ABSTRACT

VERBOSH, KYLE WILLIAM. Examining the Disciplinary Level Relationship between the Research Context of Academic Work and the Utilization of Student-Centered Pedagogy at Research Universities. (Under the direction of Dr. Paul Umbach).

The roles of researcher and teacher are fundamental to faculty work. Academic freedom enables faculty to principally direct the performance of their research and teaching; even so, these roles are not immune to normative influence. Disciplinary affiliation represents a powerful source of peer-driven, norms that inform the performance and prioritization of faculty work (Becher & Trowler, 2001; Clark, 1987, 1989; Smart, Feldman, & Ethington, 2000). Academic disciplinary culture is largely defined by its respective research ethos and profile, particularly at research universities where disciplinary affiliation and scholarly fervor are most salient (Astin & Chang, 1995; Austin, 1990, 1996; Clark, 1980, 1989; Massy & Zemsky, 1994). As such, a discipline’s normative research context at said institutions may impact the performance of the teaching role. The mass of research targeting the relationship between research and teaching suggests a weak positive to null relationship (Feldman, 1987; Hattie & Marsh, 1996). However, insufficient scholarship has scrutinized variation in this relationship based on disciplinary affiliation (Hattie & Marsh, 2002).

Analyzing data from the 2007 HERI Faculty Survey, my study employed a two level hierarchical linear model (HLM) to examine the disciplinary-level relationship between the faculty research role context and efficacious pedagogical practice at research universities. Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) and Holland’s Theory of Careers (1973, 1997) were also incorporated as separate disciplinary taxonomies for uncovering nuanced understanding in the aforementioned relationship. HLM results detected significant disciplinary variation in faculty utilization of student-centered
pedagogy. Discipline level and cross level interaction effects unearthed meaningful disciplinary insight into the studied research-teaching relation.
Examining the Disciplinary Level Relationship between the Research Context of Academic Work and the Utilization of Student-Centered Pedagogy at Research Universities

by
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CHAPTER ONE: INTRODUCTION

The two main pillars of higher education and faculty work are teaching and research. Due to academic freedom, faculty members have historically been afforded significant autonomy in directing these work roles. This autonomy encompasses not only the power to control the content of their respective teaching and research roles, but also the right to decide how these work roles are structured and performed (Gappa, Austin, & Trice, 2007). In the classroom, academics plan their courses, select materials, and decide their pedagogical approach. As scholars, faculty members possess the independence to choose their research problems, methodologies, work schedules, and publication strategies.

Given the primacy of academic freedom, scholarly inquiry that ignores the relation between faculty research and teaching relies upon a myopic vision of academic life. This faculty research-teaching relationship is subject to the normative values and behaviors that inform academic work (Gappa, Austin, & Trice, 2007). Disciplinary identification represents a critical and powerful normative force behind the performance and interplay of academic work (Becher & Trowler, 2001; Clark, 1987, 1989; Smart, Feldman, & Ethington, 2000). Accordingly, the given study sought to examine the role of disciplinary membership in differentiating the relationship between faculty research and teaching.

Problem

Research has proffered that faculty identify disciplinary affiliation as the most salient normative influence concerning their professional values and behaviors (Becher & Trowler, 2001; Clark, 1987, 1989; Smart, Feldman, & Ethington, 2000). However, the disciplinary
cultures that populate higher education have received insufficient scholarly attention as a differentiating force in the performance of faculty work (Becher & Trowler, 2001; Smart, Feldman, & Ethington, 2000). The existence of clear research norms and practices have served to shape faculty disciplinary identity through sub-disciplines and specializations, epistemological orientations, patterns of faculty communication and networking, and career progression and prestige (Becher & Trowler, 2001; Smart, Feldman, & Ethington, 2000). A prevalent vein of scrutiny even suggests that this domineering research role effect has undermined the quality of faculty teaching (Boyer, 1990; Fairweather, 1996; Massy & Zemsky, 1994; Study Group, 1984). As such, performance of the faculty teaching role might be explicated by variant norms of research engagement and activity within a given discipline.

The Disciplinary Lens of Academic Work

My study endeavored to contribute greater understanding of the relationship between research and teaching by examining the influence of academic disciplinary affiliation over this nexus. Existing comprehensive meta-analyses synthesizing the scholarly record on this relationship suggest a weak positive to null connection (Feldman, 1987; Hattie & Marsh, 1996). Given that existing literature is overwhelmingly devoid of any efforts aimed at accounting for faculty members’ disciplinary affiliation, this weak positive to null link between research and teaching may be camouflaging greater understanding and nuance (Braxton & Hargens, 1998; Hattie & Marsh, 2002).

The growth of academic disciplines in number and influence over the past few decades has been considered one of the most critical changes in higher education (Clark,
Clark argues this growth has resulted in a structural differentiation of disciplinary professionalism in which academics tend to form their interests and loyalties around disciplinary membership more than any other affiliation. Elucidating this powerful and omnipresent socializing effect, academic disciplines are marked by academics with their own languages, patterns of work, standards of conduct, and professional priorities (Becher, 1981, 1987; Becher & Trowler, 2001; Smart, Feldman, & Ethington, 2000; Umbach, 2007). Such disciplinary cultures and their respective norms are fundamental to understanding differences in the professional values and practices of academics as they perform their research and teaching roles (Becher & Trowler, 2001; Braxton & Hargens, 1996; Smart, Feldman, & Ethington, 2000). Moreover, it is vital to examine if different disciplinary cultures impact the interplay of research and teaching.

The examination of differences in faculty attitudes and behaviors based on disciplinary affiliation has not only suffered from the absence of organization and coordination, but it has also lacked true theoretical guidance (Smart, Feldman, & Ethington, 2000). The most prominent work that has brought some order to this fragmentation is Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975). Biglan’s model was an empirically derived disciplinary classification schema that through extensive subsequent research involving its dimensions has developed into a major conceptual framework for studying faculty attitudes and behaviors. The argument against Biglan’s model proffers that it provides no lasting resolution to the research fragmentation on faculty disciplinary differentiation given its failure to adhere to the fundamental criteria of a
complete theory and its exclusive emphasis on disciplinary differences (Bayer, 1987; Smart, Feldman, & Ethington, 2000). Smart, Feldman, & Ethington (2000) argued for and found empirical support for the use of Holland’s (1973, 1997) theory of careers as a theoretical foundation for the disciplinary exploration of faculty attitudes and behaviors. Both of these disciplinary taxonomies provide a lens through which greater nuance and variation may be gleaned about the relationship between faculty research and teaching.

**Holland’s Theory of Careers**

Holland’s (1973, 1997) theory posited people live and work along six main personality types that correspond with six matching environments: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. People seek out environments that maximize their skills and abilities, reflect their values and beliefs, and encompass congruent problems and roles. As such, personality and environment are not independent; if we know the personality type of people who predominate an environment, we can understand the environment’s climate. Individuals are most likely to thrive in environments where the roles, tasks, and values are congruent with their respective personality type. Three assumptions undergird this theory: people choose environments suited to their personalities; environments reinforce and reward different patterns of abilities, interest, and behaviors; and individuals succeed in environments that are congruent with their dominant personality types. Noting the absence of theory in the study of academic life; Smart, Feldman, and Ethington (2000) advanced the case of utilizing Holland’s theory as a disciplinary prism for understanding the variability in faculty teaching and research. No research was uncovered
that utilized Holland’s theory as a lens for explicitly examining the research-teaching relationship.

**Biglan’s Three-Dimensional Model**

Biglan’s (Biglan, 1973a, 1973b; Smart & Elton, 1975) three-dimensional model has also provided an atheoretical schema that a mass of scholarship has utilized to examine disciplinary variations in faculty attitudes and behaviors. The hard-soft dimension assesses the extent to which a single paradigm or standard guides academic work in a particular field. Both the hard-soft dimension and the paradigm development notion advanced by Lodahl and Gordon (1972) appraise the level of consensus (high vs. low) within a particular disciplinary field concerning theoretical orientations, the relative importance of different lines of scholarship, and appropriate research methodologies. Hard disciplines present high levels of consensus; whereas, soft disciplines display relatively lower levels of consensus. The pure-applied dimension assesses the extent to which content application is essential within different disciplinary fields. The life-nonlife dimension reflects whether or not living systems are studied.

With respect to the research-teaching relationship, four broad disciplinary classifications in Feldman’s (1987) afore mentioned meta-analysis indicated soft disciplines present a moderate positive relationship \( r = .21 \) between teaching and research; whereas, hard disciplines display more of a null relationship \( r = .05 \) (Braxton & Hargens, 1996). This finding suggests that the near zero teaching-research relationship observed in the scholarly record (Braxton, 1996; Feldman, 1987; Hattie & Marsh, 1996) might be a
composite depiction of disciplinary variation. The given study employed both Biglan’s model (Biglan, 1973a, 1973b; Smart & Elton, 1975) and Holland’s theory (1973, 1997) to explore if disciplinary differentiation impacts the teaching-research relationship. Additionally, given this focus on the normative influence of disciplinary affiliation, I operationalized teaching and research in a manner that enabled an examination of disciplinary variation in faculty values and behaviors.

**Measuring Teaching via Student-Centered Pedagogy**

The great mass of scholarship targeting the research-teaching relationship has operationalized efficacious teaching through student evaluations or ratings (Jenkins, Breen, Lindsay, & Brew, 2003). The given study departs from this traditional methodological approach. Student evaluations of efficacious teaching are subject to extraneous personality factors, biases, and knowledge gaps (Friedrich & Michalak, 1983). The cognitive burden placed on students in comprehending, judging, and reporting their responses raises strong questions concerning the validity of student ratings of their educational experience (Porter, 2011; Tourangeau, Rips, & Rasinski, 2000). Murray and Renaud (1995) found that faculty from different disciplines differed in the frequency with which they were observed utilizing specific good teaching behaviors; however, they did not differ in the correlation of these teaching behavior frequencies with corresponding student overall ratings of teaching. This evidence advances two pertinent implications. First, students lack an informed understanding of efficacious instructional behavior that inhibits an accurate measurement of
teaching effectiveness. Second, student evaluations of instruction may compromise my focus on disciplinary affiliation as a differentiating force in explicating good instructional practice.

**The Case for Student-Centered Pedagogy**

Exploring disciplinary variation in the research-teaching relationship necessitated operationalizing teaching in a manner that embodies the normative behaviors and values that define a given discipline’s academic culture. Hattie and Marsh (1996) suggested that future scholarship should consider operationalizing effective teaching from the prism of teaching orientation or pedagogy. An academic’s teaching orientation or pedagogical approach is a behavioral practice that is subject to the differentiable norms and values of disciplinary membership (Becher & Trowler, 2001; Braxton & Hargens, 1996; Smart, Feldman, & Ethington, 2000). Prominent theories of college student development suggest that instructional environments that engage students directly and actively, as opposed to more passive approaches, are more likely to foster the type of deep or higher order learning that is essential to the undergraduate experience (Astin, 1984; Chickering, 1969; Kolb, 1984). It is the deficient state of such meaningful student engagement in the learning process that broad, prominent critiques of undergraduate education have asserted as a threat to our nation’s economic security and societal best interests (Arum & Roska, 2011; Spellings Report, 2006; Weimer, 2013).

The broad scope of instruction that facilitates student learning through robust direct and active engagement has received disconnected scholarly attention; accordingly, it lacks a definitive, succinct pedagogical profile (Pascarella, 2001). Despite this rather imprecise
delineation, pedagogy that places students in a direct and active learning position has widely
garnered the designation of student-centered (Barr & Tagg, 1995; O’Neill & McMahon,
2005; Weimer, 2013). A synthesis of the literature concerning the student-centered
pedagogy identifies some core axioms: reliance on active rather than passive learning, an
emphasis on deep learning and understanding, increased student responsibility, an
appreciation for diverse student experiences and ways of knowing, increased student
autonomy, collaboration between students, and interdependence between teacher and learner
(Chickering & Gamson, 1987; Lea, Stephenson, & Troy, 2003; O’Neill & McMahon, 2005).

Maryellen Weimer (2013), one of the nation’s leading scholars on efficacious college
teaching, has detailed a more explicit five prong definition of student-centered pedagogy.
The role of the teacher should center on promoting instructional action that focuses on
student engagement in the learning process. The balance of power should reflect a shared
decision-making process between faculty and students. Instructional content should focus
not only on knowledge acquisition but also on developing learning skills and self-awareness.
Faculty should foster learning atmospheres that inspire students to accept responsibility for
their learning. Finally, evaluation activities should regularly develop students’ self- and peer
assessment skills.

Recent scholarship has supported student-centered pedagogy as a significant predictor
of college student learning (Umbach & Wawrzynski, 2005). In particular, student-centered
instructional behaviors that actively and collaboratively engage students and that emphasize
higher-order thinking were found to correlate with an educational environment of student
engagement and both student self-reported and observed learning gains. To the above, my study operationalized efficacious teaching through faculty members’ self-reported use of instructional behaviors that embody the forgoing conceptualization of student-centered pedagogy.

**Disciplinary Impact on Student-Centered Pedagogy**

Research has shown disciplinary affiliation as a critical determinant in faculty instructional behavior. In particular, Holland’s theory (1973, 1997) and Biglan’s model (Biglan, 1973a, 1973b; Smart & Elton, 1975) have both been employed to provide understanding about how disciplinary environments differentiate faculty use of student-centered pedagogy.

**Holland’s theory of careers.** Early research proffered that faculty from Investigative, Conventional, and Realistic environments favor structured instructional strategies and arrangements consistent with the traditional and teacher-centered classroom experience; whereas, faculty from the Social and Artistic environments are more attracted to unstructured teaching strategies and arrangements that emphasize student autonomy, decision making, and engagement in the learning process (Morstain & Smart, 1976; Peters, 1974).

Recent research has also supported the notion that faculty from Social and Artistic environments, compared to the remaining environments, more keenly embrace student-centered classroom pedagogy. Realistic faculty followed by Artistic and Social academics have been shown to more likely utilize student-centered learning techniques (Umbach 2006, 2007). Although this finding slightly disputes earlier research (Morstain & Smart, 1976;
Peters, 1974), the study’s survey contained explicit and low-inference items concerning student-centered pedagogy. Realistic faculty may have inferred desired structure while Social and Artistic faculty may have assumed undesirable structure and less student control. Higher-order learning activities consistent with the student-centered learning paradigm have also been linked to Realistic faculty and to a slightly lesser extent their Social, Artistic, and Enterprising peers (Umbach, 2006, 2007). Even at the sub-disciplinary level, faculty use of student-centered pedagogy was a teaching behavior on which Holland’s three engineering classifications (realistic, investigative, and enterprising) displayed significant variation (Lattuca, Terenzini, Harper, & Yin, 2010).

**Biglan’s three-dimensional model.** Biglan’s soft-hard dimension presents important findings concerning disciplinary variation in the classroom utilization of student-centered pedagogy. In particular, research has demonstrated that faculty from low consensus or soft disciplines employ more of a student-centered teaching orientation marked by instructional behavior that emphasizes direct and active student learning, holistic student development, higher-order learning, high student expectations, and diverse ways of learning and knowing (Braxton & Nordvall, 1988; Braxton, Olsen, & Simmons, 1998; Stark, Lowther, Bentley, & Martens, 1990; Gaff & Wilson, 1971). Given their concern for the quality of the classroom teaching and learning experience, soft disciplines have been coined “affinity disciplines” (Braxton, Olsen, & Simmons, 1998).
Comprehensive Conception of the Research Role Context

The research context of academic work is also subject to the normative influence of disciplinary affiliation. Examining the research-teaching nexus from a disciplinary frame necessitates research measures that fully encompass this normative influence. Academics do not often explicitly correlate teaching and pedagogy with the core essence of their respective disciplines. The research charge of academic work shapes disciplinary boundaries, the formation of sub-discipline and specializations, patterns of communication and networking, career progression, disciplinary pecking-order, and knowledge generation itself (Becher & Trowler, 2001). Accordingly, research activity more aptly gives form and function to disciplinary identity. The teaching role might be a less essential, local responsibility that is informed by the salience of research engagement within a given disciplinary culture (Becher, 1981; Blackburn & Lawrence, 1995).

To this assertion, dueling perspectives exist concerning the direction of this influence. One perspective posits that research activity competes with the responsibilities of teaching. The systematic emphasis placed on research in career advancement and prestige diminishes intrapersonal and structural commitments to teaching (Blackburn & Lawrence, 1995; Massy & Zemsky, 1994). The other view holds that research activity benefits teaching. Linsky and Strauss (1975) termed this occurrence the “spillover effect.” The idea being that research activity stimulates a faculty member’s professional excitement and subject matter interest that is transferred to students through efficacious instruction.
The Impact of Research Activity on Student-Centered Pedagogy

Along these philosophical lines, arguments exist for the research role having both a positive and negative impact on faculty utilization of student-centered pedagogy (Brew & Boud, 1995; Olsen & Simmons, 1996). The design, implementation, oversight, and evaluation of student-centered pedagogy are continual and exhaustive tasks; accordingly, research orientated disciplines are likely to fulfill their teaching responsibilities utilizing a more teacher-centered philosophy that maximizes time and energy for research pursuits and embraces the passivity of students in the learning process (Olsen & Simmons, 1996). This proposition suggests that research orientated disciplines might allocate their professional resources at the expense of effective teaching that prioritizes students in the learning process.

On the other end of the philosophical spectrum, in their investigation of the linkages between teaching and research, Brew and Boud (1995) proffered that faculty engaged in the deep or high order learning that is necessitated by effective research activity may, in turn, invest their resources in the promotion of this form of learning through pedagogical approaches and strategies that necessitate similar student engagement. This notion suggests that research-centric disciplines may foster a professional environment where faculty recognize direct, active, and continuous engagement as the common denominator between the thriving researcher and the successful learner. These alternative arguments highlight the need to account for variation in the disciplinary research context of academic work. A distinctive combination of normative values and behaviors defines a given discipline’s research context. Accordingly, from a disciplinary frame, a comprehensive
conceptualization of the research context is necessary if one seeks to fully understand its relation with faculty utilization of student-centered pedagogy.

**A Model for the Research Role Context**

The majority of research on the teaching-research relationship has tended to uniformly operationalize research effectiveness through some measure of research productivity (Jenkins, Breen, Lindsay, & Brew, 2003). My study sought to move beyond this traditional operationalization to include measures that more fully account for the normative disciplinary context of the faculty research role. The given study adapted and integrated two existing models (Gavlick; 1996; Marsh, 1984, 1987) that target the research-teaching nexus to examine if a comprehensive conception of the research role explained significant disciplinary variation in faculty utilization of student-centered pedagogy.

Gavlick’s (1996) model proffered that research activity, measured via publication productivity, shapes or informs pedagogical behaviors which, in turn, impact student success. I submit that publication productivity alone offers a narrow conception of the research role and its influence in this causal chain. Marsh (1984, 1987) proposed a model that asserted the research-teaching relationship is a function of ability, time, and, motivation. While publication productivity taps an ability or outcomes component of the research role, it does not address the full behavioral and intrapersonal facets of research activity. Time invested in research activities represents a process component of the research role. Research motivation gauges a measure of enthusiasm and commitment to research activity.
Hattie and Marsh (2002) empirically examined Marsh’s (1984, 1987) model and found evidence that supports the value of a more complete interpretation of research activity in explaining how the research role may impact the utilization of student-centered pedagogy. Like the dominant literature, teaching effectiveness was measured using student ratings. Although a non-significant yet slight negative correlation was detected between research time investment and teaching effectiveness, time spent on teaching and time spent on research presented a significant negative relationship (Hattie & Marsh, 2002). The utilization of student-centered pedagogy necessitates an intense time outlay that includes design, planning, implementation, oversight, and evaluation. Hattie and Marsh (2002) also observed a negative relationship between research motivation operationalized through self-reported goal orientation and teaching effectiveness. Some research suggests that highly autonomous professionals responsible for multiple intrinsically enjoyable activities are more likely to respond to activities that are extrinsically recognized and rewarded (Calder & Staw, 1975; Eimers, 1997). As such, it may be consequential to separate extrinsic and intrinsic faculty research motivation. Accordingly, the given study augmented the traditional publication productivity measure with research time investment and research motivation, both intrinsic and extrinsic, in order to tap a more complete conception of the disciplinary normative influence on the faculty research role.

Massy and Zemsky’s (1994) “academic ratchet” gives voice to this design decision. The “academic ratchet” contends that academics work to increase their time and energy on research activities by advancing structural efforts to reduce teaching commitments including
course loads, course preparation, grading, and meeting with students. This claim runs contrary to the core philosophy of student-centered pedagogy. Massy and Zemsky asserted that the “academic ratchet” has permeated the entire higher education sector at the hands of research universities where the reward and prestige structure is based on research. Given the strength of disciplinary cultures within research universities, their role in growing this research primacy cannot be ignored. In particular, a disciplinary culture’s level of research role primacy may impact faculty utilization of student-centered pedagogy.

**Analysis Accounting for the Significance of Disciplinary Affiliation**

The research-teaching relationship can be framed from two analytic vantage points (Ramsden & Moses, 1992). The bulk of scholarly attention has examined the research-teaching link at the level of the individual faculty member. An alternate version argues for a relationship at a higher group level of analysis. Limited scholarship has targeted this alternate analytic vantage point (Hattie & Marsh, 2002; Ramsden & Moses, 1992)

The idea that disciplinary variation masks evidence of a more robust relationship between research and teaching is couched in the analytical consideration that individual academics are clustered within their respective disciplines and subject to their normative influences. OLS regression assumes that all observations are independent of one another. However, when individuals are clustered or nested within naturally occurring units, such as disciplines, responses from the same cluster are likely to present some degree of dependence (Raudenbush & Byrk, 2002). Regression analyses that fail to account for this potential cluster dependence will produce incorrect standard errors and threaten the validity of
parameter estimates (Raudenbush & Byrk, 2002). Hierarchical linear modeling (HLM) addresses this statistical dilemma by allowing the regression intercept to randomly vary across clusters; in doing so, variance in the dependent variable is partitioned between the individual and cluster levels of analysis (Raudenbush & Byrk, 2002).

