not be necessary to implement a completely different change in their teaching practice but rather a less extensive change that takes more account of ease of implementation of or comfort of use by faculty. Not following the implication of this finding may lead to the negative impact on the promotion and tenure evaluation. Namely, a dramatic course change may lead to a lower SRTE (student ratings of teaching effectiveness) score or take away too much of faculty's time to conduct research. Before

the design of the course changes, if possible, the instructional designer may also want to get a general sense of: 1) faculty's previous SRTE scores, 2) faculty's perception of time allocated to teaching and research according to their personal preference or the contents of their contract (i.e., percentage of focus on teaching and research), and 3) their previous experience with promotion and tenure evaluation. Moreover, the design of course changes should incorporate an assessment by peers and students of changes made, because P&T feedback faculty received about course changes was found to be consistently influential in their sustaining, transferring, and diffusing of innovations. This finding has implications for the evaluation phase of an instructional design process. The current finding enhances the view that the assessment of learning and teaching innovation is crucial not only to the adoption of an innovation but to the continuing of such instructional innovations.

The second implication, based on the finding related to innovation philosophy, is that an instructional designer may want to bear in mind that innovation is an evolving and enduring process; thus, any major change may be inventive but not necessarily have a high chance of success. Minor and gradual changes that fit faculty attitudes, preferences, and philosophies are more likely to lead to the continuation of an instructional innovation (Kozma, 1985).

The third implication is that discussing teaching philosophy with faculty may help to tailor a design that not only fits the instructor's needs for change but also his/her personal style in maintaining the changes. In this case, asking faculty for their beliefs about how student learning may occur—through well-designed drills and practice; through various instructional techniques that enhance learning such as advance

organizers, concept maps, or animation; or by guiding students to build their own understanding from their engagement with projects or problems assigned—may provide the designer with information about the type of instructional activities that may work best for the faculty.

The fourth implication related to teaching motivation is that the instructional designer may want to know what motivated faculty to initiate their innovation and whether the driving force remains the same or has changed. It may give the designer needed information about the time and efforts faculty would like to devote and how far they would carry on the innovation. Particularly, being able to tell faculty's teaching motivation in advance could provide the instructional designer with hints about the number of others that such an innovation will be diffused to.

The fifth implication is that information is needed about the type of organizational support in place and other support/grants available. In this study, faculty received funding from the university to work on their instructional innovation, and their funding varied from one semester to two years. If the funding or support could remain in place for a long period of time, then the innovation would have a greater chance of diffusing. Figuring out the other sources of funding and continuing the consultation support may help faculty to continue their innovation.

Information about the nature of the course taught by faculty (class size, student background, and instructional objectives), the availability of organizational support, and faculty's status in the promotion and tenure process are not enough; a good instructional designer also needs to consider the aspects related to compatibility (e.g., faculty's belief about sustaining innovation, and about teaching and learning) and faculty's reasons for

engaging in innovative teaching in order to generate a design that is tailored to faculty and is sustainable.

Implications for Post-Adoption of an Instructional Innovation

The prevalent finding in this study was that P&T related student/peer feedback was the strongest predictor of all three post-adoption behaviors. Thus, faculty who believed that course changes impact student feedback and peer feedback were more likely to sustain, transfer, and diffuse their innovation. Perhaps universities should consider implementing a more accurate assessment of teaching performance by requesting faculty to document in their portfolios "evidence of active and collaborative instruction, peer review of classroom instruction, innovative forms of student assessment, and longitudinal tracking of student progress," as suggested by Paulson (in Fairweather, 2002, p. 99). The assessment of scholarship in teaching, research, and service should be clearly defined and modified to balance the weight placed on each of them (Wolverton, 1998). Otherwise, innovative teaching or continuation of such instructional innovation will only last for a short while. Therefore, university administrators may develop strategic plans that could modify the reward system by clarifying their emphasis on good teaching.

Limitations

It may take an instructional innovation anywhere from a few semesters to several years to sustain, transfer, or diffuse after such innovation had been implemented. Thus,

the participants in this study were restricted to those who had already implemented an innovation in order to match the study context—post-adoption of a teaching and learning innovation. A target sample that met the study criteria was chosen in order to make these factors meaningful to them and relevant to the study. Following this strategy may impact the generalizability of the findings.

The *r*-squared in the original multiple regression models accounted for a relatively low variance among the 10 predictors: 11.9% for the proportion of the changes sustained, and 18.6% for how many of the changes were transferred. This suggests that there could be some other significant factors in predicting the extent to which changes are sustained or transferred but that they were not included in this study.

Research questions 5 and 6 explain the proportion of changes sustained or transferred while question 7 related to the number of people to whom the course changes were diffused. The cases for those who did not sustain, transfer, or diffuse were removed from the multiple regression analysis, reducing the sample size to 109 for sustaining, 95 for transferring, and 70 for diffusing. Sample sizes less than 100 and 10 predictors in the original models decreased the predicting power for the original transferring and diffusing models. Thus, the results for the transferring and diffusing models in the multiple regression analysis should be interpreted cautiously.

Recommendations for Future Research

The major finding indicated that faculty perceived that the promotion and tenure feedback about course changes played an important role in their continuation of

innovation, especially the aspects related to students' feedback about course changes. Standard assessments for class teaching only measure aspects related to the instructor's competence in the content area, delivery of content, use of media in class, etc., but do not incorporate students' perceptions of the impact of course changes on their learning. Thus, future research to design a valid and reliable tool to fully measure students' ratings of teaching performance is necessary. These tasks can be accomplished by instructional designers and measurement specialists.

Another area of future research may be whether the type of instructional innovation used affects the sustaining, transferring, and diffusing of an instructional innovation, since this issue was not included in this study. Moreover, one's motivation to adopt an innovation may also be an important factor affecting the sustaining, transferring, or diffusing of a teaching and learning innovation. Also, significant factors that impact the continuation of an innovation may not be completely the same as those that impact the termination of an innovation. This issue may be of interest to future researchers.

Conclusions

The main predictor of the post-adoption of an innovation was P&T Feedback Received about Course Changes, as this factor influenced sustaining, transferring, and diffusing. Influence of Course Changes on P&T was influential only in sustaining. Innovation Philosophy and Student-centered Teaching Philosophy were influential in transferring innovation. Teaching Motivation, P&T Focus on Teaching and Research, and Organizational Support were influential in diffusing.

This study may provide a preliminary answer to the following question: Among the post-adoption behaviors of a teaching and learning innovation, will profitability factors be more crucial than compatibility factors or vice versa? The results suggest that the profitability factor P&T Feedback Received about Course Changes was more crucial than other profitability and compatibility factors regardless of faculty's sustaining, transferring, or diffusing of their instructional innovations.

The systematic investigation using the 10 predictors to compare and contrast their impact on faculty's sustaining, transferring, and diffusing of their instructional innovation may better explain the research framework for the continuation of an instructional innovation.

This study found that seven out of 10 factors suggested from previous studies were good predictors of faculty's sustaining, transferring, and diffusing of teaching and learning innovation. Moreover, this study bridged the gap between the literature on organizational innovation and individual innovation (i.e., instructional innovation) as well as prior-, during-, and post-adoption. It corroborated some of the findings from sustainability and diffusion and also linked the area of transferring, on which there has been less research.

When interpreting the importance of these factors, it may be wise to examine them in terms of their strength rather than the direction of the outcome variables. Like the two sides of a coin, each individual factor may carry dual value in sustaining, transferring, or diffusing of an instructional innovation: acting as a promoter or inhibitor. The direction may vary, with the individual as one side of the coin and his/her interaction with the environment as the other side. For instance, department culture may sustain a

Mechanical Engineering faculty member but inhibit an Earth and Mineral Science faculty member. Initially, a student-centered teaching philosophy was assumed to promote more than to inhibit a faculty's transferring of course innovation but in reality the reverse was found to be true.

In conclusion, it has been said that the world does not function by simple logic as it is conceptualized; however, the best part of the phenomenon may be captured at that moment when the investigation is conducted. The importance of some factors may remain after 10 or 20 years, some may last for one semester. Hence, innovation and change continue. The question is this: Which path will faculty members choose after acknowledging the promoting and inhibiting factors that surround them—to be an excellent researcher who does poor teaching, an excellent teacher who does not conduct or publish research, or a person who can integrate excellence in both research and teaching? If they choose to teach with innovation, are they aware of the promoters and inhibitors on the path? The findings from this study may help faculty to have a realistic vision of the path they choose, be aware of potential barriers, and continue their innovation path enthusiastically. It is also hoped that the empirical data from this study will be used by the university administrators who wish to promote course innovation and modify the reward systems for quality teaching.