**Extending the Analytic Strategy of Hattie and Marsh (2002)**

Within the scholarly record, the work of Hattie and Marsh (2002) was the only observed study that utilized HLM to examine the research-teaching relationship by statistically accounting for the nesting of academics within disciplines. Although Hattie and Marsh found no significant variation in the teaching-research relationship at the second or disciplinary level of analysis, my study extended their analytical strategy by addressing its limitations and making purposeful adaptations.

Hattie and Marsh’s (2002) sample was restricted to 182 faculty members from only 20 disciplinary departments within a single Australian research institution. Greater differentiation of academic disciplinary fields is a critical analytical consideration when exploring faculty preferences and behaviors. Disciplines present a muddled level of analysis given that their boundaries are prone to gaps and overlaps in their patterns of convergence and divergence (Becher & Trowler, 2001). Sub-disciplines or specialized areas provide a better analytical means for demarcating the intricate relationships within academic work (Becher & Trowler, 2001; Lattuca, Terenzini, Harper, & Yin, 2010; Smart, Feldman, & Ethington, 2000). The narrow or limited quality of Hattie and Marsh’s sample suggests that such disciplinary variation may not have been fully captured.
Additionally, a key element behind the significance of disciplinary affiliation in academic work has been its imperialistic dispersion across institutional and geographic boundaries (Becher & Trowler, 2001; Clark, 1987, 1989; Metzger, 1987; Baker & Zey-Ferrell, 1984; Becher, 1981). This assertion is even more prominent given the exponential growth of information and communication technologies. Hattie and Marsh’s (2002) restriction to a single university does not attend to this boundless quality of disciplinary affiliation; thus, disciplinary level findings may have been contaminated by institutional dynamics. Accordingly, I proffered that HLM might detect significant variation in the research-teaching relationship at the disciplinary level of analysis by aggregating individual faculty members across institutional boundaries based on greater delineation of academic disciplinary groupings.

**Delimiting the Disciplinary Impact on the Research-Teaching Relationship**

Given the institutional diversity within higher education, the question arises whether the influence of disciplinary culture on the interplay of academic work extends uniformly throughout the full institutional spectrum. A body of research suggests that disciplinary salience embodied through an emphasis on research activity, scholarly specialization, and graduate education is prevalent at research universities (Austin, 1990, 1996; Clark, 1980, 1989). Leslie (2002) tested Burton Clark’s assertion that disciplinary norms trump institutional culture through the lens of promotion criteria. Results indicated disciplinary consensus at institutions where teaching effectiveness was valued. Only at research universities was disciplinary variation concerning the value of teaching effectiveness present.
Scholarship (Milem, Berger, & Dey, 2000) targeting the tenets of the “academic ratchet” (Massy & Zemsky, 1994) has shown that they are most dramatic at research universities. In particular, the time faculty reported advising and counseling students declined severely. This finding posits implications for faculty utilization of student-centered pedagogy since both behaviors stress students as the focal point of undergraduate education. To this point, exploring the teaching and research emphases of a sizeable sample of institutions, Astin and Chang (1995) found that research universities were the only institutional sector that displayed a high research orientation accompanied by a low student orientation. The convergence of the above scholarly evidence suggests that the relationship between research engagement and faculty use of student-centered pedagogy is most germane at research universities where disciplinary cultures appear to act as differentiating forces in the performance of academic work.

The given study’s focus on the research-teaching relationship also necessitated a delimitation to full-time, tenured or tenure-track faculty members since they are responsible for both teaching and research. Finally, since I examined the utilization of student-centered pedagogy within undergraduate education, the given study was restricted to full-time, tenured or tenure-track faculty members that teach at least one undergraduate course.

**Research Purpose**

Faculty members are afforded significant professional autonomy in the execution of their teaching and research roles. Clark (1987, 1989) affirms disciplinary affiliation as the foremost normative force in academic work. This peer-driven normative influence carries
certain implications for faculty professional practice, especially at research universities where academic disciplines are most diverse and powerful. Research activity most vividly gives definition to disciplinary identity (Becher & Trowler, 2001). Accordingly, the teaching role might be an academic responsibility impacted by the nature of research engagement within a given disciplinary culture. The underlying assumption being that the extent of a discipline’s research orientation influences faculty time and motivational investments in teaching.

Given this potential relationship, it is proper to examine if variant disciplinary research values and behaviors impact good teaching practice. In sum, the purpose of the given study was to examine the disciplinary-level relationship between the research role context of academic work and faculty utilization of student-centered pedagogy at research universities. Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) and Holland’s six work environments (1973, 1997) served as disciplinary taxonomies for expounding disciplinary variation in faculty utilization of student-centered pedagogy and its relation with the research role context.

**Research Questions**

1. How much of the variance in faculty utilization of student-centered pedagogy at research universities lies within and between disciplines?

2. To what extent do research productivity, research time investment, and research motivation predict the utilization of student-centered pedagogy at research universities?
a. To what extent do full-time, tenured or tenure-track faculty members’ levels of research productivity, research time investment, and research motivation predict their utilization of student-centered pedagogy at research universities?

b. To what extent does a discipline’s level of research productivity, research time investment, and research motivation predict full-time, tenured or tenure-track faculty members’ utilization of student-centered pedagogy at research universities?

3. To what extent do disciplinary taxonomies predict the utilization of student-centered pedagogy at research universities?

a. To what extent does Holland’s (1973, 1997) career choice theory and its distinct model environments explain disciplinary level variance in faculty members’ utilization of student-centered pedagogy at research universities?

b. To what extent does Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) explain disciplinary level variance in faculty members’ utilization of student-centered pedagogy at research universities?

**Methodology**

Data was obtained from the 2007 Faculty Survey administered by the Higher Education Research Institute (HERI) at the University of California, Los Angeles. The annual faculty sample reflects institutions that choose to employ HERI’s research services. The HERI faculty survey targets faculty perceptions of institutional priorities, faculty time allocation, faculty goals and expectations for students, faculty pedagogical strategies, sources
of faculty stress and satisfaction, and faculty engagement in service to the local and global communities. Disciplinary culture links academics in similar fields across institutional boundaries (Austin, 1996; Becher, 1981; Becher & Trowler, 2001; Clark, 1987). The given dataset allowed for disciplinary aggregation of individual faculty respondents regardless of their institutional setting. Faculty with non tenure-track appointments are predominately responsible for either teaching or research, but not both. Accordingly, I restricted the data to full-time, tenured or tenure-track faculty.

My study utilized hierarchical linear modeling (HLM) to analyze how disciplinary and individual level variables predict faculty utilization of student-centered pedagogy. The natural condition of academia nests individual faculty members within disciplinary fields. Single level analysis, without statistical consideration to such data nesting, presents the potential for parameter misspecifications due to the lack of independence between observations at different levels of analysis (Raudenbush & Bryk, 2002). HLM allows intercepts to vary, thus permitting the simultaneous partition of variance between the individual and disciplinary levels (Raudenbush & Bryk, 2002). Unless it can be shown that academic disciplines offer no differential effects concerning the research role, it would be analytically imprudent to group individual faculty observations without regard to discipline.

**Significance of the Study**

The given study offers the potential to benefit practice, policy, and scholarship. Findings may inform the actions of administrators and professionals charged with enhancing instructional practice and undergraduate education. In particular, such prospective benefits
include a more nuanced vision of the disciplinary landscape and a greater delineation of disciplines that warrant training and support in developing their pedagogical skill set. From a policy frame, results present the potential to strategically advance a more balanced approach to good teaching and research through differential disciplinary policies and initiatives targeting such areas as resource allocation, faculty development, and tenure and promotion.

As it pertains to the existing scholarly record, the research-teaching relationship has not been given appropriate analytical attention from the disciplinary lens of academic work. In particular, hierarchical linear modeling (HLM) that accounts for the disciplinary level of academic work has been insufficiently employed. Hattie and Marsh (2002) utilized HLM to account for the disciplinary level, but their analysis included a limited number of disciplines at a single Australian university. My study aggregated faculty by disciplinary affiliation across institutional boundaries in order to tap a cosmopolitan disciplinary effect. Existing research (Becher & Trowler, 2001; Lattuca, Terenzini, Harper, & Yin, 2010; Smart, Feldman, & Ethington, 2000) has asserted that greater disciplinary differentiation provides the means for uncovering more nuanced understanding of the complex disciplinary patterns and relationships that inform the performance and interplay of academic work. The diversity of disciplinary affiliation options in the 2007 HERI Faculty Survey accommodated this analytical consideration.
CHAPTER TWO: REVIEW OF LITERATURE

The essence of my investigation reduces down to college faculty and their distinguishing charge as both educators and scholars. For those within and outside higher education, an unambiguous performance blueprint for these distinct duties is an elusive if not unfeasible pursuit. This nebulous work role condition is rooted in the tradition of academic freedom and autonomy. Academic freedom and autonomy enable faculty to principally direct the method and content of their teaching and research. Research proffers that faculty identify disciplinary affiliation as the most salient normative influence concerning their professional values and behaviors (Becher & Trowler, 2001; Clark, 1987, 1989; Smart, Feldman, & Ethington, 2000). This assertion suggests that faculty work is the assemblage of disciplinary-based professions rather than a single, universal academic culture (Clark, 1987). Accordingly, when exploring the performance of academic work, I believe it is critical to do so from a lens that accounts for disciplinary affiliation.

Applying an academic disciplinary lens, my study examined the research role’s impact on faculty teaching. This scholarly focus taps the notion that faculty members’ professionalism or expertise is grounded in their disciplinary identity as researchers not teachers. The existence of clear research role norms inform disciplinary identity by shaping disciplinary boundaries, the formation of sub-disciplines and specializations, patterns of communication and networking, career progression and prestige, and knowledge generation itself (Becher & Trowler, 2001). The faculty teaching role might be elucidated by the nature of research engagement within a given discipline.
Consequently, my study sought to uncover disciplinary variance in the research role’s impact on faculty teaching. Holland’s Theory of Careers (1973, 1997) and Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) were employed as disciplinary taxonomies for elucidating such variance. I delimited this disciplinary investigation of faculty work to research universities. Disciplinary cultures marked by a strong research role emphasis and a more divergent concern for teaching effectiveness are most salient at research universities (Austin, 1990, 1996; Clark, 1980, 1989; Leslie, 2002). Additionally, research suggests that these universities nurture a faculty work ethos that infiltrates the full postsecondary institutional spectrum (Massy & Zemsky, 1994; Milem, Berger, & Dey, 2000).

A key feature of the given study centers on how I operationalized both the faculty research and teaching roles. Since I targeted how the research role impacts good teaching practice, it was essential to utilize measures of both faculty roles that directly tap the normative influence of disciplinary membership. To this end, I integrated two models concerning the research-teaching relationship. Gavlick’s (1996) model affirmed that research activity, measured via publication productivity, impacts pedagogical behaviors which subsequently impact student success. Operationalizing research engagement via the traditional medium of productivity or output is limited because it fails to address the full behavioral and motivational context of the faculty research role. Marsh (1984, 1987) proposed a model that asserted the research-teaching relationship is a function of ability, time, and, motivation. These constructs enable a more complete conceptualization of the
research role context. Rather than the customary use of student ratings of instruction, efficacious teaching was measured via faculty utilization of student-centered pedagogy. The preceding research and teaching measures comprise value and behavioral manifestations of academic work that are subject to the normative influence of disciplinary membership.

The purpose of my study was to examine the disciplinary-level relationship between the research context of academic work and the utilization of student-centered pedagogy at research universities. To this purpose, hierarchical linear modeling (HLM) was employed to account for the nesting of faculty within their respective academic disciplines. The subsequent three research questions and respective sub-questions develop this purpose and reflect the hierarchical nature of said statistical analysis.

1. How much of the variance in faculty utilization of student-centered pedagogy at research universities lies within and between disciplines?

2. To what extent do research productivity, research time investment, and research motivation predict the utilization of student-centered pedagogy at research universities?

   a. To what extent do full-time, tenured or tenure-track faculty members’ levels of research productivity, research time investment, and research motivation predict their utilization of student-centered pedagogy at research universities?

   b. To what extent does a discipline’s level of research productivity, research time investment, and research motivation predict full-time, tenured or tenure-track
faculty members’ utilization of student-centered pedagogy at research universities?

3. To what extent do disciplinary taxonomies predict the utilization of student-centered pedagogy at research universities?
   
   a. To what extent does Holland’s (1973, 1997) career choice theory and its distinct model environments explain disciplinary level variance in faculty members’ utilization of student-centered pedagogy at research universities?
   
   b. To what extent does Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) explain disciplinary level variance in faculty members’ utilization of student-centered pedagogy at research universities?

Before undertaking any scholarly action, it is compulsory to understand how my research purpose and questions are couched in existing scholarship that targets faculty work. The ensuing review of this literature develops in a linear fashion along four main sections. The first two sections respectively isolate the faculty teaching and research roles. The teaching section is further divided into two sub-sections. The first sub-section explores faculty teaching values and preferences. The second sub-section addresses faculty teaching behaviors in terms of time investment and effective pedagogical practice. In the context of the given study, this second sub-section also focuses on the theoretical roots of student-centered pedagogy as a measure of efficacious teaching and explicates its presence in higher education research. The second section articulates faculty values and behaviors regarding the
research role of academic work and highlights the research role’s leading position in infiltrating the performance of faculty work throughout the full institutional spectrum.

The third section targets the relationship between faculty research and teaching and divides into two segments. The first segment synthesizes existing scholarship that examined the research-teaching relation. The second segment presents my adapted conceptual model for examining how the faculty research role predicts efficacious teaching measured via faculty utilization of student centered pedagogy. The fourth section identifies academic discipline as a meaningful normative lens for investigating faculty work. Two disciplinary taxonomies are introduced that possess the capacity to explain variance in faculty work values and behaviors. Finally, literature that employed these taxonomies to explore disciplinary differentiation in the faculty teaching and research roles is synthesized.

**Faculty Teaching Role**

A prioritization of academic work roles by the general public is likely to emphasize the prominence of teaching rooted in the belief that students and their learning experience must constitute the ultimate concern in the execution of faculty work. Existing scholarly exploration of faculty values and behaviors concerning the teaching role synthesized below reveals a more complex, less explicit reality. The significance of the included scholarship in illuminating this cloudy reality lies in the analysis of data from national faculty surveys that targeted the full postsecondary institutional spectrum. Faculty values or preferences regarding the teaching role reflect the motivations that direct teaching decisions and actions. These teaching motivations can be intrinsically or extrinsically driven. Faculty behaviors
concerning the performance of the teaching role present both a quantitative component in terms of time-invested and a qualitative component in terms of effective teaching practice.

**Faculty Teaching Values**

**Intrinsic teaching motivation.** Intrinsic teaching motivations reflect faculty values or preferences that arise from within to inform the teaching role. The obvious measure of intrinsic teaching motivation centers on the extent to which a faculty member primarily identifies with or has interest in the teaching role. Boyer (1990) utilized national faculty data from the Carnegie Foundation for the Advancement of Teaching to intellectualize a new scholarly prioritization in academic life. Seventy percent of all faculty respondents identified teaching as their primary work role interest. This statistic did not hold true across the full institutional spectrum; rather, a negative linear progression up the Carnegie classifications was observed. Ninety-three percent of community college faculty with a steady institutional decline to 33 percent of research university faculty described primary professional interest in teaching. Blackburn and Lawrence (1995) examined several national faculty surveys concerning the primacy of faculty interest in teaching and found the same approximate institutional trend. However, they also analyzed faculty interest in the teaching role longitudinally. Over a 20 year period spanning the end of the 20th century, the percentage of faculty identifying primarily with teaching declined across the institutional continuum with this rate of decline swelling in accordance with movement up the Carnegie classifications.

Other pertinent measures of intrinsic teaching motivation address faculty preferences for important externally defined teaching role contexts or conditions. One such measure
reflects the amount of time that faculty desire to commit to teaching role tasks. Federally sponsored national faculty survey data has indicated that faculty desire to spend nearly half of their professional time allocation on teaching (Finkelstein, Seal, & Schuster, 1998).

Analysis conducted by Blackburn and Lawrence (1995) on national survey data targeting the improvement of higher education instruction revealed differences across institution types. This institutional trend line supports the results discussed above concerning faculty primary interest in teaching. Faculty at community colleges preferred to spend approximately two-thirds of their time allocation on teaching; whereas, with movement up the Carnegie classifications, research university faculty desired roughly 30 percent of their time committed to teaching.

Analysis of preferred teaching role time allocation has also been conducted on generational lines within the professoriate using the 1993 National Study of Postsecondary Faculty (NSOPF-93) (Finkelstein, Seal, & Schuster, 1998). Full-time faculty members with 7 years or less of experience preferred to devote 5 percent less of their time to teaching when compared to their more senior colleagues (45.5% vs. 50.1%). With further disaggregation by institution type, a declining interest in teaching time allocations held true for both generational cohorts with movement along the Carnegie continuum from community colleges to research universities. Disaggregation of the generational cohorts by gender also provided more nuanced understanding. When compared to their male counterparts, female members of the new faculty cohort preferred to allocate a significantly larger percentage of their time
to teaching (51.2% vs. 41.5%). This gender-based preference pattern was also observed in
the senior faculty cohort but to a smaller degree (54.0% to 48.6%).

Faculty preferences concerning the role of teaching in determining externally
delineated faculty rewards and promotion similarly represent a noteworthy measure of
intrinsic teaching motivation. Boyer’s (1990) aforementioned reexamination of academic
work provided some description to this preference measure. Sixty-two percent of
respondents across the higher education sector agreed that teaching should constitute the
primary criterion for faculty promotion. This promotion criterion preference displayed wide
variation when disaggregated by Carnegie classification type. A near 20 percent difference
separated adjacent institution types bookended by research university and community college
faculty with 21 percent and 92 percent agreement respectively.

Inferential analysis utilizing NSOPF-93 faculty data revealed an identical pattern of
institutional type variation, and these institutional differences were statistically significant
(Leslie, 2002). Finkelstein, Seal, and Schuster’s (1998) examination of faculty teaching
preference using this same dataset found that approximately 77 percent of both new and
senior faculty agreed somewhat or strongly that teaching should represent a leading
promotion benchmark. Roughly the same institutional pattern previously discussed held firm
within each generational cohort after disaggregation by institution type. When broken down
by gender, both new and senior female faculty agreed to a more substantial level than their
male colleagues that teaching should be a salient promotion requirement.
Existing scholarship has also utilized regression models to predict intrinsic motivation concerning the teaching role. Employing national faculty data from the Carnegie Foundation for the Advancement of Teaching, Colbeck (1992) examined how the existence of extrinsic teaching rewards via the perceived importance of teaching to attaining tenure impacted faculty preference for the teaching role while controlling for the work and individual background contexts of academic work. Results indicated that faculty perceptions of the importance of teaching tasks for attaining tenure had significant positive effects on preference for the teaching role. The most dramatic effects on preference for the teaching role pertained to institutional affiliation - the greater the separation between faculty members’ affiliated Carnegie classifications the greater the odds they differed concerning their primary interest in teaching. For example, the odds that the “average” professor at a liberal arts institution preferred teaching more than the “average” professor at a research university were approximately 30 percent. Similar research focusing exclusively on faculty at liberal arts institutions found satisfaction with extrinsically defined teaching rewards and contextual conditions to be a significant positive predictor of faculty preference for teaching (Eimers, 1997).

Integrating the above research presents clear evidence of an institutional type pattern based on Carnegie classification. Movement up the Carnegie classification continuum coincides with a sharp decline in faculty intrinsic teaching role motivation. Faculty at research universities displayed a decidedly low preference for teaching in terms of time invested, rewards and promotion, and the role in general. The opposite was true for faculty
at community colleges. Research also suggested this faculty intrinsic teaching motivation pattern based on Carnegie classification matched the entrenched organizational work role emphasis at said institution types. These findings suggest the presence of self-selection and socialization effects. In particular, individual faculty members may choose institution types that echo the extent of their internal interest in the teaching role, and in turn, these institution types may possess socializing forces that reinforce such an intrinsic level of teaching interest.

**Extrinsic teaching motivation.** Extrinsic teaching motivation derives from rewards or contextual factors that reflect the environment surrounding the teaching work role (Colbeck, 1992). From a theoretical standpoint, the central question concerns whether extrinsic teaching motivation exerts a positive, negative, or neutral effect on teaching. Different schools of thought exist. Expectancy theories of motivation proffer a positive relationship between extrinsic work motivation and intrinsic work interest (Colbeck, 1992). Applied to the teaching role, if faculty perceive that extrinsic rewards for teaching are enhanced, their teaching interest will also be enhanced. A more absolute interpretation of this perspective suggests that intrinsic interest in teaching may not exist in the absence of external teaching rewards or recognition (Eimers, 1997). Other motivational theories project a negative relationship between extrinsic teaching motivation and internal teaching interest (Colbeck, 1992).

Deci and Ryan (1982) advanced a theory with a more delicate valuation. Applied to the teaching role, their cognitive evaluation theory contends that extrinsic teaching rewards decrease teaching interest when faculty believe these rewards are intended to restrict their
behavior and autonomy; whereas, when they feel extrinsic teaching rewards strengthen their competence and autonomy, teaching interest is enhanced. In this same vein, research presented earlier (Boyer, 1990; Colbeck; 1992; Eimers, 1997; Leslie, 2002) tenders that extrinsic teaching motivation and intrinsic teaching interest present a gradated relationship moderated by Carnegie institution type and the dynamics of selection and socialization.

Faculty members are increasingly loyal to their own careers; yet, career progression and prestige give little credence to teaching and classroom excellence (Boyer, 1990). Accordingly, it is reasonable to examine if external sources of teaching motivation such as tenure, promotion, rewards, and colleague teaching commitment reflect this assertion. Analysis of national faculty data from NSOPF-93 has provided some illumination (Finkelstein, Seal, & Schuster, 1998; Leslie, 2002). When considering all faculty in higher education, an even split existed between those who agree and disagree that teaching is rewarded less than research.

When broke down by institution type, a steep decline in the belief that teaching is incentivized less than research was observed on the institutional continuum between research universities and community colleges. Approximately 90 percent of research university academics believed teaching was rewarded less. This perception dipped to less than 10 percent of community college faculty. Only at research and doctoral universities did faculty perceive that teaching was given less external reinforcement than research. Moreover, analysis of variance tests resulted in significant differences among all of the main Carnegie institution types (research universities, doctorate-granting institutions, comprehensive
institutions, liberal arts institutions, and community colleges) in the expected direction.

Dissonance between the belief that teaching is extrinsically rewarded less than research and the belief that teaching should be the primary promotion criterion was observed solely at doctoral universities. Evidence concerning colleague commitment to teaching as a source of extrinsic teaching motivation has also displayed a similar trend by institution type - community college faculty perceived the highest level of colleague teaching commitment and research university faculty detected the least (Blackburn & Lawrence, 1995).

National faculty survey data collected by the Carnegie Foundation for the Advancement of Teaching has provided some contradiction to the above findings about teaching not being rewarded less than research (Boyer, 1990). In particular, faculty did not attribute extensive salience to teaching related measures in the departmental tenure-granting structure. Across the institutional spectrum, faculty did not feel that academic advisement, syllabi quality, or teaching observations were allotted meaningful importance in the tenure process. The highest percentage of faculty perceiving strong tenure importance in academic advising and syllabi quality was 15 percent at liberal arts institutions and 18 percent at community colleges respectively. The span of faculty from four-year institutions that believed tenure attainment was strongly attached to teaching observations ranged from 4 percent at research universities to 29 percent at liberal arts institutions. Of the queried teaching measures, student course evaluations garnered the strongest faculty perceptions of tenure importance across all of the Carnegie institution types; however, this ranged from a mere 10 percent at research universities to 45 percent at liberal arts institutions. Fairweather
(1993) has also argued that the entire higher education sector is de-emphasizing the importance of teaching in faculty reward structures, even to the extent of being a negative predictor of rewards.

**Faculty Teaching Behaviors**

**Time invested in teaching.** How faculty allocate their time among the distinct roles of academic life is a worthy query. Stakeholders external to higher education including the general public and public officials unmistakably demand that faculty time investments mirror the primacy of teaching. Not surprisingly, viewpoints within higher education are a bit more nuanced and multifaceted. Understanding faculty teaching behavior necessitates quantifying faculty time allocations to this role.

To this end, existing scholarship (Blackburn & Lawrence, 1995; Finkelstein, Seal, & Schuster, 1998) has utilized self-reports of teaching time allocations from faculty across the full higher education sector. Faculty throughout the higher education spectrum collectively reported spending 53.8 percent or a majority of their time on the teaching role. When disaggregated by experience, senior faculty reported spending nearly 4 percent more time on teaching than new faculty. Differences in time allocated to teaching existed when examined across institution types. A predictable linear trend between the main institution types appeared with community college faculty allocating twice as much time to teaching as compared to their research university counterparts (70 percent vs. 35 percent).

Disaggregation by experience and institution type preserved both of their respective teaching
time allocation patterns; although, the time investment gap between senior and new faculty members was more pronounced at research universities.

Gender presented the most significant demographic difference concerning teaching time allocation (Blackburn & Lawrence, 1995; Finkelstein, Seal, & Schuster, 1998). Female faculty spent approximately 10-12 percent more time on teaching than their male peers. This gender gap held true after further disaggregation by experience. However, when subset to tenured or tenure-track faculty at research universities, the gender difference in teaching time investment nearly vanished. Further understanding of faculty teaching behavior can be ascertained by comparing actual and preferred faculty time investments in teaching. A single pattern emerged from this comparison that held firm across experience, institution type, and gender - faculty preferred to spend somewhat less of their time on the teaching role.

An examination of if and how faculty time investments in teaching have changed over time provides yet another means for elucidating greater understanding of faculty teaching behavior. One of the most prominent studies examining faculty time allocation coined the slogan the “academic ratchet” (Massy & Zemsky, 1994). This phrase described the existence of a longitudinal trend in which academia continually seeks to increase the amount of faculty discretionary time available for research activity by championing policies that reduce faculty teaching role responsibilities. This work also found that the “academic ratchet” produced sharp declines in the time faculty invested as academic advisors and mentors. Such non-traditional teaching roles are consistent with the given study’s student-centered approach to measuring efficacious teaching.
Milem, Berger, and Dey (2000) explored the extent of the “academic ratchet” using national faculty data from 1972 and 1992. Mixed results with regards to the “academic ratchet” were found. Faculty across the higher education displayed significant increases in the amount of time devoted to the traditional teaching role; furthermore, faculty at two-year, liberal arts, comprehensive, and doctoral institutions also presented statistically significant increases in this measure. The greatest proportional increase occurred at liberal arts colleges. Research university faculty presented a statistically nonsignificant decrease in time spent on the traditional teaching role. Time spent on the student-centric teaching role via advising and mentoring decreased across all institutions types over the twenty year span; however, only at research, doctoral, and liberal arts institutions did this decrease rise to statistical significance. Faculty at research universities presented the largest proportional decrease. These findings suggested that the “academic ratchet” has indeed negatively impacted the quality of the undergraduate educational experience, not in the traditional sense, but rather from a faculty-student engagement standpoint.

Scholarly inquiry has also employed regression analysis to seek understanding of what predicts or explains faculty time investment in the teaching role (Blackburn & Lawrence, 1995; Milem, Berger, & Dey, 2000). In their work discussed above, Milem, Berger, and Dey (2000) regressed both of their traditional and non-traditional teaching time allocation constructs. The traditional teaching time allocation measure produced statistically significant findings with respect to institution type. Faculty from research, doctoral, and comprehensive universities were significantly less likely than their peers at liberal arts and
two-year institutions to allocate more time to traditional teaching duties. Sixty-four percent of the variance in time spent on traditional teaching duties was explained by the research university dummy variable. The regression model for time spent on non-traditional teaching duties did not result in any significant predictors. Consistently low faculty time allocations offered little variance to be accounted for. Other research has found that faculty interest in teaching or the perception of an institutional preference for greater teaching time investments can predict larger faculty time allocations in the teaching role (Blackburn & Lawrence, 1995). However, these predictors did not maintain significance at research universities.

**Teaching effectiveness – student ratings.** Lecturing constitutes the overwhelming primary teaching method in higher education regardless of faculty experience, gender, and institution type (Finkelstein, Seal, & Schuster, 1998). Despite this dominance, exploration of NSOPF-93 data has displayed some lecture usage distinctions by gender and institution type (Finkelstein, Seal, & Schuster, 1998). More male than female faculty employed lecturing as their primary teaching method by nearly 10 percent. Faculty in liberal arts institutions claimed lecturing as their main pedagogy at a significantly smaller predominance (approximately 63 percent) than the other institution types. National faculty data has also shown that roughly four-fifths of faculty self-reported as good lecturers, and this proportion held consistent across institution type (Blackburn & Lawrence, 1995).

The teacher is the focal point of the lecturing teaching method. The teacher, as the content expert, is charged with delivering knowledge. Students are predominately the passive receivers of the teacher’s expert knowledge. As such, the classroom lecture
experience is defined in terms of the teacher’s actions or behaviors. From a scholarly frame, an instructor’s lecture actions or behaviors are commonly classified as low-inference or high-inference (Murray, 1997). Low-inference teaching behaviors are concrete and easily observed instructor actions that can be recorded with little inference or error by an observer. Examples include “lesson objectives are stated and developed” and “teacher addresses students by name.” High-inference instructional behaviors are those that necessitate a considerable degree of observer inference or judgment. Examples include “clarity” and “enthusiasm.” Both classifications center on the behavioral mechanics of the lecturer not on if the lecturer’s behavior impacts the occurrence or quality of student learning. Given the teacher-centric nature of lecturing, meaningful learning can occur in the presence or absence of the traditional low- or high- inference teaching behaviors.

Student ratings constitute the most common medium for quantifying and evaluating low- and high- inference instructor behaviors. Student ratings serve three core purposes: formative faculty feedback, matters of collegial or administrative decision-making (tenure decisions), and an outcome or process measure for research on teaching (Marsh & Dunkin, 1997). Student ratings of the lecture-based classroom predominately reflect a process definition of effective teaching. The process definition of effective teaching stresses the instructor’s actions rather than focusing on any subsequent learning consequences (Abrami, Apollonia, & Rosenfield, 1997). Given the pervasiveness and teacher-centered ethos of the lecture-based classroom, student ratings instruments are overwhelmingly designed around instructional behaviors that emphasize the process of delivering knowledge.
One of the main corollaries of the process definition of effective teaching is its multidimensional nature. This notion proffers that there are many different instructional behaviors that encompass teaching effectiveness. Several well-known studies (Abrami, d’Apollonia, & Rosenfield, 1997; Feldman, 1976, 1983, 1984, 1987, 1989; Marsh, 1984, 1991) have sought to empirically derive such a multidimensional framework utilizing student ratings of classroom instruction (as cited in McKeachie, 1997). The associated methodology typically involved conducting a comprehensive review of literature or directed queries to identify germane teaching behaviors followed by factor analysis of student ratings data that incorporated said teaching behaviors.

Abrami, d’Apollonia, and Rosenfield’s (1997) and Marsh’s (1984, 1991) respective multidimensional frameworks were composed of low-inference items loading on a factor structure; Feldman’s (1976, 1983, 1984, 1987, & 1989) framework developed into twenty-eight separate dimension that tend to vary on a continuum of low- to high-inference (as cited in McKeachie, 1997). A vein of thematic congruence runs through the factors or dimensions that comprise these frameworks. Enthusiasm, organization, and attracting student interest reflect some of this thematic congruity. Moreover, logical context analysis has established substantial overlap between Feldman’s distinct dimensions and Marsh’s nine factor structure (Marsh & Dunkin, 1997).

Given that the process definition of teaching effectiveness asserts its multidimensionality, it is reasonable to expect that student ratings of narrowly-defined teaching behaviors should present a differential pattern of importance. A few well-known
meta-analyses (Cohen, 1987; Feldman, 1989) tackled this expectation by examining how studies incorporating multi-dimensional student ratings of teaching behavior correlate with student learning via achievement; results indicated that some specific behavioral dimensions with a lower need for inference were more highly correlated with achievement than overall student ratings of instruction that require a higher degree of inference (as cited in Marsh & Dunkin, 1997). Furthermore, higher correlations between student ratings and achievement emerged when specific behavioral dimension were measured via multi-item scales as opposed to single items. These findings cumulatively advanced the importance of student ratings instruments that account for the multidimensional nature of effective teaching behavior via multi-item scales.

Student ratings of faculty teaching are also marked by significant critiques and ascribed weaknesses. Concerns over biased student ratings represent a main source of criticism. Numerous forms of possible bias can be found in the literature. One potential basis for biased student ratings centers on the context of the classroom experience. Research has demonstrated that somewhat higher ratings have been associated with faculty members based on certain course contextual factors: smaller rather than larger courses, upper-level rather than lower-level courses, elective rather than required courses, and major rather than non-major courses (Feldman, 1997). The most discussed and compelling form of potential bias concerns students linking an instructor’s ratings to their respective course grades. To which, scholarly evidence has suggested a moderate positive relationship (Feldman, 1997). One interpretation of such ratings bias has been classified as attributional when students take
credit for their successes but sidestep responsibility for poor performance; a second interpretation has been coined retributional bias when students reward teachers for good grades and punish them for poor ones (Marsh, 1987; Marsh & Dunkin, 1997).

The content validity of student instructional ratings also represents a prominent concern. Content validity necessitates that student ratings instruments are equally applicable across the full range of instructional contexts and pedagogical methods (Abrami, d’Apollonia, & Rosenfield, 1997). As discussed earlier, the lecture format represents the most common instructional format or pedagogical philosophy within higher education. Not surprisingly, the vast majority of student instructional ratings forms and their accompanying behavioral dimensions were designed from and for the lecture format (Abrami, d’Apollonia, & Rosenfield, 1997). The archetypal behavioral dimensions addressed in these student ratings instruments are couched in the teacher-centered nature of lecturing and reflect a passive view of students in the learning equation. For example, such teacher-centric instructional dimensions target overarching areas including teacher preparation, teacher clarity, teacher subject knowledge, and teacher elocutionary skills. Efficacious pedagogies that emphasize student learning mandate the centrality and active engagement of students in the learning experience. Accordingly, insufficient pedagogical content validity in student ratings instruments obstructs a conceptualization of teaching effectiveness that underscores a student-centered approach to learning.

The limited pedagogical content validity of student instructional ratings also threatens the quality of student learning. The lecture format’s faculty resource efficiency ethos places
a premium on the transfer of knowledge from expert faculty members to students as passive receivers. What follows is a classroom educational experience designed around lower-level learning objectives including declarative/descriptive knowledge and basic comprehension (Feldman, 1997). This pedagogical design runs counter to higher education’s widely espoused focus on fostering higher-level learning competencies such as critical thinking, problem solving, and knowledge synthesis. Given their development from and for the traditional lecture format, student instructional ratings serve to potentially reinforce a definition of teaching effectiveness centered narrowly on pedagogical behaviors that advance lower-level student learning outcomes (Boyer, 1990; Feldman, 1997).

**Teaching effectiveness – student-centered pedagogy.** Boyer’s (1990) seminal reconsideration of faculty work recognized teaching as a form of scholarship. His scholarship of teaching affirmed that higher-order learning outcomes such as application, evaluation, synthesis, and integration cannot be nurtured through mere teacher-driven instruction but through student-directed transformation and extension of knowledge. Student-centered pedagogy provides a medium for this transformation and extension because it demands direct and active student engagement with course content; students are the fundamental elements of both the learning process and the learning outcomes (Barr & Tagg, 1995).

Student-centered pedagogy represents a fundamental pedagogical shift away from the expert instructor as the supplier of disciplinary content to the student as the critical player in the production of learning (Barr & Tagg, 1995; O’Neill & McMahon, 2005). The traditional,
status quo teaching philosophy of higher education embraces its existence as the provider of
instruction. The delivery of knowledge to students via faculty expertise constitutes both the
means and the ends of undergraduate education. Rather, the alternative posits that higher
education must center its classroom content delivery on the production of learning. A
student-centered learning paradigm demands a power-shifting pedagogical approach where
professors design classroom environments and activities around the students.

Lea, Stephenson, and Troy (2003) synthesized the literature on student-centered
learning and identified its essential tenants: reliance on active rather than passive learning,
an emphasis on deep learning and understanding, increased student responsibility, increased
student autonomy, interdependence between teacher and learner, and a reflexive approach to
the teaching and learning process on the part of both the teacher and learner. Similarly,
O’Neill and McMahon (2005) laid out three criteria for employing student-centered
classroom pedagogy: active and collaborative student engagement, student autonomy in the
process, and student power in the process.

Weimer (2013) contends that student-centered pedagogy continues to be outpaced by
the traditional lecture format. To this assertion, Weimer (2013) explicates five pedagogical
changes that are essential to the realization of a student-centered learning paradigm in
undergraduate education. First, the teacher’s role is to employ pedagogy that focuses on
active not passive student engagement in the learning process. Second, the teacher is not the
sole arbitrator of instruction and learning; rather, it is the teacher’s duty to responsibly
involve students in the decision-making process and balance of power. Third, course content
should advance not only a strong student knowledge base but also the skills that promote students as independent and self-aware learners. Fourth, faculty should nurture learning environments that encourage student responsibility and enthusiasm for learning. Lastly, evaluation activities should be designed as pedagogical tools for developing students’ self- and peer assessment skills.

Increasing student engagement and autonomy within the learning process promotes higher-order learning competencies (Lea, Stephenson, & Troy, 2003; O’Neill & McMahon, 2005; Weimer, 2013). Such an effectual relationship can be classified as a process-product definition of effective teaching. This process-product view refers to the pedagogical activities which take place during teaching and yield meaningful student learning (Abrami, d’Apollonia, & Rosenfield, 1997). Where student ratings lack a true theoretical foundation, student-centered pedagogy as a process-product metric of effective teaching is couched in established theories of student development and success.

**Theoretical foundation.** Measures of teaching effectiveness present more credibility and validity when they are grounded in theory. Prominent theories of college student development and success (Astin, 1984; Chickering, 1969; Kolb, 1984) proffer that educational environments that engage students directly and actively in the learning process cultivate deep or higher order learning. Student-centered pedagogy embodies and prioritizes this theoretical orientation to student engagement and learning within the classroom environment.
Chickering (1969) argued that student identity develops along seven vectors of psychosocial development, and educational environments apply prevailing influence on the identity maturation process. Chickering and Gamson’s (1987) seven principles for good practice delineated the theory’s vision for how educational environments should engage students in the learning process. These principles include student-faculty contact, student engagement and cooperation, active learning, prompt feedback, time on task, high expectations, and respecting diverse ways of learning. Together, said educational interventions foster psychosocial identity maturation along Chickering’s vectors because they embrace the centrality of students in the development process. The themes of engagement, interaction, cooperation, expectations, responsibility, and diversity that permeate these precepts exemplify a student-centered philosophy of teaching and learning.

Astin’s theory of involvement (1984) holds that students optimize learning when they are involved in their academic experiences; furthermore, the quality and quantity of student involvement impacts quality and quantity of learning. Within the classroom, the theory focuses not on learning outcomes but on the processes or mechanisms that bring about the desired outcomes. Pedagogical practice should not be centered on the teacher and his content expertise; rather, it should be structured around active student participation within the learning process. Astin holds that his theory offers an improvement over traditional pedagogies because it stresses student behavior.

Kolb’s theory (1984) of experiential learning proffers that learning is a “process whereby knowledge is created through the transformation of student experience” (p. 38).
This notion of knowledge transformation corresponds with the process that Boyer underscored as facilitating higher-level learning in his scholarship of teaching. Learning constitutes a four stage cycle composed of concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). Given the sequential nature of these stages, without direct and active student engagement in the classroom environment at the concrete experience stage, learning cannot optimally progress through the remaining stages. Student-centered pedagogy functions as an engine for driving this four stage cycle of learning. All three of the above outlined theories are consistent with the core tenets of the student-centered learning paradigm.

Evidence from the scholarly record. Recent scholarship (Pascarella & Terenzini, 2005; Umbach & Wawrynski, 2005) provides evidence that supports the importance of student-centered pedagogy in undergraduate education. Pascarella and Terenzini’s (2005) all-encompassing empirical review of the college impact on students found that student-centered pedagogy that engages students actively, promotes interaction, and encourages collaboration enhances learning outcomes and thereby constitutes good teaching practice. These student-centered pedagogical practices have also been shown to differentiate educationally effective institutions on measures of student learning and engagement (Pascarella & Terenzini, 2005).

Umbach and Wawrynski (2005) merged two national datasets to examine if an institution’s student-centered pedagogical climate as reported by faculty predicted student claims of similar student-centered engagement and self-reported growth. The student-
centered pedagogy predictors averaged at the institutional level included faculty course-related interactions with students, active and collaborative learning techniques, faculty emphasis on higher-order activities, faculty reports of academic challenge, and faculty emphasis on enriching educational activities. The dependent variables for student claims of student-center engagement included academic challenge, student-faculty interactions, and active and collaborative learning techniques; the dependent variables for student self-reported growth reflected personal, general education, and practical competency gains respectively.

Hierarchical linear modeling was employed to account for the student-centered pedagogy predictors being averaged at the institutional or second level (Umbach & Wawrynski, 2005). Each pedagogy predictor with pertinent control variables at both levels of analysis was run separately on each respective student reported measure of engagement and growth. Even after including all controls; average institutional faculty reports of course-related student interactions, active and collaborative learning techniques, and emphasis on enriching educational activities were significantly positively related to all student reports of student-centered engagement and growth. Not surprisingly, institutional faculty reports of academic challenge and emphasis on higher-order activities presented a similar trend – they were significantly positively related to student reports of engagement via academic challenge and active and collaborative learning and only to student self-reported gains with respect to general education. These findings do suggest that students experience meaningful engagement and growth when faculty commit to a pedagogical philosophy based on the principles of student-centered learning.
Existing empirical evidence (Umbach, 2006, 2007; Umbach & Wawrynski, 2005) based on data collected from 137 colleges and universities elucidated demographic and contextual factors that predict the faculty utilization of student-centered pedagogy at both the individual and institutional levels of analysis. Women and faculty of color were all more likely to employ student-centered learning techniques than their male and Caucasian counterparts. Professors of all ranks were more prone to using such student-centered pedagogy than full professors, whereas, part-time faculty utilized them less often than tenured and tenure-track faculty colleagues. Age presented a negative relationship with the use of student-centered instructional techniques. At the institutional level, after including germane controls, liberal arts colleges tended to hold a slight advantage on the remaining Carnegie classification institutions in advancing a student-centered pedagogical climate. Selective institutions displayed a negative relationship with student-centered pedagogy marked by student collaboration and higher-order activities.