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Appendix A

Informed Consent Form

Informed Consent Form for Social Science Research
The Pennsylvania State University

Title of Project: A Study of Teaching and Learning Innovation in Higher Education

Principal Investigator: Meng-Fen Michelle Hsieh, Ph.D. Candidate
301 Rider II Building
University Park, PA 16802
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Other Investigator: Dr. Jill Lane
301 Rider II Building
University Park, PA 16802
TELEPHONE: (814) 865-9785
EMAIL: jlane@psu.edu

Purpose of the Study: The purpose of the study is to identify conditions that may have a greater impact on course changes after a faculty member has implemented them.

Procedures to be followed: This research involves completing an online survey. The survey contains questions about the factors that affected your experiences, and about course changes in your class. If you agree to take part in this research, please finish reading this form and then click the “Next" button at the bottom of this page.

Discomforts and Risks: There are no risks in this research beyond those found in everyday life. Some of the questions you will be asked are about your experiences and opinions about continuing or discontinuing use of your course changes. The demographic information you will be asked to provide in the last part of the survey might require you to provide some identifiers, but the information will not be associated with any survey responses. The survey software will generate a random code linked to both your response and email to help the principal investigator identify those who have not yet responded so

that she can send a remainder email only to them. Only the investigators will know your identity.

Benefits: You may learn more about your own perceptions of course changes in higher education by participating in this study. You may gain a better understanding of the factors that facilitate or hinder the sustaining of course changes. You may find that others have had experiences similar to yours.

Duration: This survey (about 22 questions) should take you 15-20 minutes to complete.

Statement of Confidentiality: Only the investigators will know your identity. Nevertheless, all information that you provide will remain confidential. That is, your name or other identifiable information will not be linked to your individual responses when reporting or publishing the data results. The following may review and copy records related to this research: The Office of Human Research Protections in the U.S. Department of Health and Human Services, Penn State University's Social Science Institutional Review Board and Penn State University's Office for Research Protections. In that case, the study process and data may be reviewed without revealing your identity. Your confidentiality will be safe to the degree permitted by the technology used. Specifically, no guarantees can be made regarding the interception of data sent via the Internet by any third parties. The data will be stored on the Schreyer Institute server at Penn State for one year. The Principal Investigator will save the data file in a CD format for reference.

Right to Ask Questions: You may ask questions about this research. Contact Meng-Fen Michelle Hsieh. If you have questions about your rights as a research participant, contact The Pennsylvania State University's Office for Research Protections at (814) 865-1775.

Voluntary Participation: Your decision to participate in this research is voluntary. You can stop at any time. You do not have to answer any questions you do not want to answer.

You must be 18 years of age or older to take part in this research study. Completion and return of the survey implies your consent to participate in this research.

If you agree to take part in this research study and to the information outlined above, please print this form and keep it for your records and click the "Next" button below. If you do not want to take part in this research, Please close this window or exit your browser.

Consent

- ☐ I agree to participate
- ☐ I do not want to participate

This informed consent form was reviewed and first approved by the Social Science Institutional Review Board at The Pennsylvania State University on 3/09/05 and the modified version was approved on 1/26/06. It will expire on 03/07/06 (D. Maney – IRB# 20467 – Doc. #1).

Appendix B

Survey of Post-Adoption of Teaching and Learning Course Changes

Thank you for participating in this research. The survey should take about 15-20 minutes to complete. It must all be completed at one time (you cannot save or return to it later). Please try to answer each question as best you can. Try not to skip items, since if too many items are missing, your responses will be unusable. Once you complete all of the questions, please hit the "submit" button.

Please answer the following questions based on the course changes you have implemented since receiving support or funding from the following:

- *FELT* (Fund for Excellence in Learning and Teaching) projects from *CELT* (Center for Excellence in Learning and Teaching)
- Curricular support/funding projects from *SITE* (Schreyer Institute for Teaching Excellence) or *SIIL* (Schreyer Institute for Innovation in Learning)
- FTI (Faculty Technology Initiative) or CBEL projects from Education Technology Services
- TDG (Technology Development Grant) projects from the Commonwealth College (CWC)

If you have worked with more than one project related to the support/funding source indicated above, please base your survey answers on the course/project title and support/funding source that we have provided in the invitation e-mail.