**Faculty Research Role**

Just as the faculty teaching role can be examined from the prism of faculty preferences and behaviors, the research role warrants similar analysis. Some argue that contemporary forces within higher education have moved the emphasis away from student to the professoriate as they purse research endeavors for professional prestige, tenure and promotion, and external funding (Boyer, 1990; Leslie, 2002). An examination of the scholarly record as it pertains to faculty preferences and behaviors regarding their research
pursuits offers the potential for a more nuanced understanding of how academics view and execute the research role.

To this objective, like the previous section, most of the literature reviewed will key on prominent works that utilized national faculty survey datasets. As with the teaching role, faculty values or preferences concerning the research role impact the motivations that direct the nature and degree of research activity, and these motivations can be fueled internally or externally. Faculty behaviors regarding research activity can also illuminate greater understanding based on time-invested and productivity levels.

**Faculty Research Values**

**Intrinsic research motivation.** Intrinsic research motivation encompasses faculty values or preferences that originate internally to direct the nature and extent of faculty research activity. Stated professional preference for the research role constitutes a direct measure of such intrinsic motivation. National faculty data from the Carnegie Foundation for the Advancement of Teaching addressed this research motivation measure (Boyer, 1990). Thirty percent of all faculty respondents claimed their interests lie primarily with research. This statistic did not hold constant across the institutional span of higher education. Where primary interest in teaching declined with progression up the Carnegie classification types, the opposite relationship was observed for primary faculty interest in the research role. While only 7 percent of two-year college faculty described research as their primary role interest, research university faculty asserted their chief concern for research activity by a two-thirds majority.
Blackburn and Lawrence’s (1995) examination of several national faculty survey results delineated the same approximate institutional trend. However, there were some noteworthy differences. Both research and doctorate-granting university faculty displayed slightly higher rates of primary interest in research with roughly 75 and 50 percent support respectively. Additionally, when both liberal arts and comprehensive institutions were divided into their two sub-categorizations, a significant 12 percent variance emerged. The given scholar’s also examined how faculty primary interest in research changed over a 20 year period spanning the end of the 20th century. Opposite their findings concerning faculty primary interest in teaching, the percentage of faculty identifying primarily with the research role increased across the institutional gamut with this rate of increase tending to grow with movement up the Carnegie classification types.

Intrinsic motivation for research activity can be manifested in other relevant measures related to the context or performance of the research role. Faculty research role time-investment preferences reflect one of these measures. NSOPF-93 survey data has shown that higher education faculty collectively desire to devote a little over a quarter of their time to research (Finkelstein, Seal, & Schuster, 1998). Analysis conducted on national survey data from the National Center for Research to Improve Postsecondary Teaching and Learning (NCRPTAL) revealed differences along the institutional spectrum. A near linear decline was observed from research university faculty desiring to devote 42 percent of their time to research to two-year faculty preferring only 4 percent (Blackburn & Lawrence, 1995). This institutional trend line parallels the one discussed above concerning primary interest in
research and indicates a degree of co-variance between both measures. In line with the tenets of academic freedom and autonomy, this potential covariance further suggests that faculty allot their professional time in proportion to their own role interests (Blackburn & Lawrence, 1995).

Analysis of preferred research role time allocation has also been analyzed along faculty generational lines utilizing NSOPF-93 data (Finkelstein, Seal, & Schuster, 1998). Full-time faculty members with 7 years or less of experience preferred to allocate approximately 5 percent more of their time to research when compared to their more senior colleagues (29.5% vs. 25.1%). With additional disaggregation by institutional type, a preference for ever-increasing research time allocations held true for both generational cohorts with movement along the Carnegie continuum from community colleges to research universities; although, the rate of increase was slightly greater for the new faculty cohort. Disaggregation of the generational cohorts by gender also presented more refined understanding. When compared to their male counterparts, female members of the new faculty cohort preferred to allocate a significantly smaller percentage of their time to research (34.1% vs. 22.9%). This gender-based preference pattern held true for the senior faculty cohort but to a smaller extent (27.0% to 20.3%). The authors proffered that the under-representative population of female faculty at research-orientated institutions may be driving this gender gap.

Faculty preferences concerning the role of teaching in delineating externally defined criteria for rewards and promotion also represent an important measure of intrinsic teaching
motivation. Boyer’s (1990) reconsideration of faculty work and its priorities provided some definition to this measure. Thirty-one percent of respondents across the higher education sector asserted that research should constitute the primary faculty rewards and promotion criterion. This promotion criterion preference displayed wide disparity when disaggregated by Carnegie classification type. In line with the preceding intrinsic research motivation measures, a steep linear decline concerning research as the primary rewards and promotion criterion was observed from research university faculty who favored it by a 70 percent margin to two-year faculty with a meager 4 percent preference (Blackburn & Lawrence, 1995). Using NSOPF-93 data, Leslie’s (2002) noted work not only found a similar pattern of institution type variance, but it also identified these institutional differences as statistically significant. Research university faculty were the only institution type, on average, to prefer research as the primary criterion for rewards and promotion.

Inferential analysis utilizing NSOPF-93 data revealed an identical pattern of institutional type variation, and these institutional differences were statistically significant (Leslie, 2002). Finkelstein, Seal, and Schuster’s (1998) analysis of NSOPF-93 data indicated that roughly a third of both new and senior faculty agreed somewhat or strongly that research should represent the leading rewards and promotion criterion. The same approximate institutional pattern discussed above was preserved within each generational cohort after disaggregation by Carnegie institution type. When broken down by gender, a majority of both new and senior male faculty agreed at a significantly greater level than their female colleagues that research should constitute the foremost rewards and promotion criterion.
Existing literature has utilized national faculty data to run regression models predicting intrinsic motivation for the research role. Colbeck (1992) examined how extrinsic research motivation via the perceived importance of research activity to attaining tenure impacted faculty preference for the research role. Results indicated that faculty perceptions of the importance of research activity for attaining tenure had significant positive effects on intrinsic preference for the research role. The most vivid effects on intrinsic preference for the research role arose from institutional affiliation - the greater the separation between faculty members’ affiliated Carnegie classifications the greater the odds they differed concerning their primary interest in research. This finding buttresses the Carnegie institution type trends concerning the intrinsic research motivation measures discussed above.

Analogous to intrinsic faculty teaching motivation, the preceding review of literature suggests that academics may choose institution types that reinforce the extent of their internal interest in research activity, and simultaneously, these institution types may enact socializing forces that underscore a particular level of intrinsic faculty research motivation.

**Extrinsic research motivation.** Extrinsic research motivation derives from rewards and structural conditions that inform the faculty research role (Colbeck, 1992). The common viewpoint external and internal to higher education proffers that the research role measured narrowly through research productivity dominates the faculty rewards structure (Boyer, 1990; Fairweather, 1993). Clark (1987) suggested that such a research-centric extrinsic motivation structure is necessary to ensure the dynamic nature of American higher education. Colbeck’s (1992) analysis above suggested that extrinsic research motivation via its
importance in tenure attainment has a positive impact on faculty desire to engage in research activity and this relationship is moderated by Carnegie institution type.

The existence of a research-centric extrinsic motivation structure is certainly positioned to impact the performance of academic work. Academics make decisions and take action based on the structural priorities that they detect will progress their careers. Therefore, understanding extrinsic faculty research motivation requires an examination of how faculty perceive its emphasis. NSOPF-93 provided a data source that some prominent studies (Finkelstein, Seal, & Schuster, 1998; Leslie, 2002) analyzed for this purpose. Half of all academics within higher education agreed somewhat or strongly that research is the most extrinsically rewarded faculty role. This proportion also held consistent when comparing new and senior faculty. Disaggregation by gender presented a “gender gap” where approximately 10 percent more of men than women perceived research as the primary faculty rewards criterion.

When broke down by Carnegie type, the perception that research represents the primary extrinsic rewards criterion grew sharply with movement along the institutional range from community colleges to research universities; furthermore, analysis of variance tests indicated significant differences among all the institution types. Only at research universities and doctoral-granting institutions did a majority of faculty agree somewhat or strongly with this perception, and these rates were quite large at 90 percent and 70 percent. Agreement concerning the primacy of research in the rewards structure dropped off to 15 percent and 9 percent of liberal arts and community college faculty, respectively. When subset to tenured
and tenure-track faculty at research and doctoral-granting universities, the “gender gap” identified above dissolved. The only discord between the perceived and preferred position of the research role in defining the extrinsic rewards structure occurred at doctoral-granting institutions. Faculty at these institutions did not prefer research as the primary rewards criterion, but they perceived its supremacy in the rewards structure.

Faculty tenure and promotion criteria constitute a major source of motivation within the faculty extrinsic rewards structure. National faculty survey data collected by the Carnegie Foundation for the Advancement of Teaching tended to support the NSOPF-93 institutional trend with respect the primacy of research in attaining tenure (Boyer, 1990). The rates at which faculty perceived specific research activity measures as being critical in tenure attainment approximated the same growth, as outlined above, with movement up the Carnegie classifications. These measures included number of publications, research grants received, and reputation of publication venues. Boyer (1990) also uncovered a longitudinal trend that suggests the primacy of research activity in attaining tenure and promotion is steadily mounting across the institutional spectrum. In 1969, a fifth of all higher education faculty felt it was difficult for an academic to receive tenure without publishing. By 1989, this proportion doubled. At research universities, the rate nearly doubled from 44 percent to 83 percent. At comprehensive institutions, the rate increased sevenfold, and it quadrupled at liberal arts institutions. Only community colleges displayed no significant change over time.
Faculty Research Behaviors

**Time invested in research.** How faculty allocate their time reflects a critical behavioral consideration when exploring the performance of academic work. Understanding faculty research behavior necessitates quantifying faculty time allocations to this role. The general public and public officials often charge that faculty devote too much of their time to research activities. In addition to the faculty rewards structure within higher education, external forces including private industries and foundations, federal research organizations, and disciplinary organizations also incentivize greater time allocations to research (Milem, Berger, & Dey, 2000). Appearances are not always reality; accordingly, it imperative to examine faculty time investment from academics themselves in order to elucidate an accurate and nuanced understanding of faculty research behavior.

Prominent studies of faculty work (Blackburn & Lawrence, 1995; Finkelstein, Seal, & Schuster, 1998) have analyzed faculty self-reports of research time allocations from across the higher education sector. Faculty throughout the higher education spectrum collectively reported spending roughly a fifth of their time on the research role. When disaggregated by experience, new faculty reported spending nearly 4 percent more time on research than their more senior colleagues. Significant differences in faculty research time allotments emerged after disaggregation by institution type. An institutional trend line surfaced that was consistent with those for both intrinsic and extrinsic faculty research motivation. Research university faculty reported allocating 41 percent of their time to research; whereas, after steady decline by institution type, community college faculty reported devoting only
5 percent of their time to research. Of particular note, faculty from no institution type reported spending a majority of their time on research. Disaggregation by institution type and experience produced a deviation from the experience trend. The time investment gap between senior and new faculty members was a bit more pronounced at research and doctorate-granting institutions, but the entire “experience gap” disappeared at the remaining institution types.

Gender also presented a significant demographic difference in research time allocation (Blackburn & Lawrence, 1995; Finkelstein, Seal, & Schuster, 1998). Male faculty, on average, spent approximately 10 percent more time on research than their female colleagues. This “gender gap” held true after disaggregation by experience. When further subset to tenured or tenure-track faculty at research universities, the gender difference in research time investment narrowed slightly. Additional nuance concerning faculty research behavior can be teased out by comparing actual and preferred faculty research time investments. A pattern emerged from this comparison that remained relatively stable across experience, institution type, and gender - faculty preferred to spend 5 to 9 percent more of their time on the research role.

An examination of change in faculty research time investment over time offers a wider frame of reference that cross-sectional analysis cannot provide. Massy and Zemsky’s (1994) aforementioned “academic ratchet” argues that, over time, forces have and continue to spur faculty to devote more of their professional time to research endeavors. To this prominent assertion, Milem, Berger, and Dey (2000) explored faculty research time
investment using national faculty data from 1972 and 1992. Faculty at each Carnegie institution type with the exception of community colleges displayed significant increases in time allotments to research. Faculty at research universities devoted the most time to research; however, faculty at doctorate-granting institutions narrowed the gap slightly over the twenty year span. In particular, the most significant proportional increases occurred at comprehensive and doctoral universities with 20 percent and 15 percent growth respectively.

In separate regression analysis utilizing the 1992 data, the same study sought to detect meaningful predictors of faculty research time investment. A significant positive relationship was observed for several covariates: 1972 faculty research time investment, institutional percentage of academics with doctorates, and both research and doctoral universities. The model accounted for 92.3 percent of the variance in faculty research time investment.

**Research effectiveness – research productivity.** Research productivity in terms of a quantitative count of published works constitutes the most prevalent method for measuring research effectiveness (Blackburn & Lawrence, 1995; Boyer, 1990; Finkelstein, Seal, & Schuster, 1998). Regardless of academic field, this research effectiveness standard also customarily mandates a publication process that employs some process of peer review (Boyer, 1990). Faculty engagement in the research and writing process was a measure utilized in the NSOPF-93 to gauge faculty behavior consistent with a publication productivity definition of research effectiveness. Finkelstein, Seal, and Schuster (1998) analyzed this survey item through disaggregation by institution type and demographic categorizations. Overwhelming majorities of faculty in research, doctoral, and comprehensive institutions and
two-thirds of liberal arts faculty self-reported their engagement in research, writing, or creative works. Approximately 70 percent of both new and senior faculty declared their engagement in the publication process, and the institutional rates of publication activity remained stable irrespective of faculty experience.

In terms of gender, males were significantly more likely than females to be involved in the research and writing process regardless of faculty experience (Finkelstein, Seal, & Schuster, 1998). Comparing gender across experience, both males and females in the new faculty grouping were more likely to be engaged in the publication process than their respective senior faculty colleagues. Because the faculty gender discrepancy can be tied to contextual and non-random factors, the investigators also isolated analysis to tenured or tenure-track men and women at research universities. After these controls, the “gender gap” virtually dissolved.

Examining the kinds of scholarly activity faculty engage in also provides greater context to publication productivity as a means for measuring research effectiveness (Finkelstein, Seal, & Schuster, 1998). Refereed journals and conference presentations represented the most dominant scholarly formats. The next grouping of popular faculty publication formats, all hovering around a 30 percent rate, included engagement in research funding, non-refereed journals, published book reviews, published chapters, and published technical reports. Some distinct findings appeared after demographic controls. Engagement in funded research was the only scholarly or publication activity that new faculty displayed a higher rate of involvement in than their more senior colleagues.
Within the new faculty cohort, the aforementioned “gender gap” persisted based on engagement in funded research or creative endeavors and publication in refereed journals. However, the gender discrepancy faded for published books and conference presentations. While the extent and nature of faculty engagement in publication activities is important, it is also worthwhile to explore faculty perceptions of their publication productivity ability. Blackburn and Lawrence’s (1995) found that strong majorities of faculty at research and doctoral institutions reported such competence as being somewhat or highly characteristic of their skillset. Even faculty rates at comprehensive and liberal arts institutions approached a majority.

The structural emphasis placed on publication productivity can be delineated by examining how faculty perceive its importance as a criterion in the tenure attainment process. National faculty data from the Carnegie Foundation for the Advancement of Teaching indicated that four-fifths of all four-year institution faculty believed that the number of publications is very or fairly important to obtaining tenure (Boyer, 1990). After controlling for institution type, nearly all faculty from research and doctoral-granting institutions perceived publication count as critical to tenure attainment. Even 75 percent of comprehensive university faculty and 40 percent of liberal arts faculty believed that publication productivity was very or fairly important to attaining tenure.

A distinguishing element of Blackburn and Lawrence’s (1995) prominent examination of faculty work included testing a comprehensive, explanatory casual framework for understanding publication productivity. Socio-demographics, career related
measures, self-knowledge, social knowledge, and research behavior comprised the framework’s predictive domains. The framework’s central behavioral variable, effort given to research, was a positive predictor of publication productivity at research I universities and both liberal arts sub-classifications; though, it was a negative predictor at doctoral II and comprehensive II institutions. The faculty career component of the framework produced significant findings concerning research universities. Specifically, younger faculty were publishing at a higher rate than their more senior colleagues, and graduates from non-research university institutions were publishing more than research university graduates at said institutions. This latter finding suggests that research universities are open to hiring productive scholars regardless of their graduate school origins. The strongest predictors of publication output across the institutional spectrum were self-reported research competence and research support via grant funding.

Faculty Research Role & Institutional Isomorphism

A popular theory about the organizational structure of postsecondary education posits that it is highly institutionalized due to numerous external forces exerting conforming pressures across the range of higher education institutions (DiMaggio & Powell, 1983; Milem, Berger, & Dey, 2000; Riesman, 1956). These cross-institutional conforming pressures spur isomorphic tendencies. Institutional isomorphism or “institutional drift” proffers that, over time, institutions in the lower and middle levels of the higher education hierarchy try both intentionally and unintentionally to imitate institutions at the top
One area of such imitation centers on a rising prioritization of the faculty research role across the postsecondary institutional spectrum. Potential changes in the performance of faculty work as a consequence of isomorphic pressures toward amplified research activity have spawned scholarly attention (Fairweather, 1993; Dey, Milem, & Berger, 1997; Milem, Berger, & Dey, 2000). Dey, Milem, and Berger (1997) found that publication productivity has increased significantly across all institution types over a 20-year span as faculty in the lower and middle institutional tiers seek to emulate the research role performance of their peers in the research-centric upper tier of higher education. In an analogous follow-up study, Milem, Berger, and Dey (2000) also uncovered a significant increase in time devoted to research across all four-year institution types over a 20-year span. Fairweather (1993) has also argued that isomorphic forces are gradually moving the entire higher education sector towards a faculty rewards structure where compensation, tenure, and advancement are centered on research activity.

**Relationship between Faculty Research and Teaching**

**Framing Scholarship Targeting the Research-Teaching Link**

Public stakeholders and policymakers have criticized higher education for giving priority to research activities at the expense of undergraduate instruction (Boyer, 1990; Fairweather, 1996; Massy & Zemsky, 1994; Study Group, 1984). One of the primary sources of contemporary public mistrust with higher education is the manner in which faculty allocate their time and effort (Fairweather, 1996). Accordingly, the relationship between teaching and research has been the subject of purposeful scholarly exploration. The
prevailing vein of investigation targeted whether or not these pillars of academic work conflict with each other. In essence, how do measures of research engagement and effectiveness correlate with similar teaching related constructs?

This scholarship is framed by three relationship perspectives: null, conflict, and complementarity (Braxton, 1996). The null perspective proffers the absence of any relationship between the teaching and research roles. As such, teaching and research are independent of one another; one role neither benefits nor detracts from the other (Linsky & Straus, 1975). The conflict perspective posits a negative relationship due to diverging role expectation and obligations (Boyer, 1990; Clark, 1989; Fox, 1992). Extending this line of thought, Massy and Zemsky (1994) hold that institutions struggle at advancing teaching priorities due to the autonomous discretionary time that faculty are privy to. These researchers coined the term “academic ratchet” to describe a trend towards faculty devoting more of their time to research endeavors at the expense of teaching. More time spent on research translates to less time and energy dedicated to designing and implementing good pedagogical practice. The complementarity perspective advances a positive relationship between teaching and research. This perspective embodies the notion that both roles necessitate similar abilities, values, or goals (Braxton, 1996). For example, the spill-over effect asserts that engaged and productive scholars transfer their excitement and expertise to the classroom and their students (Linsky & Straus, 1975).
Research-Teaching Relationship - Publication Productivity & Student Ratings

The question arises to what extent are the above divergent perspectives concerning the relationship between teaching and research supported by the scholarly record. The predominant mass of existing literature has operationalized research and teaching effectiveness via publication productivity and student ratings of instruction respectively. Two prominent and systematic meta-analyses (Feldman, 1987; Hattie & Marsh, 1996) standout and illuminate the research-teaching relationship. Both works targeted studies that measured teaching efficacy through student ratings and research effectiveness via publication productivity. Feldman’s (1987) meta-analysis of twenty-nine studies found weak support ($r = .12, p < .001$) for a complementary relationship between teaching and research. Feldman also organized student ratings into nineteen specific instructional dimensions in order to account for any overall masking effects. Teacher subject knowledge ($r = .21, p < .001$) and course organization ($r = .21, p < .001$) emerged as significant instructional facets. In terms of the given study, none of the individual dimensions were directly consistent with the utilization of student-centered pedagogical techniques. Strong teacher subject knowledge and course organization can thrive and often do in the absence of student-centered pedagogy. The only related dimension, teacher encouragement of questions and discussion, presented a non-significant, approximate $r$ of zero.

Braxton (1996) followed up and revised Feldman’s (1987) study given that its method did not permit a simultaneous appraisal of all three perspectives, thus masking the variation amongst the twenty-nine individual studies. Based on correlation criteria for each teaching-
research perspective, the analysis utilized a vote count method based on the average $r$ from each of included studies. Results contradicted the conflict perspective and provided modest support for the null and complementarity perspectives. Given that the institutional names associated with each study were available, Braxton also examined the existence of a systematic relationship based on Carnegie classification types. Although no systematic institutional pattern emerged, ten of the thirteen sampled research universities presented a null relationship.

Hattie and Marsh’s (1996) meta-analysis supplemented Feldman’s study sample with more current scholarship. An overall correlation of .06, based on 498 correlations from 58 studies, reinforced support for a fragile complementary relationship between teaching and research and more readily reflected a null perspective. Findings also supported a strong null perspective at research universities (Braxton, 1996) and a positive relationship concerning student perceptions of teacher subject knowledge and course organization (Feldman, 1987).

**Research-Teaching Relationship – Not Measured via Student Ratings**

While student ratings of instruction represent the prevalent scholarly means for measuring teaching effectiveness, there exists literature that operationalized this construct from the faculty vantage point. Studies utilizing national faculty data from the Carnegie Foundation for the Advancement of Teaching provided some insight into the research-teaching relationship from such a faculty frame of reference (Boyer, 1990; Colbeck, 1992). Approximately half of academics from all four-year institutions agreed that pressures concerning publication productivity negatively impacted the quality of undergraduate
education (Boyer, 1990). In terms of explicating a shift in the balance of faculty work roles, faculty at doctoral and comprehensive noted an overwhelming movement towards research at the expense of other faculty responsibilities (Boyer, 1990). Publication productivity and perceptions of the importance of research to tenure attainment produced negative effects on faculty intrinsic preference for the teaching role, even after controlling for salient contextual and demographic considerations (Colbeck, 1992). Blackburn and Lawrence’s (1995) prominent examination of faculty work also identified a significant negative relationship between publication productivity and the extent to which faculty value teaching.

Contrasting these preceding findings, Eimers’ (1997) examination of the research-teaching link found a significant positive relationship between faculty self-reports of intrinsic enjoyment of research and intrinsic enjoyment of teaching; however, it should be noted that this proffered positive relationship emerged from a faculty sample restricted to selective liberal arts institutions. Literature has shown that academics at this institution type exhibit faculty work values and behaviors that distinguish them from the rest of the higher education sector (Umbach & Wawrzynski, 2005).

**Conceptual Model for Examining the Research-Teaching Relationship**

**Dependent variable - student-centered pedagogy.** The given study departs from the use of student ratings as a measure of instructional effectiveness. Student evaluations of efficacious teaching are subject to extraneous personality factors, knowledge gaps, and biases (Friedrich & Michalak, 1983). The cognitive burden placed on students in comprehending, judging, and reporting their responses based on their own personal background and
knowledge of efficacious instructional practice raises strong questions about the validity of student ratings as a measure of teaching effectiveness (Porter, 2011; Tourangeau, Rips, & Rasinski, 2000). In terms of student ratings bias, a widespread critique argues that ratings correspond with the expected grade that students think they will receive rather than the actual quality of instruction (Arum & Roska, 2011). This bias often takes two distinct forms. Attributional bias arises when students take credit for their successes but evade responsibility for poor performance, and retributinal bias denotes when students reward teachers for good grades and punish them for poor ones (Marsh, 1987; Marsh & Dunkin, 1992).

The most serious criticism of student ratings of instruction centers on their content validity. Content validity necessitates that student ratings instruments are equally applicable across the full range of instructional contexts and pedagogical methods (Abrami, d’Apollonia, & Rosenfield, 1997). However, student ratings instruments are overwhelmingly designed to assess good pedagogical progress as defined by the dominant lecture format where faculty are central and students are passive receivers of knowledge. This prioritization of faculty expertise over student engagement fosters lower-level learning outcomes as opposed to higher-level learning that emphasizes critical thought, problem solving, and knowledge integration.

Hattie and Marsh’s (1996) prominent meta-analysis of the research-teaching link suggested that future scholarship should consider viewing instructional effectiveness from the prism of teaching orientation or pedagogy. Based on the critiques of student-ratings above, faculty self-reports of good pedagogical practice potentially offer a more accurate and
valid measurement of teaching effectiveness. Insufficient research has been undertaken utilizing measures of efficacious teaching that facilitate student engagement (Pascarella, 2001). Prominent theories of college student success and development (Astin, 1984; Chickering, 1969; Kolb, 1984) assert that educational environments that engage students directly and actively in the learning process, as opposed to the more passive lecture format, are more likely to foster deeper, higher-order learning outcomes. Pedagogy placing students in a direct and active position within the learning process reflects a student-centered learning paradigm (Barr & Tagg, 1995; O’Neill & McMahon, 2005; Weimer, 2013). Accordingly, I operationalized teaching effectiveness via faculty self-reports of student-centered pedagogy.

The research-student-centered pedagogy relationship in the scholarly record.

Some existing scholarship has utilized various expressions or manifestations of student-centered pedagogy when operationalizing teaching effectiveness in the research-teaching link. Bray, Braxton, and Smart (1996) employed national faculty data restricted to research and doctoral universities to investigate the relationship between research productivity and two faculty attitudinal measures consistent with innovative student-centered pedagogy - importance of breadth of knowledge in undergraduate education and faculty accessibility to students. Highly productive scholars were just as likely as faculty who publish at lower levels to assert the curricular importance of breadth of knowledge. Supporting a complementary relationship between research and teaching, highly prolific scholars also claimed significantly greater accessibility to students than their less productive peers. Sullivan (1996) examined the relationship between publication productivity and ethical
undergraduate teaching norms among research university faculty. Results indicated no significant relationship between research productivity and faculty support for principled teaching norms.

The student-centered learning paradigm can also be manifested in assessment efforts based on the extent of higher-order question design. Johnson (1996) explored the relationship between faculty research productivity and student assessment design at research universities. Implied a conflict relationship, higher rates of article publication productivity presented a significant negative association with the use of higher-order exam questions. Extending this notion of a conflict relation, Milem, Berger, and Dey (2000) examined the aforementioned “academic ratchet” and its contentions. Student-centered pedagogy places students at the center of the learning experience; as such, an instructional philosophy marked by accessibility to and interaction with students is essential. Over a twenty-year span across all institution types, faculty devoted significantly more time to research endeavors while also spending significantly less time on non-traditional, student-centered advising and counseling activities.

Olsen and Simmons (1996) examined the research-teaching link based on faculty self-reported utilization of efficacious pedagogy using Chickering and Gamson’s (1987) principles of good practice in undergraduate education. Results provided no evidence for a significant relationship between the utilization of good instructional practices and research productivity. Caution should be noted given that the study’s faculty sample came from only two colleges at a single research university. In addition to a more robust and representative
sample of research universities, I also sought to augment publication productivity with a more comprehensive construct of the research context of academic work.

**Independent variables – comprehensive research role context of academic work.**

External stakeholders have criticized academe for giving priority to research activities at the expense of undergraduate instruction, and in a more nuanced appraisal, internal voices within higher education have also decried a systematic emphasis placed on research in career advancement and prestige at the expense of intrapersonal and structural commitments to teaching (Blackburn & Lawrence, 1995; Boyer, 1990; Fairweather, 1996; Massy & Zemsky, 1994; Study Group, 1984). Accordingly, my main block of independent variables focuses on the research context of academic work.

Arguments exist for the research role having both a positive and negative impact on faculty use of student-centered pedagogy (Brew & Boud, 1995; Olsen & Simmons, 1996). The design, implementation, oversight, and evaluation of student-centered pedagogy are continual and exhaustive tasks. As such, research focused faculty may perform their teaching responsibilities utilizing a more teacher-centered philosophy that relies on faculty expertise and student passivity to maximize time and energy available for research pursuits at the expense of student-centered pedagogy (Olsen & Simmons, 1996). On the other end of the argument, faculty engaged in the deep or high-order learning that is demanded by efficacious research activity may, as a consequence, invest their efforts and resources in pedagogical approaches that compel similar student engagement (Brew & Boud, 1995). This perspective asserts direct and active engagement as the common denominator between the
prolific researcher and the successful learner, and it is consistent with the complementary research-teaching association that Linsky and Strauss (1975) labeled the “spillover effect.”

**Integrating Gavlick’s & Marsh’s models.** Most studies examining the research-teaching relationship have tended to solely operationalize research effectiveness through some measure of publication productivity (Jenkins, Breen, Lindsay, & Brew, 2003). I seek to include a more comprehensive conception of the research role context by integrating two existing models (Gavlick; 1996; Marsh, 1984, 1987). Gavlick’s (1996) model proffered a causal chain in which research activity, measured via publication productivity, informs pedagogical behaviors which, in turn, impact student learning. I contend that publication productivity alone offers a limited conception of the research role context, thus potentially inhibiting a more complete understanding of how the research context impacts efficacious instructional practice.

Marsh (1984, 1987) proposed a model that asserted the research-teaching relationship is a function of ability, time, and, motivation. Publication productivity taps an ability or outcomes component of the research role; however, it does not address the full behavioral and motivational facets of the research role. Time invested in research activities represents a process component of the research role. Massy and Zemsky’s (1994) “academic ratchet” underscores faculty research time allotment as a process component of the research-teaching nexus. Research motivation gauges a measure of enthusiasm and internal commitment to the research role. The faculty research role has traditionally served as the preeminent extrinsic source of professional prestige and advancement (Boyer, 1990; Fairweather, 1993).
As such, measures of research motivation that tap both its intrinsic and extrinsic manifestations are of scholarly concern.

Hattie and Marsh (2002) empirically examined Marsh’s (1984, 1987) model and found evidence that supports the value of a more comprehensive interpretation of research activity in explaining how the research role may impact the utilization of student-centered pedagogy. Like the dominant literature, teaching effectiveness was measured using student ratings. Although a non-significant yet slight negative correlation was detected between research time investment and teaching effectiveness, time spent on teaching and time spent on research presented a significant negative relationship (Hattie & Marsh, 2002). The utilization of student-centered pedagogy demands an intense time investment pertaining to its design, planning, implementation, oversight, and evaluation. Consequently, the use of student-centered pedagogy as a measure of teaching effectiveness merits examination with time spent on research.

Research motivation operationalized through faculty self-reported goal orientation also presented a negative relationship with student ratings of teaching (Hattie & Marsh, 2002). Some research suggests that highly autonomous professionals responsible for multiple intrinsically enjoyable activities are more likely to respond to activities that are extrinsically recognized and rewarded (Calder & Staw, 1975; Eimers, 1997). As such, it may be difficult to separate faculty extrinsic and intrinsic motivation; hence, measures of research motivation that tap both constructs also warrant investigation. In sum, the above empirical findings support augmenting the customary research productivity measure with faculty
research time investment and research motivation in order to explore a more complete conceptualization of the research role context.

**Restricting the Research-Teaching Relationship to Research Universities**

The spread of a prioritization of research activity is one of the most recognized and deliberated isomorphic trends in higher education. Existing scholarship (Fairweather, 1993; Massy & Zemsky, 1994; Milem, Berger, & Dey, 2000) examined the progression of this isomorphism and its impact on undergraduate education over the course of time. This literature proffered that non-traditional, student-centered teaching roles have steadily deteriorated over time at the hands of research universities where this decline has been most concentrated. To this point, exploring the teaching and research emphases of institutions across the postsecondary spectrum, Astin and Chang (1995) found that research universities were the only institutional sector that displayed a high research orientation accompanied by a low student orientation. When disaggregated by institution type, consensus from my earlier literature review of faculty work role values and behaviors also supported a high research-low student orientation at research universities (Blackburn & Lawrence, 1995; Boyer, 1990; Finkelstein, Seal, & Schuster, 1998).

A body of research suggests that academic disciplinary affiliation embodied through an emphasis on research activity, scholarly specialization, and graduate education is most salient and prevalent at research universities (Austin, 1990, 1996; Clark, 1980, 1989). Leslie (2002) examined Burton Clark’s assertion that disciplinary norms trump institutional culture through the lens of tenure criteria. Disciplinary consensus existed at institutions where
teaching effectiveness was prized. Only at research universities was disciplinary variation concerning the value of teaching effectiveness present. Accordingly, I sought to examine the disciplinary level relationship between the research context of academic work and faculty utilization of student-centered pedagogy exclusively at research universities.

**The Disciplinary Frame of the Research-Teaching Relationship**

Disciplinary cultures exert a strong normative influence over faculty work (Becher & Trowler, 2001; Clark, 1987, 1989; Smart, Feldman, & Ethington, 2000). The given study centers on the proposition that the relationship between the research role context and faculty use of student-centered pedagogy is most germane at research universities where the strength of disciplinary cultures potentially serve as a differentiating forces in the performance of faculty work. In particular, a disciplinary culture’s level of research role primacy may impact faculty utilization of student-centered pedagogy. This suggests that research orientated disciplines might allocate their professional resources to the advantage or disadvantage of effective teaching that prioritizes students in the learning process.

Variant normative patterns of faculty values and behaviors present certain implications for the execution and interplay of research and teaching. Extensive research posits that academic discipline constitutes the central affiliation for faculty (Becher & Trowler, 2001; Clark, 1987, 1989; Smart, Feldman, & Ethington, 2000). As such, the normative influence of disciplinary affiliation represents a critical socializing force in the proliferation of faculty roles and work patterns (Becher, 1981, 1987; Becher & Trowler, 2001; Smart, Feldman, & Ethington, 2000; Umbach, 2007). This disciplinary normative
influence is not housed solely in disciplinary-based departments; it also extends in a cosmopolitan fashion to disciplinary colleagues at other institutions, national professional organizations, and peer-reviewed research ventures (Baker & Zey-Ferrell, 1984; Becher, 1981; Becher & Trowler, 2001; Clark, 1987, 1989; Metzger, 1987).

Through such ubiquitous normative socialization, academic disciplines are defined by academics with their own lexicons, patterns of work, standards of conduct, and professional priorities (Becher & Trowler, 2001; Becher, 1981; Smart, Feldman, & Ethington, 2000). The faculty research role shapes disciplinary boundaries, the formation of sub-disciplines and specializations, patterns of communication and networking, career progression, and knowledge generation itself (Becher & Trowler, 2001). The teaching role, especially at research universities, is more of a locally designated responsibility carrying limited importance to an academic’s disciplinary identity and reputation (Baker & Zey-Ferrell, 1984; Becher, 1981; Blackburn & Lawrence, 1995). In this sense, the faculty research role most fittingly provides form and function to disciplinary membership and is critical to explaining and understanding variability in the performance of faculty work.

Analysis based on national faculty data has demonstrated substantive disciplinary differentiation concerning faculty work preferences and behaviors (Blackburn & Lawrence, 1995; Boyer, 1990; Finkelstein, Seal, & Schuster, 1998; Leslie, 2002). Such examinations of disciplinary differentiation in faculty work have traditionally lacked grounding in appropriate theory or established conceptual frameworks (Becher & Trowler, 200; Light, 1974; Smart, Feldman, & Ethington, 2000). In the given study, I examined if disciplinary membership
differentiates the research-teaching relationship. The consensus of existing research on this relationship indicates a weak positive to null connection (Feldman, 1987; Hattie & Marsh, 1996). However, this research is largely devoid of true theoretical efforts aimed at accounting for faculty disciplinary affiliation. This absence potentially camouflages greater understanding and nuance concerning the espoused weak positive to null nexus between research and teaching (Braxton & Hargens, 1998; Hattie & Marsh, 2002). In order to elucidate a latent disciplinary effect, I propose interpreting my conceptual model through the lens of Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) and Holland’s Theory of Careers (1973, 1997).

**Biglan’s Three-Dimensional Model**

Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) has represented the prevalent scholarly lens for studying faculty differences in attitudes, interests, and behaviors. Biglan’s disciplinary classification dimensions were empirically derived from faculty survey data at two institutions. The first dimension, “hard” versus “soft”, reflects a discipline’s level of paradigm development. Hard disciplines present a high level of consensus over central research problems and scholarly methodologies; whereas, soft disciplines display relatively lower levels of consensus. The “pure” versus “applied” dimension assesses the extent to which a discipline involves the practical application of its content. The “life systems” versus “nonlife systems” dimension reflects whether the discipline investigates life systems.
Biglan’s model in the scholarly record. Biglan’s dimensions have served as a guiding conceptual framework for research targeting faculty disciplinary differentiation. This research has enhanced systematic knowledge concerning disciplinary differentiation and provided more grounding to Biglan’s classification schema (Smart, Feldman, & Ethington, 2000). Most research employing Biglan’s schema to elucidate disciplinary differences in faculty teaching and research centers on the hard-soft dimension. A methodical research synthesis by Braxton and Hargens (1996) and the subsequent work of Braxton, Olsen, and Simmons, (1998) produced three critical conclusions concerning how the hard-soft dimension impacts the relationship between teaching and research. These three assertions directly inform my scholarly focus.

First, faculty in hard or high-consensus disciplines are more orientated to research due to their higher publication rates (Hargens, 1978), higher scholarly time commitments (Blackburn & Bentley, 1993; Hargens, 1978), and more friendly research-role infrastructure (Hargens, 1975; Lodahl & Gordon, 1975; Neumann & Neumann, 1990). On the other end of the disciplinary spectrum; faculty in soft or low-consensus fields are more orientated to teaching due to their higher interest in teaching (Biglan, 1973b), greater teaching time commitments (Biglan, 1973b; Stoecker, 1993), and higher teaching evaluations (Neumann & Neumann, 1983).

Second, faculty members from soft or low consensus disciplines employ more of a student-centered teaching orientation marked by adherence to student development, faculty-student contact, active learning, high student expectations, higher-order learning assessments,
low gatekeeping grading beliefs, and diverse ways of learning (Barnes, Bull, Campbell, & Perry, 2001; Braxton & Nordvall, 1988; Braxton, Olsen, & Simmons, 1998; Gaff & Wilson, 1971; Stark, Lowther, Bentley, & Martens, 1990). Braxton, Olsen, and Simmons (1998) compared the habits of faculty in hard and soft disciplines. These scholars titled low consensus or soft academic fields as “affinity” disciplines given their commitment to and interest in teaching. In particular, “affinity” academic fields emphasize student development and student-centered pedagogy. Third, based on the correlations of four broad disciplinary classifications in Feldman’s (1987) afore mentioned meta-analysis, soft disciplines presented a moderate positive relationship ($r = .21$) between research and teaching; whereas, high consensus or hard fields displayed more of a null relationship ($r = .05$). This findings suggests that the near-zero research-teaching relationship observed in the scholarly record (Braxton, 1996; Feldman, 1987; Hattie & Marsh, 1996) is a composite depiction of disciplinary variation.

Although the mass of significant findings pertaining to faculty attitudes and behaviors highlights the hard-soft dimension, analyses involving Biglan’s typology should include all three dimensions giver their non-independence (Smart & Ethington, 1995). An investigation (Smart & Ethington, 1995) of faculty disciplinary differentiation concerning faculty learning goal preferences ranging from knowledge acquisition to application to integration supported this claim. Academics in hard disciplines assigned significantly greater importance to knowledge application than faculty in soft disciplines. While no other learning goal preference produced significance on the hard-soft dimension, interactive effects with the
nonlife-life systems dimension rose to the level of significance. Specifically, within nonlife
disciplines, faculty in soft academic fields placed significantly greater importance on
knowledge acquisition and integration than their colleagues in hard fields.

**Holland’s Theory of Careers**

The given study contends that the execution of faculty work reflects the inherent
diversity of academic disciplines and the unique normative environments established by their
affiliated academics. To this contention, John L. Holland (1973, 1997) provided a theory of
person-environment fit that asserts it congruence with faculty and students in their
corresponding academic disciplinary environments. Some argue that Biglan’s empirically
derived dimensions lack the theoretical requirements to serve as a typology or model for
examining disciplinary differentiation (Bayer, 1987; Smart, Feldman, & Ethington, 2000).
Holland’s theory has been advanced as a response to the dearth of proper theory for
examining disciplinary differentiation in faculty work (Smart, Feldman, & Ethington, 2000).

At the individual level, Holland’s theory (1973, 1997) posits that a person’s chosen
field of study is a function of personality, motivation, knowledge, and ability. It further
affirms that this choice also depends on its environmental setting. Academic environments
require, reinforce, and incentivize the characteristics of the individuals which populate them.
This socialization process is facilitated by environmental forces that encourage preferred
environmental competencies and behaviors, inspire an internalization of desired
environmental values, and reward the enactment of said values. Holland put forth six
personality and matching environment types: realistic, investigative, artistic, social,
enterprising, and conventional. For example, a realistic academic environment should be inhabited by members with a realistic personality type. The assumption being that an individual chooses and thrives in the environment that matches his or her personality type. Figure 2.1 displays these types in a hexagonal model - the longer the path between two types the greater their differences. In sum, three assumptions ground this theory: people choose environments suited to their personalities; environments reinforce and reward different patterns of abilities, interest, and behaviors; and individuals succeed in environments that are congruent with their dominant personality types.

Smart, Feldman, & Ethington (2000) ascribed Holland’s theory as a lens for exploring disciplinary variation to the channeling of Holland’s faculty personality types into parallel disciplinary environments that espouse clear normative philosophies, values, and behaviors regarding faculty work. Table 2.1 presents the salient characteristics of Holland’s six model environments. These distinct environment types stand to inform the execution and interplay of faculty work. To this proposition, I also employed Holland’s academic environments as a theoretical lens for explicating disciplinary variation in the research-teaching relationship.

**Holland’s theory of careers in the scholarly record.** Holland’s theory (1973, 1997) has garnered attention as a theoretical prism for explicating disciplinary differences in faculty attitudes and behaviors. Much of the existing research employing Holland’s academic environments centers on differentiating faculty teaching philosophies manifested through their pedagogical preferences and behaviors. The ensuing findings suggest that certain
Holland academic environments might be more consistent with faculty values and behaviors that correlate with the utilization of student-centered pedagogy.