Section I. Background Information about Course Changes

Please answer the following questions based on the way things were at the time when you made course changes.

1. What was the **main** reason you initiated the course changes? (Choose only the primary reason)

- ❍ The need to improve student learning in my course
- ❍ In response to changes in the curriculum
- ❍ In response to changes in student demographics
- ❍ In response to knowledge of a new way to present the course
- ❍ To address the demands of external agencies
- ❍ Students' suggestions
- ❍ The feedback from SRTEs
- ❍ Adaptation of new technologies
- ❍ Other, please specify _____

2. How many years of teaching experience did you have at that time?
   - ❍ Less than 3 years
   - ❍ 3-6 years
   - ❍ 7-9 years
   - ❍ 10-12 years
   - ❍ More than 12 years

3. What was your academic rank?
   - ❍ Lecturer or instructor
   - ❍ Senior lecturer or senior instructor
   - ❍ Assistant professor
   - ❍ Associate professor
   - ❍ Professor
   - ❍ Other, please specify _____

4. Which of the following had you received?
   - ❍ Tenure
   - ❍ Promotion
   - ❍ Both tenure and promotion
   - ❍ Neither tenure nor promotion

5. Were you the only instructor teaching the course?
   - ❍ Yes
   - ❍ No

5a. How many other faculty were involved in your course change proposal?
   - ❍ None
   - ❍ 1 faculty
   - ❍ 2-3 faculty
   - ❍ 4-5 faculty
   - ❍ More than 5 faculty

6. How many of the changes did you use in any other courses you taught at that time?
   - ❍ None of them
   - ❍ Less than half of them
   - ❍ About half of them
   - ❍ More than half, but not all
   - ❍ All of them

7. How many other faculty members utilized the ideas that originated from your course/project at that time?
   - None
   - 1 faculty
   - 2-3 faculty
   - 4-5 faculty
   - More than 5 faculty
   - Some, but I don't know how many

8. Priot to spring 2006, how many semesters have you taught the course since the changes were implemented?
   - None (go to question 10)
   - 1-2 semesters (go to question 9)
   - 3-4 semester (go to question 9)
   - 5-6 semesters (go to question 9)
   - More than 6 semesters (go to question 9)

Section II. Current Status of Your Changes

Please identify the *current status* of your course changes.

9. Thinking of the changes you made in your class, what proportion of them have you c*ontinued to use* in subsequent versions of that course?
   - ❍ None of them
   - ❍ Less than half of them
   - ❍ About half of them
   - ❍ More than half, but not all
   - ❍ All of them

10. How many of the changes *have you used* in your other courses?
   - ❍ None of them
   - ❍ Less than half of them
   - ❍ About half of them
   - ❍ More than half, but not all
   - ❍ All of them

11. How many other faculty members have utilized the ideas that originated from your course or project?
   - ❍ None
   - ❍ 1 faculty
   - ❍ 2-3 faculty
   - ❍ 4-5 faculty
   - ❍ More than 5 faculty
   - ❍ Some, but I don't know how many

Section III. Factors that Impacted Course Changes

Teaching Philosophy

12. Using the scale given below, please rate your level of agreement/disagreement with the following statements *during the time you made course changes, regardless of whether your views or philosophies have changed or not since then.*

I believed that …..

a. Students should learn to become more independent learners during the learning process.
b. In order to learn, students should be actively involved with the learning materials.
c. It is preferable to use a variety of methods for effective teaching (i.e., lectures, class discussions, group projects, guest speakers, etc.).
d. Teaching is an ongoing process of refining.
e. Teaching is a process of trying different things and keeping what works.
f. Teaching is a process of making gradual adaptations that evolve over time.
g. It is important to continue learning things from teaching.