Early research applying Holland’s theory posited that faculty from investigative, conventional, and realistic environments favor significant structure in their classroom and pedagogical strategies, while faculty from the social and artistic environments are more attracted to unstructured learning environments and corresponding pedagogy that stress student autonomy, decision making, and engagement (Morstain & Smart, 1976; Peters, 1974). In terms of content, Smart, Feldman, and Ethington (2000) detected that Holland’s academic environments differ concerning faculty course specialization predilections. Faculty in enterprising environments favored teaching highly specialized courses, while faculty in social environments desired the least amount of course content specialization.

*Figure 2.1.* Hexagonal model for Holland’s personality types & academic environments
Table 2.1

<table>
<thead>
<tr>
<th>Holland’s Model Environment</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Realistic</td>
<td>Realistic environments emphasize concrete, practical activities and the use of machines, tools, and materials. These behavioral tendencies lead, in turn, to the acquisition of mechanical and technical competencies and to a deficit in human relations skills. People in these environments are encouraged to perceive themselves as having practical, productive, and concrete values.</td>
</tr>
<tr>
<td>Investigative</td>
<td>Investigative environments emphasize analytical or intellectual activities aimed at the creation and use of knowledge. Such environments devote little attention to persuasive, social, and repetitive activities. These behavioral tendencies lead, in turn, to the acquisition of analytical, scientific, and mathematical competencies and to a deficit in persuasive and leadership abilities. People are encouraged to see themselves as cautious, critical, complex, curious, independent, precise, rational, and scholarly.</td>
</tr>
<tr>
<td>Artistic</td>
<td>Artistic environments emphasize ambiguous, free, and unsystematic activities that involve emotionally expressive interactions with others. These environments devote little attention to explicit, systematic, or ordered activities. These behavioral tendencies lead, in turn, to the acquisition of innovative and creative competencies (language, art, music, drama, and writing) and to a deficit in clerical and business system competencies. People are encouraged to perceive themselves as having unconventional ideas and having aesthetic value.</td>
</tr>
<tr>
<td>Social</td>
<td>Social environments emphasize activities that involve the mentoring, treating, healing, or teaching of others. These environments devote little attention to explicit, ordered, systematic activities involving materials, tools, or machines. These behavioral tendencies lead, in turn, to the acquisition of interpersonal competencies and to a deficit in manual and technical competencies. People are encouraged to perceive themselves as cooperative, empathetic, generous, helpful, idealistic, responsible, tactful, understanding, and having concern for the welfare of others.</td>
</tr>
<tr>
<td>Enterprising</td>
<td>Enterprising environments emphasize activities that involve the manipulation of others to attain organizational goals or economic gain. These environments devote little attention to observational, symbolic, or systematic activities. These behavioral tendencies lead, in turn, to an acquisition of leadership, interpersonal, speaking, and persuasive competencies and to a deficit in scientific competencies. People are encouraged to perceive themselves as aggressive, ambitious, domineering, energetic, extroverted, optimistic, popular, self-confident, sociable, and talkative.</td>
</tr>
<tr>
<td>Conventional</td>
<td>Conventional environments emphasize activities that involve the explicit, ordered, systematic manipulation of data to meet predictable organizational demand or specified standards. The behavioral tendencies lead to the acquisition of clerical, computational, and business system competencies necessary to meet precise performance standards and to a deficit in artistic skills. People are encouraged to see themselves as having a conventional outlook and concern for order and routines.</td>
</tr>
</tbody>
</table>

* Adapted from Smart, Feldman, and Ethington (2000)
Scholarship has also shown that faculty preferences within Holland’s academic environments align differently concerning the goals of undergraduate education and specific classroom student competencies (Smart, 1982; Smart, Feldman, & Ethington, 2000; Smart & Thompson, 2001; Smart & Umbach, 2007; Thompson & Smart, 1999). Faculty in enterprising, realistic, and conventional environments tend to emphasize educational goals devoted to the career or vocational development of students. Social and artistic environments contain faculty focused more on fostering holistic character development. In terms of explicit student competencies, faculty from investigative environments prefer mathematical, analytical, and scientific skill development; faculty from the social and artistic environments favor creative, literary, interpersonal, altruistic, and innovative competencies; and academics for the enterprising environments accentuate managerial, leadership, and persuasive competencies.

Based on analysis of national faculty data, recent research has supported the notion that faculty from social and artistic environments, compared to the remaining environments, more keenly embrace student-centered pedagogy. Realistic faculty followed by artistic and social academics displayed a substantive proclivity for student-centered pedagogical strategies that stress direct engagement, collaboration, and higher-order learning (Umbach 2005, 2007). Although this finding slightly disputes earlier research (Morstain & Smart, 1976; Peters, 1974), realistic faculty may have inferred desired structure within the survey item design while social and artistic faculty may have assumed undesirable structure and less student control. A cluster of research has also posited that academics from social and artistic
disciplines are more likely than their colleagues in the other Holland environments to employ
diversity related activities that echo the ethos of student-centered pedagogy (Milem &
Umbach, 2003; Umbach, 2006; Umbach & Milem, 2004; Smart & Umbach, 2007).

Finally, using a nationally representative sample, Lattuca, Terenzini, Harper, and Yin (2010) examined whether faculty from different engineering sub-disciplines varied in response to curricular and pedagogical requirements brought on by new national engineering program accreditation standards (EC 2000). Use of student-centered pedagogical techniques was one of only eight curricular and pedagogical constructs on which Holland’s environmental classifications (realistic, investigative, and enterprising) for engineering sub-disciplines displayed significant variation. As a disciplinary manifestation that extends beyond institutional boundaries, the new engineering accreditation standards’ (EC 2000) impact on student-centered pedagogy suggests that the utilization of such pedagogy warrants investigation based on disciplinary affiliation. This research implication is especially applicable to the full disciplinary spectrum within higher education given that Lattuca et al.’s (2010) study focused exclusively on sub-disciplines within a single, broad disciplinary field.

Analysis Accounting for Faculty Disciplinary Affiliation

From an analytical frame, scholarship focusing on the research-teaching relationship can be classified as strong or weak (Ramsden & Moses, 1992). The strong version has received the majority of scholarly attention and examines the research-teaching link at the level of the individual faculty member. The weak version argues for a research-teaching relationship at a higher level of analysis. Existing yet limited research (Volkwein &
Carbone, 1994; Ramsden & Moses, 1992) suggests that faculty teaching and research roles vary significantly at the departmental level of analysis. However, a research-teaching relationship at the departmental level taps both institutional and disciplinary influences.

To date, Hattie and Marsh (2002) conducted the most analytically sophisticated investigation of the research-teaching relationship at the departmental level of analysis. They hypothesized that systematic disciplinary variation in the research-teaching relationship might be observed between departments. This study examined the research-teaching link using the traditional variables of student evaluations of teaching and faculty publication productivity from a sample of 182 faculty members at a single Australian research university. The significance of Hattie and Marsh’s work centered on their use of hierarchical linear modeling or multilevel modeling to account for the natural nesting of faculty members within academic disciplines. The absence of this methodological consideration in previous research threatened the validity of findings given the non-independence of faculty belonging to the same academic discipline.

Hattie and Marsh (2002) found no significant variation in the teaching-research relationship at the disciplinary or second-level of analysis; however, their sample was restricted to only 20 disciplinary departments within in a single research institution. The narrow or limiting quality of this sample suggests that disciplinary variation may have been insufficiently accounted for. A key facet of disciplinary affiliation in academic work has been its imperialistic diffusion across institutional and geographic boundaries (Baker & Zey-Ferrell, 1984; Becher, 1981; Becher & Trowler, 2001; Clark, 1987, 1989; Metzger, 1987).
This assertion is even more salient given the exponential growth of information and communication technologies over the past two decades.

Greater differentiation of academic disciplinary fields is also a critical methodological consideration when exploring variation in faculty work role values and behaviors (Lattuca, Terenzini, Harper, & Yin, 2010; Smart, Feldman, & Ethington, 2000). Accordingly, I conjectured that hierarchical linear modeling might detect significant disciplinary variation at the disciplinary or second-level of analysis by aggregating individual faculty members across institutional boundaries based on greater delineation of academic disciplinary groupings. In the context of my investigation, this methodological extension of Hattie and Marsh’s work (2002) potentially enabled a more nuanced understanding of the disciplinary-level relationship between the research role context of academic work and faculty utilization of student-centered pedagogy at research universities.
CHAPTER THREE: METHODOLOGY

The execution of faculty research and teaching has represented a source of scrutiny, both within and outside academe. A prominent contention holds that faculty time and efforts skew toward research pursuits at the expense of faculty investments in the teaching role (Boyer, 1990; Fairweather, 1996; Massy & Zemsky, 1994; Milem, Berger, & Dey, 2000; Study Group, 1984). The engine behind this espoused antagonistic relationship reflects the peer-driven premium placed on research productivity as the means for career prestige and advancement. Research universities provide the environment for this research primacy to flourish and seep through the entire higher education sector (Astin & Chang, 1995; Boyer, 1990; Massy & Zemsky, 1994; Milem, Berger, & Dey, 2000).

The research charge of academic work, most salient at research universities, shapes disciplinary boundaries, the formation of sub-discipline and specializations, patterns of communication and networking, career progression, disciplinary pecking-orders, and knowledge generation itself (Becher & Trowler, 2001). Many define higher education as the collection of distinct fields of knowledge that serve as the principal normative influence in faculty work (Becher & Trowler, 2001; Clark, 1987, 1989; Smart, Feldman, & Ethington, 2000). This proposition suggests that disciplinary affiliation is fundamental to explaining and understanding how variability in the research role impacts the faculty teaching charge. Regrettably, the disciplinary context of academic work has received limited scholarly interest as a theoretical frame for investigating higher education generally and faculty work specifically (Smart, Feldman, & Ethington, 2000).
Conceptual Model

Examining the relationship between faculty research and teaching based on a disciplinary frame of inquiry necessitates manifestations of these roles that quantify the normative influence of disciplinary membership on faculty preferences and behaviors. Student ratings of instruction have long represented the prevailing means for measuring good teaching; however, they are subject to extraneous personality factors, biases, and knowledge gaps (Friedrich & Michalak, 1983). Given their reliance on students, they also represent an indirect if not incongruent source of measurement for capturing the normative impact of disciplinary affiliation on efficacious teaching values and behaviors. To these critiques, my study utilized faculty self-reports of student-centered pedagogy as a measure of efficacious teaching. Contemporary theories (Astin, 1984; Chickering, 1969; Kolb, 1984) about student success affirm the centrality of direct and active student engagement within the learning process. Pedagogy that stimulates such engagement corresponds with a student-centered learning paradigm.

The ongoing design, implementation, and execution of student-centered pedagogy are resource intensive. One line of thought posits that the intense resource demands of student-centered pedagogy may be avoided in favor of greater faculty research pursuits (Massy & Zemsky, 1994; Olsen & Simmons, 1996). An alternate argument holds that the deep and meaningful engagement required of faculty in their research pursuits is transferred to the classroom learning experience based on faculty pedagogical strategies that demand similar
engagement of students (Brew & Boud, 1995). Yet another postulation asserts that the faculty research and teaching roles are mutually exclusive.

Given the salience of research activity within disciplinary cultures, a meaningful evaluation of the above alternatives should employ measures of the faculty research role that fully embody the normative influence of disciplinary affiliation. Publication productivity has historically constituted the most common means for operationalizing research effectiveness (Jenkins, Breen, Lindsay, & Brew, & 2003). I sought to include a more complete conception of the research role context by integrating two existing models (Gavlick; 1996; Marsh, 1984, 1987). Gavlick’s (1996) model advanced a causal chain between research productivity, pedagogical behaviors, and student success. Research productivity alone offers a narrow conception of the research role context. Marsh (1984, 1987) proposed a model that affirmed the research-teaching relationship is best conceived as a function of motivation, time, and ability. Research role motivation, research time investment, and research productivity provided a more comprehensive conceptual approach to capturing the normative preferences and behaviors that define a disciplinary culture’s research role context.

Synthesis of existing scholarship on the relation between research and teaching suggests a weak positive to null link (Feldman, 1987; Hattie & Marsh, 1996). Traditionally, research efforts have been deficient in accounting for faculty disciplinary affiliation, thereby potentially camouflaging nuanced understanding of the research-teaching relation (Braxton & Hargens, 1998; Hattie & Marsh, 2002). To this critique, I sought to examine if disciplinary affiliation differentiated the given study’s research-teaching relationship.
Accounting analytically for the disciplinary clustering of faculty members enabled an examination of student-centered pedagogy using level-one (individual faculty members) and level-two (academic discipline) variables. This analytic consideration resulted in a multifaceted research focus. First, I explored the differential individual and disciplinary level impact of research motivation, productivity, and time investment on faculty utilization of student-centered pedagogy. Second, I employed Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) and Holland’s Theory of Careers (1973, 1997) as separate disciplinary taxonomies for predicting faculty utilization of student-centered pedagogy. Finally, I explored the presence of interactive or moderating effects within both preceding purposes. The following three research questions and respective sub-questions expound the above research focus.

1. How much of the variance in faculty utilization of student-centered pedagogy at research universities lies within and between disciplines?

2. To what extent do research productivity, research time investment, and research motivation predict the utilization of student-centered pedagogy at research universities?

a. To what extent do full-time, tenured or tenure-track faculty members’ levels of research productivity, research time investment, and research motivation predict their utilization of student-centered pedagogy at research universities?
b. To what extent does a discipline’s level of research productivity, research time investment, and research motivation predict full-time, tenured or tenure-track faculty members’ utilization of student-centered pedagogy at research universities?

3. To what extent do disciplinary taxonomies predict the utilization of student-centered pedagogy at research universities?
   a. To what extent does Holland’s (1973, 1997) career choice theory and its distinct model environments explain disciplinary level variance in faculty members’ utilization of student-centered pedagogy at research universities?
   b. To what extent does Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) explain disciplinary level variance in faculty members’ utilization of student-centered pedagogy at research universities?

**Study Design Overview**

**Research Design Classification**

Traditional nonexperimental quantitative research design typologies are often unclear and contradictory within educational research and unfamiliar to the greater interdisciplinary community (Johnson, 2001). To these critiques, Johnson (2001) proposed a new two-dimensional classification of nonexperimental quantitative educational research. The first dimension involves identifying the primary research objective as descriptive, predictive, or explanatory. The second dimension requires a classification of the collected data with
reference to time. Cross-sectional, longitudinal, and retrospective comprise the three time
categorical options. Accordingly, my study constituted explanatory, cross-sectional research
given its intent to explain the relationship between the research context of academic work
and the utilization of student-centered pedagogy from the disciplinary frame and its
limitation to data drawn exclusively from the 2007 HERI Faculty Survey.

The Survey Instrument

The given study utilized data obtained from the 2007 Higher Education Research
Institute (HERI) Faculty Survey that I obtained access to through an application process.
The survey is administered by HERI’s Cooperative Institutional Research Program (CIRP) at
the University of California, Los Angeles. It has been administered triennially by CIRP since
1989, and the 2007 faculty survey was the seventh edition in the series. In addition to
demographic and background information, the survey targeted faculty perceptions of
institutional priorities and climate, faculty time allocation, faculty goals and expectations for
students, faculty pedagogical strategies, faculty interactions with students that promote life-
long learning, sources of faculty stress and satisfaction, and faculty engagement in service to
the local and global communities. A section was also available for each participating
institution to include up to 20 customized questions.

CIRP presented results to participating schools via an institutional profile including
results broken down by gender and employment status, peer institution benchmarking,
significance testing, effect sizes, a national results summary monograph, and access to the
respective institution’s raw data. Participating institutions historically utilize results for
planning and policy analysis, accreditation purposes, faculty development, and improving the student learning experience. Data from the 2007 HERI Faculty Survey was also augmented with Carnegie Classification data from the Integrated Postsecondary Education Data System (IPEDS).

Data Collection

CIRP administered the survey to 104,924 faculty from 449 institutions including 41 community colleges and 408 universities or four-year colleges (HERI, 2009). This overall sample included faculty from two sources, participating institutions and a supplemental sample. Participating institutions chose to employ HERI’s research services. In exchange for associated fees, participating institutions received the aforementioned institutional profile results along with the option for additional services and reports. CIRP designed the survey to be completed by all faculty members regardless of status or appointment. Participating institutions had the prerogative to choose their faculty sample; however, HERI has historically recommended and found that most institutions survey their entire faculty population in order to maximize the analytical utility of their survey data (HERI, 2010).

The 2007 faculty survey administration was the first conducted through electronic format. Individual faculty members were invited to complete the survey via email by linking to the HERI portal. The HERI portal was a website that enabled secure communications between HERI and participating institutions (HERI, 2009). A participating institution’s access to the portal began with the registration process and empowered an institutional designee to set the dates of the initial administration, optional follow-up administrations, and
reminder messages to non-respondents up until two days before the initial administration. The portal also allowed institutions to customize the invitations and reminder messages. The entire email distribution schedule was automatically controlled by the portal to ensure efficiency and privacy. CIRP also created a supplemental sample to augment the number of respondents from institutional types participating at lower comparative rates (HERI, 2009). This supplemental sample included respondents from the 2004 faculty survey that provided email information and consent for follow-up research contact but whose respective institutions did not participate in the 2007 administration. A mass of 15,127 respondents from 199 institutions met these criteria and constituted the supplemental sample for the 2007 survey.

**Targeted 2007 HERI Faculty Survey Population & Sample**

Usable surveys were received from 34,479 respondents of the 104,924 faculty administered the 2007 HERI Faculty Survey (HERI, 2009). This reflected a response rate of 33 percent. Breaking the overall sample down by its component parts, participating institutions presented a response rate of 32.6 percent while faculty from the supplemental sample responded at a rate of 34.5 percent.

Requesting data access to the HERI 2007 Faculty Survey requires an application process that includes an overview of the prospective research study, a list of survey variables pertinent to the prospective study, and a description of the prospective study’s faculty population or subset. HERI does not provide access to the complete faculty survey dataset. Approved requests are subset to the particular faculty population under study and the
specified survey variables. Given my study’s focus on the relationship between the faculty
teaching and research roles, I requested a subset to full-time, tenured or tenure-track faculty
respondents. More specifically, the given study centered on how the research role context
impacts faculty utilization of student-centered pedagogy in undergraduate education. This
focus also necessitated further delimitation of the subset to full-time, tenured or tenure-track
faculty teaching undergraduate students. Table 3.1 provides the survey items along with
response options that enabled the above data subset.

The given study also restricted its focus to research universities. No explicit items in
the faculty survey permitted this delimitation. HERI data access does offer the option to
merge faculty survey data with specified IPEDS variables. In order to differentiate
respondents’ institutional affiliation, I requested that my approved dataset be merged with the
Carnegie 2000: basic classification variable. Two response options within this item’s
doctorate-granting category enable restriction to research universities. Accordingly, the
given study’s population and sample was restricted to full-time, tenured or tenure track
faculty members teaching at least one undergraduate course at research universities that
respectively received and responded to the 2007 HERI Faculty Survey.
Table 3.1
HERI Faculty Survey Items Used to Delimit the Given Study

<table>
<thead>
<tr>
<th>2007 HERI Faculty Survey Item</th>
<th>Response Options</th>
<th>Delimiting Options</th>
</tr>
</thead>
</table>
| Are you considered a full-time employee of your institution for at least nine months of the current academic year? | 1 = Yes  
2 = No | 1 = Yes |
| What is your tenure status at this institution?                                               | 1 = Tenured  
2 = On tenure track, but not tenured  
3 = Not on tenure track, but institution has tenure system  
4 = Institution has no tenure system | |
| Including all institutions at which you teach, how many undergraduate courses are you teaching this term? | Respondents enter an integer | Response ≥ 1 |

Analysis & Instrumentation

Hierarchical Linear Modeling

The mass of quantitative analysis in educational research utilizes linear regression to model the relationship between variables of interest. Most linear regression analyses employ ordinary least squares (OLS) as the standard approximation method to calculate a line of best fit between independent variables and a purposeful dependent variable. OLS carries with it certain statistical assumptions. One such assumption states that the observed error term for any individual in the sample must be uncorrelated with any other individual’s error term. In other words, respondent observations must be independent of one another. This assumption is one that many educational studies fail to address during research design (McCoach, 2010;
Osborne & Waters, 2002). In most social science research, data is nested hierarchically (McCoach, 2010). Hierarchical data structures indicate that individuals are clustered within naturally occurring organizational units. Individuals clustered within the same organizing unit are likely to present some degree of relatedness or correlation concerning the dependent variable of interest. OLS does not account for this nesting condition.

Research examining the performance of faculty work presents an inherent hierarchically structure. Academic disciplinary membership represents a powerful normative force behind the performance and interplay of faculty work (Becher & Trowler, 2001; Clark, 1987, 1989; Smart, Feldman, & Ethington, 2000). Disciplinary cultures link academics across institutional boundaries (Baker & Zey-Ferrell, 1984; Becher, 1981; Becher & Trowler, 2001; Clark, 1987, 1989; Metzger, 1987). However, disciplinary salience and faculty work role differentiation appears to be most prominent at research universities (Leslie, 2002; Massy & Zemsky, 1994; Milem, Berger, & Dey, 2000). The HERI faculty survey enabled individual faculty respondents to be aggregated by discipline regardless of their institutional affiliation. The given study employed statistical analysis that accounts for the clustering of faculty within academic disciplines in order to elucidate the disciplinary level relationship between the research context of academic work and the utilization of student-centered pedagogy at research universities.