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly Agree

Teaching Motivation

13. Using the scale given below, please rate your level of agreement/disagreement with the following statements about teaching motivation *during the time you made course changes, regardless of whether your views or teaching motivation have changed or not since then.*

a. A major reason for being a teacher was that I believed I played a significant role in my students' growth.
b. It was important to me to have the flexibility to determine the classroom methods I would like to use.
c. I enjoyed being able to justify to others the reasons behind the teaching strategies I used.
d. I valued the feedback from my students about the changes I made in my teaching.
e. I was willing to accept difficult but attainable challenges to change my course.
f. When making course changes, it was important to feel connected to my colleagues in the program/department.
g. It was important to me to have opportunities to interact with other colleagues with similar research interests.

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly Agree

13h. How much time, if any, did you believe faculty members should make themselves available to students in addition to class time and office hours?
_____ hours per week

Organizational Support

14. The following questions are about the *organizational support* you had during the time you implemented your course changes. Using the scale given below, please rate the extent of your agreement or disagreement with the following statements *during the time you made course changes, regardless of whether the organizational support is still in effect.*

a. Financial support (such as money, software, equipment, etc.) from my program/department was helpful to my course changes.
b. Verbal support from my program/department chair was helpful to my course change.
c. Technical support I received from my program/department was helpful to my course changes.
d. Consultation assistance from my program/department was helpful to my course changes.
e. Financial support (such as money, software, equipment, etc.) from the college or University was helpful to my course changes.
f. Verbal support from the dean or other authority figures at the college or University was helpful to my course changes.
g. Technical support from teaching resources available at the college or the University was helpful to my course changes.
h. Consultation assistance from a teaching or learning unit at the college or the University was helpful to my course changes.

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly Agree

Collegiality

15. Using the scale given below, please indicate your level of agreement/disagreement with the statements below about collegiality *during the time you made course changes, regardless of whether the collegiality has changed or not since then.*

a. I often discussed my course change ideas with colleagues in my program/department.
b. I collaborated with my program/department colleagues on **my** course changes.
c. I collaborated with my program/department colleagues on **their** course changes.
d. I often discussed my course change ideas with colleagues from outside my program/department.
e. I collaborated with colleagues from outside my program/department on **my** course changes.
f. I collaborated with colleagues from outside my program/department on **their** course changes.

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly Agree

Department Culture

16. *"Department" here refers to the academic program/department or campus that you are from.* Using the scale given below, please rate each item below based on how well each statement describes your work environment *at the time you made course changes, regardless of whether your department culture has changed or not since then.*

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly Agree

a. My program/department *head* was generally considered to be an entrepreneur, an innovator, or a risk-taker.

b. My program/department *head* was generally considered to be a mentor, facilitator, or a father or mother figure.

c. My program/department *head* was generally considered to be a producer, a technician, or a hard driver.

d. My program/department *head* was generally considered to be a coordinator, an organizer, or an administrator.

e. The glue that held my program/department together was a commitment to innovation and development. There was an emphasis on being first.

f. The glue that held my program/department together was loyalty and tradition. Commitment to the program/department ran high.

g. The glue that held my program/department together was the emphasis on tasks and goal accomplishment. A production orientation was commonly shared.

h. The glue that held my program/department together was formal rules and policies. Maintaining a smooth-running institution was important.

i. My program/department was a place where faculty were innovative and willing to take risks. It was dynamic, adaptable, and creative.

j. My program/department was a very personal place. It was like an extended family. People seemed to share a lot of themselves.

k. My program/department was a production-oriented place. A major concern was with getting the job done. People were not very personally involved.

l. My program/department was a very formal, structured place. Generally, procedures governed what people did.

Division of Scholarly Activities

When you respond to the questions in the following section, please think about the concepts "teaching," "research," and "service" in terms of the definitions provided from Policy HR23 at Penn State.

- *The Scholarship of Teaching and Learning*: ability to convey subject matter to students; demonstrated competence in teaching and capacity for growth and improvement; ability to maintain academic standards, and to stimulate the interests of students in the field; effectiveness of counseling, advising, and service to students.

- *The Scholarship of Research and Creative Accomplishments*: competence, usually demonstrated through publication, exhibition, performance, or presentation and scholarly papers, to carry out research or creative work of high quality and scholarly significance and the ability to train students in research methods and practice; evidence of thorough understanding of the field; maintenance of high levels of academic performance; recognized reputation in the subject matter field; evidence of continued professional growth and active contribution to professional organizations.

- *Service and the Scholarship of Service to the University, Society, and the Profession:* participation in the University, college, departmental, and unit affairs; competence in extending specialized knowledge to the University and to the public.

17. During the period in which you made course changes, what percentage of time did you spend on the following scholarly activities <u>over a one-year period</u>? The percentages below should add up to 100.
Teaching made up what percentage of your scholarly activities? _____
Research made up what percentage of your scholarly activities? _____
Service made up what percentage of your scholarly activities? _____

17a. Using the scale given below, which of the following best describes the focus of the promotion and tenure process overall <u>at the following levels</u> during the time when you made the course changes?

17a1. At the program/department level

17a2. At the college or University level

- o A great deal more focus on research than teaching
- o Somewhat more focus on research than teaching
- o Equal focus on research and teaching
- o Somewhat more focus on teaching than research
- o A great deal more focus on teaching than research
- o I don't know

17b. Using the scale given below, how would you characterize the impact that your course changes had on the tenure and/or promotion evaluation you received at the following levels?

17b1. At the program/department level

17b2. At the college or University level

- o Contributed very negatively
- o Contributed somewhat negatively
- o Neither negatively nor positively contributed
- o Contributed somewhat positively
- o Contributed very positively
- o I don't know

17c. Using the scale given below, please rate each item based on how well each statement describes the impact of your *course changes.*

17c1. I believe my course changes had an impact on the *student feedback* I received about my course.

17c2. I believe my course changes had an impact on the *peer feedback* I received about my course.

- o Strongly disagree
- o Disagree
- o Neutral
- o Agree
- o Strongly Agree

Section IV: Demographic Information

18. What is the discipline area that you belong to?
    - o Agricultural Sciences
    - o Arts and Architecture
    - o Business
    - o Communications
    - o Earth and Mineral Sciences
    - o Education
    - o Engineering
    - o Health and Human Development
    - o Information Sciences and Technology
    - o Liberal Arts
    - o Science
    - o Other

19. What is your *current* academic rank at Penn State?
    - o Lecturer or instructor
    - o Senior lecturer or senior instructor
    - o Assistant professor
    - o Associate professor
    - o Professor
    - o Other, please specify _____

20. Which of the following have you received?
    - o Tenure
    - o Promotion
    - o Both tenure and promotion
    - o Neither tenure nor promotion

21. What is your gender?
    - o Male
    - o Female

22. Do you have additional comments about your course changes? Did any other factors or reasons also impact your course changes?

    _____
    _____
    _____

Appendix C

Invitation E-mail

Invitation Email Title- Research Study on the Impact of Teaching Support
Dear Professor _____:

As a Course and Curricular Development Consultant at the Schreyer Institute for Teaching Excellence and a Ph.D. candidate in Instructional Systems, I am working with Dr. Jill Lane on a dissertation study to evaluate the impact of course changes. By filling out the following short survey about your course change experience in the following project: "_____" [project title or course number] with "_____" [support source and year], you will be contributing knowledge and expertise that may help support units to assist faculty with course transformations. Your participation will help us explore the factors that help or hinder faculty members' changes to their courses. The results from this study will be used to help University administrators better understand the challenges faculty members encounter during the process of making course changes.

You have been selected as a potential participant in this study not only because you received support or funding from CELT (Center for Excellence in Learning and Teaching), SIIL (Schreyer Institute for Innovation in Learning), SITE (Schreyer Institute for Teaching Excellence), ETS (Education Technology Services), or CWC (Commonwealth College) but also because you are considered to be a faculty innovator. This project is supported by the Schreyer Institute for Teaching Excellence and is being accomplished with the permission of Teaching and Learning with Technology (CBEL or FTI grant) and the Commonwealth College (TDG grant).

We realize that this is a busy time of the semester and for that reason we are asking you to complete the survey by Jan. 15. We will send you a reminder email after Jan. 1. The survey should take 15-20 minutes to complete. To access the on-line survey and the informed consent document, please go to: http://128.118.92.131/pta/fcc1.htm or http://128.118.92.131/ptb/fcc2.htm

If you have further questions, please do not hesitate to contact Dr. Jill Lane at jlane@psu.edu or 814-865-9785 or Michelle Hsieh at mxh392@psu.edu or 814-865-7848.

Thank you so much in advance.