Hierarchical linear modeling (HLM) adjusts for the clustering of faculty members within disciplines. By assuming independence, traditional statistical analyses including OLS generate underestimated standard errors (Raudenbush & Bryk, 2002). Underestimated
standard errors increase the rate of Type I error that claims a significant relationship where one does not exist. HLM addresses undervalued standard errors by appraising and modeling the degree of observational dependence within each data cluster. Estimating the degree of cluster level dependence is enabled by allowing the intercept to randomly vary across the cluster units (Raudenbush & Bryk, 2002). The significance of HLM also includes the explication of both between- and within-cluster variance of a given dependent variable (McCoach, 2010). In so doing, variance in a dependent variable can be explained using independent variables at each level of analysis.

**HLM Models**

The multilevel nature of analysis in HLM demands statistical specificity and clarity. Given this complexity, equations constitute the customary format for presenting HLM statistical models (McCoach, 2010). The multilevel equations below present a model that predicts the utilization of student-centered pedagogy for faculty members clustered within academic disciplines. The ensuing sub-sections explicate the dependent variable, the first level of analysis (individual faculty member), and the second level of analysis (academic discipline).

**Dependent variable.** Faculty utilization of student-centered pedagogy constituted the study’s normative disciplinary manifestation of effective teaching. In particular, student-centered pedagogy was examined via specified instructional strategies. A series of Likert-type survey items requested faculty to report in how many courses they use varying instructional techniques. Participants responded on a four-point ordinal scale: none, some,
most, or all. Surveyed instructional options included class discussions, cooperative learning (small groups), experiential learning/field studies, teaching assistants, recitals/demonstrations, group projects, extensive lecturing, multiple drafts of written work, readings on racial and ethnic issues, readings on women and gender issues, student-developed activities, student-selected topics for course content, reflective writing/journaling, community service as part of coursework, electronic quizzes with immediate feedback in class, using real-life problems, and using student inquiry to drive learning.

Most of these options appeared to embody the essential student-centered pedagogical themes of student engagement, empowerment, cooperation, and diversity. Exploratory factor analysis was conducted on the instructional techniques to establish the existence of an overall student-centered factor. A summative composite measure of items loading on the student-centered factor represented the study’s dependent variable.

**Individual faculty member level (level-one).** Equation 1 displays my study’s within discipline or individual faculty member level of analysis. $Y_{ij}$ represents the utilization of student-centered pedagogy for faculty member $i$ in discipline $j$. Allowing the model intercept to random vary across cluster units to account for cluster level dependence is the defining element of HLM. To this statistical feature, $\beta_{0j}$ is the model intercept for discipline $j$; it denotes the average faculty utilization of student-centered pedagogy for discipline $j$ when all other predictors are held constant at 0. $\beta_1$ through $\beta_{19}$ correspond to the fixed effects for my specified level-one predictors. For example, $\beta_1$ indicates the predicted relationship between research productivity for faculty within discipline $j$ and their utilization of student-centered
pedagogy when all other predictors are held constant at 0. The $r_{ij}$ term constitutes the level-one residual term. It captures individual faculty member level differences in utilization of student-centered pedagogy around the predicted student-centered pedagogy scores for faculty within each disciplinary cluster.

$$Y_{ij} = \beta_{0j} + \beta_1(\text{research productivity})_{ij} + \beta_2(\text{research time investment})_{ij}$$

$$+ \beta_3(\text{intrinsic research motivation})_{ij} + \beta_4(\text{extrinsic research motivation})_{ij}$$

$$+ \beta_5(\text{teaching time investment})_{ij} + \beta_6(\text{intrinsic teaching motivation})_{ij}$$

$$+ \beta_7(\text{extrinsic teaching motivation})_{ij} + \beta_8(\text{female})_{ij} + \beta_9(\text{Other})_{ij} + \beta_{10}(\text{Asian})_{ij}$$

$$+ \beta_{11}(\text{Black})_{ij} + \beta_{12}(\text{Hispanic})_{ij} + \beta_{13}(\text{full prof.})_{ij} + \beta_{14}(\text{associate prof.})_{ij} + \beta_{15}(\text{age})_{ij}$$

$$+ \beta_{16}(\text{not married})_{ij} + \beta_{17}(\# \text{ of children})_{ij} + \beta_{18}(\text{English not native lang.})_{ij}$$

$$+ \beta_{19}(\text{gen. ed. course load})_{ij} + r_{ij}$$

Table 3.2 presents the 2007 HERI Faculty Survey items and response options that comprised my study’s predictors at the within discipline or individual faculty member level of analysis. Predictors delineating the faculty research role context were of primary interest. These comprehensive research role predictors included research productivity, research time investment, intrinsic research motivation, and extrinsic research motivation. Research productivity was a summative composite measure of two separate ordered-category survey items that targeted a more current or active measure of one’s research output. Research time investment was a summative composite measure of four separate ordered-category items that collectively tapped a broader disciplinary conception of research activity. The intrinsic and
extrinsic research motivation predictors represented the distinct locus of control dimensions that shape an academic’s overall research motivation.

A meaningful examination of the above research role predictors’ impact on faculty utilization student-centered pedagogy warranted controlling for analogous measures pertaining to the faculty teaching role. Teaching time investment was the summative composite of three ordered-category items gauging respondent time allotments to instructional preparation, scheduled instruction, and advising. Intrinsic and extrinsic teaching motivation represented the differing locus of control dimensions that inform an academic’s overall teaching impetus. Instructional productivity is somewhat of a nebulous construct that the 2007 HERI Faculty Survey did not support with a viable proxy.

Demographic and background variables were also included at the individual faculty member level of analysis to account for maximum variance in faculty utilization of student-centered pedagogy. Prior research explicating normative faculty role values and behaviors isolated several essential variables including sex, race/ethnicity, faculty rank, age, marital status, number of children, and English as native language status. I also included general education course load as a structural control given that general education courses at research institutions often exhibit large student enrollments that potentially place resource constraints on the utilization of student centered pedagogy. The race/ethnicity item was derived by HERI from a series of survey items that asked respondents to select all races/ethnicities with which they identify. Small response rates and ease of interpretation resulted in combining the American-Indian and two or more races response options with the Other racial/ethnic
grouping. The marital status item was also collapsed into a dichotomous variable with classifications of *married* and *not married*. Dummy variables were created for sex, race/ethnicity, faculty rank, marital status, and English as native language status. *Male, White, assistant professor, married,* and *native English speakers* served as the corresponding reference groups. Respondent age was calculated by subtracting inputted year of birth from 2007. Number of children and general education course load were measured on respective 5-point and 6-point ratio scales.

**Academic discipline level (level-two).** Equations 2a and 2b present the between-discipline or the academic disciplinary level of analysis. Two equations for the between-discipline model are exhibited because two distinct series of analyses were run to account for Biglan’s three-dimensional model and Holland’s work environments. Statistical analysis that includes these disciplinary taxonomies simultaneously introduces the potential for multicollinearity issues that threaten parameter estimation.

\[
\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{disciplinary research productivity})_j + \gamma_{02}(\text{disciplinary research time investment})_j + \gamma_{03}(\text{disciplinary intrin. research motivation})_j + \gamma_{04}(\text{disciplinary extrin. research motivation})_j + \gamma_{05}(\text{disciplinary teaching time investment})_j + \gamma_{06}(\text{disciplinary intrin. teaching motivation})_j + \gamma_{07}(\text{disciplinary extrin. teaching motivation})_j + \gamma_{08}(\text{hard})_j + \gamma_{09}(\text{pure})_j + \gamma_{10}(\text{life})_j + u_{oj} \quad (2a)
\]

\[
\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{disciplinary research productivity})_j + \gamma_{02}(\text{disciplinary research time investment})_j + \gamma_{03}(\text{disciplinary intrin. research motivation})_j + \gamma_{04}(\text{disciplinary extrin. research motivation})_j + \gamma_{05}(\text{disciplinary teaching time investment})_j + \gamma_{06}(\text{disciplinary intrin. teaching motivation})_j + \gamma_{07}(\text{disciplinary extrin. teaching motivation})_j + \gamma_{08}(\text{realistic})_j + \gamma_{09}(\text{artistic})_j + \gamma_{10}(\text{enterprising})_j + \gamma_{11}(\text{investigative})_j + u_{oj} \quad (2b)
\]
Since I am allowing my student-centered pedagogy intercept to vary across disciplines, equations 2a and 2b display that the intercept for discipline $j$ ($\beta_{0j}$) is a function of an overall or grand disciplinary mean intercept, specified disciplinary level fixed effects, and a residual term that captures how $\beta_{0j}$ deviates from the grand disciplinary mean intercept. This grand disciplinary mean intercept is symbolized by $\gamma_{00}$. It is the average of the separate disciplinary cluster intercepts, and it represents the average disciplinary mean level on faculty utilization of student-centered pedagogy when all other predictors are held constant at zero.

The terms $\gamma_{01}$ through $\gamma_{11}$ correspond to the fixed effects for the disciplinary level predictors specified in equations 2a and 2b. For example, $\gamma_{02}$ quantifies the relationship between disciplinary research time investment and faculty utilization of student-centered pedagogy when all other variables are held constant. The $u_{0j}$ term represents the level-two residual term. It captures disciplinary level differences in faculty utilization of student-centered pedagogy around the grand disciplinary mean intercept ($\gamma_{00}$). Since the $u_{0j}$ term is the same for every faculty member in discipline $j$, disciplinary dependence of observations can be accounted for (Raudenbush & Byrk, 2002). As such, $u_{0j}$ embodies the central analytic utility of HLM.

Disciplinary level variables for research productivity, research time investment, intrinsic research motivation, and extrinsic research motivation were generated by finding mean composite measures of all individual level responses to these respective variables based on self-selected disciplinary affiliation. Collectively, these 2nd level variables appraised each discipline’s research role context. A 2007 HERI Faculty Survey item requesting the field of
current faculty appointment enabled this disciplinary clustering. See Appendix A for the list of all disciplinary categories provided in the survey. This survey item was also employed to operationalize Biglan’s three-dimensional model and Holland’s work environments. Using Biglan’s dimensions, three separate dummy variables were created with soft, applied, and nonlife disciplines serving as the respective reference groups. Four dummy variables were generated for Holland’s realistic, artistic, enterprising, and investigative disciplines utilizing the Dictionary of Holland Occupational Codes (Gottfredson & Holland, 1996). Social disciplines served as the reference group. Conventional disciplines were excluded from analysis because only one disciplinary option (accounting) from the 2007 HERI Faculty Survey fit such a classification.

Table 3.2
Level-One Independent Variables: HERI Faculty Survey Items & Response Options

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>2007 HERI Faculty Survey Item</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Productivity</td>
<td>How many exhibitions or performances in the fine or applied arts have you presented in the last two years:</td>
<td>1 = None</td>
</tr>
<tr>
<td></td>
<td>How many of your professional writings have been published or accepted for publication in the last two years:</td>
<td>2 = 1-2</td>
</tr>
<tr>
<td></td>
<td>During the present term, how many hours on average do you actually spend on each of the following activities:</td>
<td>3 = 3-4</td>
</tr>
<tr>
<td></td>
<td>1) research and scholarly writing</td>
<td>4 = 5-10</td>
</tr>
<tr>
<td></td>
<td>2) other creative products/performances</td>
<td>5 = 11-20</td>
</tr>
<tr>
<td></td>
<td>3) consultation with clients/patients</td>
<td>6 = 21-50</td>
</tr>
<tr>
<td></td>
<td>4) outside consulting/freelance work</td>
<td>7 = 51+</td>
</tr>
<tr>
<td>Research Time Investment</td>
<td>1 = None</td>
<td>2 = 1-4</td>
</tr>
<tr>
<td></td>
<td>2 = 1-4</td>
<td>3 = 5-8</td>
</tr>
<tr>
<td>Intrinsic Research Motivation</td>
<td>4 = 9-12</td>
<td>5 = 13-16</td>
</tr>
<tr>
<td></td>
<td>6 = 17-20</td>
<td>7 = 21-34</td>
</tr>
<tr>
<td></td>
<td>8 = 35-44</td>
<td>9 = 45+</td>
</tr>
<tr>
<td>Extrinsic Research Motivation</td>
<td>1 = not important</td>
<td>2 = somewhat</td>
</tr>
<tr>
<td></td>
<td>3 = very important</td>
<td>important</td>
</tr>
<tr>
<td></td>
<td>Indicate the importance to you of the following:</td>
<td>4 = essential</td>
</tr>
<tr>
<td></td>
<td>obtaining recognition from my colleagues for contributions to my special field:</td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>2007 HERI Faculty Survey Item</th>
<th>Response Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Time</td>
<td>During the present term, how many hours on average do you actually spend on each of the following activities:</td>
<td>1 = None 1) scheduled teaching (actual, not credit hours) 2 = 1-4 2) preparing for teaching 3 = 5-8 including reading papers and grading 4 = 9-12 3) advising and counseling students 5 = 13-16 6 = 17-20 7 = 21-34 8 = 35-44 9 = 45+</td>
</tr>
<tr>
<td>Intrinsic Teaching</td>
<td>Personally, how important to you is research:</td>
<td>1 = Not important 1) Not descriptive 2 = Somewhat important 2) Somewhat descriptive 3 = Very important 3) Very descriptive 4 = Essential</td>
</tr>
<tr>
<td>Extrinsic Teaching</td>
<td>Indicate how well each of the following describes your college or university: Faculty are rewarded for being good teacher.</td>
<td>1 = Not descriptive 1) Not descriptive 2 = Somewhat descriptive 2) Somewhat descriptive 3 = Very descriptive 3) Very descriptive</td>
</tr>
<tr>
<td>Motivation</td>
<td>Sex</td>
<td>1 = Male 1) Male 2 = Female 2) Female</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td>Derived by HERI</td>
<td>1 = American Indian 1) Derived by HERI 2 = Asian 2) Derived by HERI 3 = Black 3) Derived by HERI 4 = Hispanic 4) Derived by HERI 5 = White 5) Derived by HERI 6 = Other 6) Derived by HERI 7 = Two or more races 7) Derived by HERI</td>
</tr>
<tr>
<td>Faculty Rank</td>
<td>What is your present academic rank:</td>
<td>1 = Full Professor 1) Full Professor 2 = Associate Professor 2) Associate Professor 3 = Assistant Professor 3) Assistant Professor</td>
</tr>
<tr>
<td>Age</td>
<td>Enter the four-digit year that each occurred: year of birth:</td>
<td>1 = Single 1) Respondent entered 2 = Married 2) Respondent entered 3 = Unmarried, living with partner 3) Respondent entered 4 = Divorced 4) Respondent entered 5 = Widowed 5) Respondent entered 6 = Separated 6) Respondent entered</td>
</tr>
<tr>
<td>Marital Status</td>
<td>Are you currently: (mark one)</td>
<td>1 = 0 1) 0 2 = 1 2) 1 3 = 2 3) 2 4 = 3 4) 3 5 = 4+ 5) 4+</td>
</tr>
<tr>
<td>Number of Children</td>
<td>How many children do you have in the following age ranges: under 18 years old</td>
<td>1 = 0 1) 0 2 = 1 2) 1 3 = 2 3) 2 4 = 3 4) 3 5 = 4+ 5) 4+</td>
</tr>
<tr>
<td>English Native</td>
<td>Is English your native language:</td>
<td>1 = No 1) No 2 = Yes 2) Yes</td>
</tr>
<tr>
<td>Language Status</td>
<td>General Education Course Load</td>
<td>1 = 0 1) How many of the following courses are you teaching this term: general education courses 2 = 1 2) How many of the following courses are you teaching this term: general education courses 3 = 2 3) How many of the following courses are you teaching this term: general education courses 4 = 3 4) How many of the following courses are you teaching this term: general education courses 5 = 4 5) How many of the following courses are you teaching this term: general education courses 6 = 5+ 6) How many of the following courses are you teaching this term: general education courses</td>
</tr>
</tbody>
</table>
HLM & SAS PROC MIXED

I employed SAS 9.4 statistical software to conduct my HLM analyses. The statistical crux of HLM is its ability to account for the linear dependence that accompanies nested data by allowing the dependent measure of interest to vary between higher level units of analysis. Nested data structures also permit specified parameters to vary between higher level units of analysis. Such variance allowances are termed random effects; whereas, as is standard in single level OLS regression, parameters deemed to not vary between higher level units are classified as fixed effects. The SAS PROC MIXED program was developed as a generalization of the standard linear model for the purpose of examining both fixed and random effects concurrently (Singer, 1998). This flexibility enables a variety of purposeful specifications in the hierarchical or multilevel model building process. Given my multifaceted research focus entailed both random and fixed effects, SAS’s PROC MIXED program was an ideal analytic medium.

As a generalization of the standard linear model, PROC MIXED necessitates a continuously measured dependent variable in order to prevent violation of the OLS core assumptions of homoscedasticity and normal distribution of standard errors (Agresti, 2007). The given study regressed a summative composite of 4-point Likert-type items quantifying faculty use of pedagogical strategies that emerged from exploratory factor analysis as student-centered in form and function. I conducted diagnostic analyses to evaluate the extent to which this dependent variable supported the aforementioned OLS distributional assumptions.
Model Building

**Descriptive and diagnostic analysis.** Before the formal model building process, I conducted robust descriptive and diagnostic analyses. First, in order to probe and discern their distributional profiles, every dependent and independent variable was analyzed via standard univariate summary statistics. These summary statistics included each variable’s mean, standard deviation, frequency breakdown, skew, and kurtosis. Extending the notion of a measure’s distributional profile, my study’s primary predictors targeted analogous behavioral and motivational manifestations of faculty teaching and research. These related measures presented the potential for erroneous HLM parameter and standard error estimations due to excessive linear dependence (multicollinearity). Accordingly, I conducted principal component analysis (PCA) on my faculty work role predictors. PCA enabled critical diagnostics in the detection of harmful multicollinearity.

Lastly, I conducted bivariate descriptive analyses to assess my analytic model’s fidelity to the OLS assumptions of normality, linearity, and homoscedasticity at both the individual faculty and disciplinary levels of analysis. Assumptions not robust until violation increase the likelihood of Type I and II errors (Osborne & Waters, 2002). The normality assumption can be assessed via histograms or box-and-whisker plots by the extent to which the distribution of overall model residuals at each level of analysis adheres to the normal or bell-shaped curve. The assumptions of linearity and homoscedasticity respectively assert a linear relation between dependent and independent variables at each level of analysis and an error term displaying equality of variance at each level of analysis. Both assumptions can be
examined via a scatter plot of predicted values against overall model residuals (Bell et al., 2010).

To the extent fidelity to these assumptions was less than ideal, I employed data transformations of my model’s continuously measured variables in order to optimize their respective normality. Specifically, I employed the Box-Cox series of transformations that produce a continuum of power transforms, thereby enabling selection of the transform that best corrects a given variable’s normality. The combined effect of these univariate modifications often serves to improve overall model normality, linearity, and homoscedasticity (Osborne, 2013). My research study called for a HLM model composed of two levels. Sequentially, this hierarchical structure mandated attention to the null, within discipline, and between discipline models during the model building process.

**Null model.** The first step of the modeling process was to estimate the variance in faculty utilization of student-centered pedagogy that was attributable to individual faculty members (within discipline) and disciplinary affiliation (between discipline). The null or unconditional model, absent the presence of predictors, enabled clean estimations of the variance present both within- and between- disciplines by allowing the intercept to vary between level-two units (disciplines). Estimating these variance components permitted calculation of the intraclass correlation coefficient and provided a baseline for assessing the explanatory power of future, more parameterized models (McCoach, 2010). The intraclass correlation coefficient (ICC) reflects the proportion of variance that is between clusters or that can be explained by the clustering effect (McCoach, 2010). Alternatively, in the context
of my study, the ICC can be thought of as the expected correlation between two randomly selected faculty members within the same discipline (Hox, 2002).

Equation 3 presents the null model. The $Y_{ij}$ term represents the utilization of student-centered pedagogy for faculty member $i$ in discipline $j$. $\beta_{0j}$ corresponds to the mean intercept for discipline $j$, while the $\gamma_{00}$ term denotes the grand disciplinary mean intercept. The $r_{ij}$ term represents the deviation of a faculty member’s score from his or her disciplinary mean, and the $u_{oj}$ term captures the deviation of a given disciplinary mean from the grand disciplinary mean.

$$Y_{ij} = \beta_{0j} + r_{ij}$$
$$\beta_{0j} = \gamma_{00} + u_{oj}$$

**Within discipline model.** The second step of the model building process involved the inclusion of all predictors at the individual faculty level of analysis and encompassed three stages of development. The first stage involved the inclusion of my central faculty work role predictors and demographic/background variables as level-one fixed effects. This stage corresponds to the base within discipline model defined in Equation 1. Given the significance of a potential disciplinary effect to my study, it was meaningful to explore if the relation between faculty utilization of student-centered pedagogy and my faculty work role predictors varied based on disciplinary affiliation. Accordingly, in addition to the standard randomly varying intercept, the second stage involved allowing the slopes of my level-one faculty work role predictors to randomly vary across disciplinary clusters. I conducted this
phase by examining the significance of each random slope separately in the presence of all level-one fixed effects. If my faculty work role slopes failed to present statistically significant variability across disciplinary clusters, they were specified as fixed effects throughout the model building process.

The last stage systematically probed the presence of significant level-one interactions involving my faculty work role predictors. An interactive effect occurs when a moderating predictor impacts the direction and/or strength of the relationship between a focal predictor and the dependent measure of interest. In the interest of parsimonious model fit, I only expanded my model with interactions that rose to significance. Subsequent reductions in the within discipline variance estimate at each of the above parametrization stages served as means for evaluating their explanatory power.