Jill Lane,
Research Associate/Program Manager, Schreyer Institute for Teaching Excellence

Meng-Fen Michelle Hsieh,
Course & Curriculum Consultant, Schreyer Institute for Teaching Excellence

December 1, 2005

Appendix D

First Reminder E-mail

Dear Professor _____:

At the end of last semester, you received an email message inviting you to participate in a dissertation study about factors affecting faculty course changes. This is a reminder to ask you to take part in this study before the end of January. We would very much appreciate your help.

The goal of this study is to help teaching support units identify ways to assist faculty with course transformations. This project is sponsored by the Schreyer Institute for Teaching Excellence with the permission of Teaching and Learning with Technology (CBEL or FTI grant) and the Commonwealth College (TDG grant).

We hope that you will take part in the survey based on changes you have experienced in the following project: "Sustainability" [project title or course number] with "Schreyer 2005" [support source and year]. The survey should take 15-20 minutes to complete. Your participation will help us explore the factors that facilitate a faculty member's changes to their courses.

The survey and the informed consent document may be found at http://128.118.92.131/pta/fcc1.htm?25514. If you have further questions, please do not hesitate to contact Dr. Jill Lane at jlane@psu.edu or 814-865-9785 or Michelle Hsieh at mxh392@psu.edu or 814-865-7848.

Thank you so much in advance!

Jill Lane,
Research Associate/Program Manager, Schreyer Institute for Teaching Excellence

Meng-Fen Michelle Hsieh,
Course & Curriculum Consultant, Schreyer Institute for Teaching Excellence

Jan 5 , 2005 (UP faculty)
Jan 6 , 2005 (Non-Up faculty)

Appendix E

Second Reminder E-mail

Dear Professor _____:

About three weeks ago, you received an email message inviting you to participate in a study about factors affecting faculty's course changes. The goal of this study is to help teaching support units identify ways to assist faculty with course transformations. This is a friendly reminder to take part in this study before the end of January.

This project is sponsored by the Schreyer Institute for Teaching Excellence and is being accomplished with the permission of Teaching and Learning with Technology (CBEL or FTI grant) and the Commonwealth College (TDG grant).

We very much hope that you will take part in the survey based on changes you have experienced in the following project: "_____" [project title or course number] with "_____" [support source and year]. The survey should take less than 20 minutes to complete.

The survey and the informed consent document may be found at http://128.118.92.131/pta/fcc1.htm. If you have further questions, please do not hesitate to contact Dr. Jill Lane at jlane@psu.edu or 814-865-9785 or Michelle Hsieh at mxh392@psu.edu or 814-865-7848.

Thank you so much in advance!

Jill Lane,
Research Associate/Program Manager, Schreyer Institute for Teaching Excellence

Meng-Fen Michelle Hsieh,
Course & Curriculum Consultant, Schreyer Institute for Teaching Excellence

January 23, 2006

VITA

Meng-Fen Michelle Hsieh

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Ph. D. in Instructional Systems, The Pennsylvania State University, 2007
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B.A. in English Language and Literature, Fu-Jen University, Taiwan, 1992

PROFESSIONAL EXPERIENCE

Curricular and course consultant, Schreyer Institute for Teaching Excellence, The Pennsylvania State University, Aug. 2002–Jun. 2006

Co-instructor, Computer as Mindtools (INSYS 446), Dept. of Learning and Performance Systems, The Pennsylvania State University, Fall 2004

Instructor, Department of Foreign Languages, Foo-Yin University, Taiwan, Aug. 1999–Jul. 2001

RESEARCH PRESENTATIONS

Hsieh, M. F., & Lane, J. L., & Grabowski, B. L. (2007). Binary Logistic Model for Predicting Factors That Lead to Transferability of Course Innovation. The American Education Research Association (AERA) 2007 Annual Meeting, Chicago, IL.

Hsieh, M. F., & Popp, D. (2005). Lessons learned teaching a computer innovation. The Pennsylvania Educational Technology Exposition & Conference (PETE & C) 2005, Hershey, PA.

Buchanan, P., Lane, J., Dudley, V., Kim, H., & Hsieh, M. F. (2004). A new instructional perspective to walk in the statistics world: Experience of redesigning Stat100 at Penn State. The International Society for Exploring Teaching and Learning (ISETL) Conference 2004, Baltimore, MD.