**Between discipline model.** The third step of the model building process concerned the inclusion of all predictors at the disciplinary level of analysis. It proceeded along three stages of development. The first stage involved the addition of my faculty work role predictors averaged by disciplinary affiliation and my designated disciplinary taxonomies. However, at this stage, I ran two separate models incorporating Biglan’s three dimensions and Holland’s academic environments to avoid potential multicollinearity and parameter misestimation issues. These progressions in the model building process correspond to the base between discipline models defined in Equation 2a and Equation 2b. The addition of disciplinary level predictors could potentially explain away the significant between discipline variability in a level-one random slope. In this scenario, the slope of the level-one predictor
in question is neither fixed nor random; rather, it systematically varies as a function of the disciplinary level predictors (McCoach, 2010).

The second stage methodically explored the presence of significant interactions involving my level-two fixed effects. In particular, I examined if the relation between a disciplinary work role or taxonomy predictor and faculty utilization of student-centered pedagogy varied based on another level-two predictor. The last stage systematically examined the extent to which the relationship between a level-one faculty work role predictor and faculty utilization of student-centered pedagogy varied based on a specified disciplinary level predictor. Such a model specification constitutes a cross-level interaction. I only included level-two and cross-level interactions that rose to statistical significance. Successive reductions in the between discipline variance estimate at each of the above parametrization stages elucidated my model’s power in explaining the observed disciplinary level variance in faculty utilization of student-centered pedagogy. In sum, my final full model reflected the convergence of my base within and between discipline models supplemented with same and cross level interactive effects that reached significance.

Limitations

Population and Sample

Key limitations pertain to the population and sample of both the 2007 HERI Faculty Survey and my delineated study. The faculty survey’s sample was obtained from institutions that chose to employ HERI’s research services. This institutional self-selection lacked randomization and restricted inference and generalizability to the faculty members and
disciplines surveyed within these institutions. To this point, I did not have access to knowledge concerning if the institutions in question surveyed their complete faculty and academic disciplinary populations. The subset of the 2007 HERI Faculty Survey defining my study was subject to the same methodological critiques.

**Level-Two Sample Size**

Sample size is a critical consideration in HLM analysis. The overall level-one sample size tends to be less critical than the number of level-two clusters and the average number of level-one observations within each level-two cluster (McCoach, 2010). The number of level-one observations within each level-two cluster can produce biased random effect estimates (McCoach, 2010). To this concern, I selected a minimum level-two disciplinary cluster size of fifteen. Clusters not meeting this threshold were combined with an allied disciplinary cluster categorized within the same Biglan dimensions and Holland work environment. If such a combination was not viable, the cluster was eliminated from analysis.

The number of level-two clusters (level-two sample size) is the most critical sample size consideration in HLM analysis (McCoach, 2010). The number of clusters must be large enough to generate relatively unbiased variance, parameter, and standard error estimates. Maas and Hox (2005) performed a series of simulations to assess the relationship between level-two sample size and unbiased HLM analyses. With a minimum of 30 clusters, fixed effects and both level-one and level-two variance components were estimated with little bias. Standard error estimations for fixed effects and level-one variance components also exhibited minimal bias; however, standard errors for level-two variance components tended to be
underestimated. A level-two sample size of 100 clusters continually prevented specious standard error estimates of the level-two variance component. The 2007 HERI Faculty Survey offered respondents 97 response options for affirming their disciplinary affiliation. In addition to cluster combinations, unclear Biglan or Holland categorizations resulted in several cluster eliminations. These level-two sample size reductions increased the risk of assigning greater than warranted prominence to my between-cluster variance.

**Scale of Measurement**

The use of ordinal scales of measurement to quantify behavioral and psychological constructs is standard practice in survey research within the social sciences. Two fundamental properties of measurement delineate ordinal scales – a clear ordered relationship exists between item response options and every response option has a unique meaning (Krathwohl, 2009). On the other hand, ordinal scales lack a true zero point and a precise, objective distance between any two response options (Krathwohl, 2009). The given study’s dependent variable and faculty work role predictors were measured on ordinal scales via Likert-type and ordered category survey items (Table 3.2). My Likert-type items were defined by response options with inexact tags prone to respondent subjectivity, and my ordered-category items contained response options demarcated by fixed numeric ranges. Forcing faculty to quantify their survey scores on such ambiguous and/or broad item response options reduced precision and masked the true variance between respondents. The extent of this psychometric limitation potentially threatened the ability of HLM to accurately predict nonrandom relationships.
CHAPTER FOUR: RESULTS

Research suggests that structural trends in higher education have advanced a vision of faculty work that emphasizes research pursuits at the expense of teaching and undergraduate education (Boyer, 1990; Fairweather, 1996; Massy and Zemsky, 1994; Milem, Berger, & Dey, 2000; Study Group, 1984). An underlying premise of the above contention is the broad autonomy that higher education affords academics to direct their work roles. However, academic autonomy does not exist in isolation devoid of normative stimulus. In the absence of a strong vertical power structure, disciplinary membership serves as an important horizontal, peer-driven normative influence over faculty work (Becher & Trowler, 2001; Clark, 1987, 1989; Smart, Feldman, & Ethington, 2000). Disciplinary boundaries, specializations, patterns of communication and networking, career progression and prestige, and issues of debate are predominately defined by the research role of academic work (Becher & Trowler, 2001). As such, a given discipline’s normative research role context may inform its respective faculty members’ teaching values and behaviors.

The current scholarly record suggests a weak positive to null relationship between the faculty research and teaching roles; however, little scholarship has explored the research-teaching relation from a disciplinary lens. I contend that a nuanced examination of the impact of faculty research activity on teaching merits an understanding of if and how disciplinary membership differentiates this relationship. A disciplinary frame of inquiry necessitates measures of research and teaching that tap the peer driven normative influence of disciplinary membership on faculty preferences and behaviors.
Accordingly, the purpose of the given study was multidimensional. First, I examined the differential individual and disciplinary impact of research motivation, productivity, and time investment on faculty utilization of student-centered pedagogy at research universities. Second, I also employed Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) and Holland’s Theory of Careers (1973, 1997) as separate disciplinary taxonomies for predicting faculty utilization of student-centered pedagogy at research universities. Lastly, I sought nuanced understanding concerning the preceding purposes via the moderating effects of same level and cross level interactions. The research questions below explicate this research purpose.

1. How much of the variance in faculty utilization of student-centered pedagogy at research universities lies within and between disciplines?

2. To what extent do research productivity, research time investment, and research motivation predict the utilization of student-centered pedagogy at research universities?

   c. To what extent do full-time, tenured or tenure-track faculty members’ levels of research productivity, research time investment, and research motivation predict their utilization of student-centered pedagogy at research universities?

   d. To what extent does a discipline’s level of research productivity, research time investment, and research motivation predict full-time, tenured or tenure-track faculty members’ utilization of student-centered pedagogy at research universities?
3. To what extent do disciplinary taxonomies predict the utilization of student-centered pedagogy at research universities?

c. To what extent does Holland’s (1973, 1997) career choice theory and its distinct model environments explain disciplinary level variance in faculty members’ utilization of student-centered pedagogy at research universities?

d. To what extent does Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) explain disciplinary level variance in faculty members’ utilization of student-centered pedagogy at research universities?

Hierarchical linear modeling (HLM) enabled empirical consideration of my research agenda based on data from the 2007 Higher Education Research Institute (HERI) Faculty Survey administered by the University of California, Los Angeles. The following chapter details my data analysis process and HLM results. First, I present data analysis that addresses my decision-making concerning two preliminary yet consequential methodological issues: treatment of missing data and eliminating or combining disciplinary units at the second level of analysis. The second section contains exploratory factor analysis results grounding the study’s use of a summative dependent variable to measure efficacious teaching via utilization of student-centered pedagogy. Next, I address important considerations concerning my independent variables including a descriptive analysis of all first and second level predictors, an assessment of multicollinearity, and an explanation of my centering approach. The fourth section evaluates and addresses regression assumptions fundamental to
the hierarchical linear modeling process. The chapter concludes with a comprehensive presentation of my HLM results and a discussion of these results within the framework of my study’s research questions.

**Initial Methodological Considerations**

The raw dataset provided to me contained 31,534 unique individual faculty respondents that self-identified into 99 distinct disciplinary groupings. See Appendix A for a list of all disciplinary classifications within the 2007 HERI Faculty Survey. As outlined in chapter three, I subset the dataset to respondents who self-identified as tenure-track faculty and to respondents from research universities based on their respective institution’s Carnegie classification. These delimitations inherent to my research focus resulted in 6,606 individual faculty observations that self-identified into 98 distinct disciplinary units. The secretarial studies disciplinary classification was eliminated through this restriction.

**Treatment of Missing Data**

Missing data is as an unavoidable methodological consideration in research relying on survey data. Significant missing data, especially when nonrandom, carries critical analytical handicaps including biased parameter estimates and loss of power (Maas & Hox, 2005). The standard regression approach to missing data is listwise deletion or complete case analysis in which a given respondent observation is excluded from analysis under the condition that one or more model variables is missing. I conducted a complete case analysis based on all independent and dependent variables comprising my analytic model.
Results indicated a complete case subset composed of 6,074 individual faculty observations or approximately 92% of the original dataset. All 98 distinct disciplinary units were retained. A level one sample reduction of only 8% negligibly impacted my model’s analytic power and minimized potential biased parameter estimates due to nonrandom nonresponse. To the latter concern, the nonresponse rate for every level one variable within my model was at most 2%, and a chi-square test of goodness-of-fit indicated no distributional difference based on disciplinary membership between the original and complete case analysis datasets, $X^2(97, N = 6074) = 7.96, p = .99$. Consequently, I chose listwise deletion or complete case analysis as my treatment for missing data.

**Level-Two Sample Size**

Hierarchical or multilevel modeling possesses multiple sample sizes corresponding to the number of analysis levels under investigation. My study presents two samples sizes at the individual faculty and disciplinary levels. Treating missing data through complete case analysis produced an initial analytic sample of 6,074 individual faculty observations that self-identified within 98 disciplinary clusters. Coding these disciplinary clusters within both Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) and Holland’s six work environments (1973, 1997) was central to my research focus. Since accounting was the only sampled discipline representing Holland’s conventional environment, all accounting faculty observations were omitted. If broad or ambiguous language defining the HERI Faculty Survey’s disciplinary response options prevented Biglan or Holland categorization, clusters were excluded from analysis. This standard resulted in
the elimination of four clusters: general/other humanities fields, general/other social sciences, other vocational, and all other fields. The ensuing subset included 5,758 individual faculty observations within 93 disciplinary clusters.

In a two level HLM model, the number of level-one observations within level-two clusters is important, but the number of level-two clusters is most critical (Maas & Hox, 2005; McCoach, 2010). To the former, given that small cluster sizes can produce biased random effect estimates, I chose a conservative minimum discipline size of fifteen (Maas & Hox, 2005). I combined a cluster falling below this minimum with a closely related disciplinary cluster categorized within the same Biglan dimensions and Holland work environment; otherwise, if a combination was not possible, I removed the cluster from analysis. Table 4.1 details my decisions regarding such clusters. These cluster decisions resulted in a final analytic sample of 5,745 individual faculty observations clustered within 69 disciplines. Level-two sample sizes over 30 support accurate and unbiased fixed effects and variance components (Maas & Hox, 2005). Fewer than 100 clusters can underestimate the standard error of the level-two variance component (Maas & Hox, 2005). See Appendix B for a record of my final disciplinary clusters.
Table 4.1
Level-Two Cluster Decisions (below 15 observations)

<table>
<thead>
<tr>
<th>Disciplinary Classification</th>
<th>Cluster Size</th>
<th>Cluster Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Education</td>
<td>1</td>
<td>excluded from analysis</td>
</tr>
<tr>
<td>Music or Art Education</td>
<td>7</td>
<td>excluded from analysis</td>
</tr>
<tr>
<td>Archaeology</td>
<td>2</td>
<td>excluded from analysis</td>
</tr>
<tr>
<td>Law Enforcement</td>
<td>3</td>
<td>excluded from analysis</td>
</tr>
<tr>
<td>Forestry</td>
<td>13</td>
<td>Combined with Agriculture</td>
</tr>
<tr>
<td>Biophysics</td>
<td>2</td>
<td>Combined with Biochemistry</td>
</tr>
<tr>
<td>Marine (life) Sciences</td>
<td>3</td>
<td>Combined with Environmental Science</td>
</tr>
<tr>
<td>International Business</td>
<td>4</td>
<td>Combined with general/other business</td>
</tr>
<tr>
<td>Educational Administration</td>
<td>11</td>
<td>Combined with Higher Education and general/other educational fields</td>
</tr>
<tr>
<td>Higher Education</td>
<td>9</td>
<td>Combined with Educational Administration and general/other educational fields</td>
</tr>
<tr>
<td>Dentistry</td>
<td>8</td>
<td>Combined with Health Technology, Veterinary Medicine, and general/other health fields</td>
</tr>
<tr>
<td>Health Technology</td>
<td>1</td>
<td>Combined with Dentistry, Veterinary Medicine, and general/other health fields</td>
</tr>
<tr>
<td>Veterinary Medicine</td>
<td>7</td>
<td>Combined with Dentistry, Health Technology, and general/other health fields</td>
</tr>
<tr>
<td>Astronomy</td>
<td>10</td>
<td>Combined with Atmospheric Sciences, Marine Sciences, and general/other physical sciences</td>
</tr>
<tr>
<td>Atmospheric Sciences</td>
<td>6</td>
<td>Combined with Astronomy, Marine Sciences, and general/other physical sciences</td>
</tr>
<tr>
<td>Marine Sciences</td>
<td>11</td>
<td>Combined with Astronomy, Atmospheric Sciences, and general/other physical sciences</td>
</tr>
<tr>
<td>Counseling and Guidance</td>
<td>8</td>
<td>Combined with Clinical Psychology</td>
</tr>
<tr>
<td>Data Processing, Computer Prog.</td>
<td>6</td>
<td>Combined with Computer Science</td>
</tr>
<tr>
<td>Drafting/Design</td>
<td>3</td>
<td>Combined with Electronics, Industrial Arts, Mechanics, Building Trades, and other technical</td>
</tr>
<tr>
<td>Electronics</td>
<td>5</td>
<td>Combined with Drafting/Design, Industrial Arts, Mechanics, Building Trades, and other technical</td>
</tr>
<tr>
<td>Industrial Arts</td>
<td>3</td>
<td>Combined with Drafting/Design, Electronics, Mechanics, Building Trades, and other technical</td>
</tr>
<tr>
<td>Mechanics</td>
<td>1</td>
<td>Combined with Drafting/Design, Electronics, Industrial Arts, Building Trades, and other technical</td>
</tr>
<tr>
<td>Building Trades</td>
<td>1</td>
<td>Combined with Drafting/Design, Electronics, Industrial Arts, Mechanics, and other technical</td>
</tr>
<tr>
<td>Ethnic Studies</td>
<td>7</td>
<td>Combined with Women’s Studies</td>
</tr>
<tr>
<td>Women’s Studies</td>
<td>9</td>
<td>Combined with Ethnic Studies</td>
</tr>
</tbody>
</table>
Dependent Variable: Faculty Utilization of Student-Centered Pedagogy

Faculty utilization of student-centered pedagogy constituted my study’s dependent variable. I chose to operationalize this construct based on an eventual summative composite of survey items quantifying the extent to which faculty employ explicit pedagogical behaviors. Table 4.2 displays these seventeen Likert-type items measured on a 4-point ordinal scale. A prima facie review suggested that they were crafted to gauge good instructional practice based upon the fundamental student-centered pedagogical themes of student engagement, autonomy, cooperation, and diversity (Barr & Tagg, 1995; Lea, Stephenson, & Troy, 2003; O’Neill & McMahon, 2005).

Only two items strikingly deviated from this thematic hypothesis: teaching assistants and extensive lecturing. The presence of teaching assistants does not directly imply anything about the nature or quality of instruction, and extensive lecturing stands diametrically opposed to the theoretical underpinnings of student-centered pedagogy. Nevertheless, both pedagogical methods are widespread, particularly at research universities. Supporting my initial prima facie assessment, internal consistency analysis suggested a robust degree of reliability (17 items; α = .77). A strong Cronbach Alpha does not automatically mandate a single underlying construct; rather, multiple latent constructs may best define such robust reliability. In other words, internal consistency implies dimensionality but not its multiplicity (Cortina, 1993).
Exploratory Factor Analysis

Factor analysis techniques provide a means for quantifying the dimensionality of an internally consistent grouping of variables (Cortina, 1993). In particular, exploratory factor analysis (EFA) is a statistical technique that examines the interrelationships among observed measures in order to identify a latent factor solution without imposing the measures on a predetermined factor structure (Bandalos & Finney, 2010; Child, 1990). In order to ascertain evidence of a student-centered construct underlying the 17 given pedagogical items, I conducted EFA with a principal-axis factor extraction.

**Principal-axis factor extraction.** Factor extraction defines the estimation process for solution parameters including factor loadings and prospective factor intercorrelations. The descriptive nature of principal-axis factoring’s (PAF) estimation method does not enable interpretability of the factor solution to a wider population beyond the sample under analysis; nonetheless, it has been shown to be markedly robust and accurate (Briggs & McCallum, 2003; Finch & West, 1997). Given that my analytic sample included de-identified research institutions that procured access to HERI’s 2007 Faculty Survey, my study’s constrained generalizability supported principal-axis factor extraction.

**Assessing normality.** The distributional characteristics of EFA variables necessitate inspection. Observed variables with non-normal distributions or few scale points can estimate false factors. As long as absolute skew and kurtosis does not persistently exceed 2.0, factor falsification should be of no concern (Bandalos & Finney, 2010). Table 4.2 indicates that the observed faculty pedagogical items overwhelmingly demonstrated robust
normality. Only **community service as part of coursework** and **electronic quizzes with immediate feedback in class** deviated from the ascribed normality parameters.

**Communalities and variable elimination.** A meaningful EFA model solution must navigate factor parsimony and plausibility. Given that EFA is concerned only with the segment of total variance that is shared by the observed variables, scrutinizing common variance is most critical to obtaining an empirically sound yet coherent factor solution (Bandalos & Finney, 2010). Communalities are gauges of common variance that enable such scrutiny by estimating the proportion of variance for each observed variable that is error free and shared with the remaining variables under analysis. Low communality estimates suggest that variables might be measuring different underlying constructs than the remaining observed variables (Bandalos & Finney, 2010; Child, 1990). In such situations, elimination from analysis warrants careful consideration. Initial analysis prior to factor extraction revealed four variables with strikingly low communality estimates. Only 18% of the total variance for faculty utilization of *recitals/demonstrations* was shared with the remaining pedagogical items. Such a modest level of common variance should be expected given that *recitals/demonstrations* are germane to a finite grouping of disciplines, mainly in the fine arts and technical fields. Excluding this item would unjustifiably restrict varied forms of student-centered pedagogy manifested in diverse disciplines.

*Electronic quizzes with immediate feedback in class, teaching assistants, and extensive lecturing* shared 6%, 12%, and 19% of their variance with the remaining pedagogical items, respectively. For the latter two items, low communalities reinforced my
earlier supposition postulating their incongruity with a latent student-centered pedagogical construct. Quite oppositely, *electronic quizzes with immediate feedback in class* undoubtedly embody the student-centered themes of engagement and empowerment; however, a review of its descriptive measures from Table 4.2 indicated a sharply peaked and positively skewed distribution with a mean close to the response scale minimum. From this univariate evidence and the age of the dataset, I concluded a prevalence of faculty responded at the scale minimum due to a deficiency in institutional resources and facilities that enable such a technology based pedagogical approach. Accordingly, I eliminated all three of the above items and reran my EFA model. The remaining items presented a higher degree of internal consistency (14 items; $\alpha = .83$).

### Table 4.2

*HERI Faculty Survey: Pedagogical Survey Items & Descriptive Statistics*

<table>
<thead>
<tr>
<th>Pedagogical Method Survey Items</th>
<th>Mean</th>
<th>SD</th>
<th>Kurtosis</th>
<th>Skew</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class discussions</td>
<td>3.28</td>
<td>0.91</td>
<td>-0.49</td>
<td>-0.90</td>
</tr>
<tr>
<td>Cooperative learning (small groups)</td>
<td>2.61</td>
<td>1.07</td>
<td>-1.30</td>
<td>0.00</td>
</tr>
<tr>
<td>Experiential learning/Field studies</td>
<td>1.95</td>
<td>1.01</td>
<td>-0.54</td>
<td>0.78</td>
</tr>
<tr>
<td>Teaching assistants</td>
<td>1.96</td>
<td>0.98</td>
<td>-0.51</td>
<td>0.74</td>
</tr>
<tr>
<td>Recitals/Demonstrations</td>
<td>1.81</td>
<td>0.99</td>
<td>-0.20</td>
<td>0.99</td>
</tr>
<tr>
<td>Group projects</td>
<td>2.17</td>
<td>0.97</td>
<td>-0.68</td>
<td>0.51</td>
</tr>
<tr>
<td>Extensive lecturing</td>
<td>2.65</td>
<td>0.98</td>
<td>-1.02</td>
<td>-0.12</td>
</tr>
<tr>
<td>Multiple drafts of written work</td>
<td>1.95</td>
<td>0.87</td>
<td>-0.05</td>
<td>0.74</td>
</tr>
<tr>
<td>Readings on racial and ethnic issues</td>
<td>1.67</td>
<td>0.95</td>
<td>0.52</td>
<td>1.29</td>
</tr>
<tr>
<td>Readings on women and gender issues</td>
<td>1.62</td>
<td>0.92</td>
<td>0.89</td>
<td>1.40</td>
</tr>
<tr>
<td>Student-developed activities</td>
<td>1.92</td>
<td>1.08</td>
<td>-0.58</td>
<td>0.88</td>
</tr>
<tr>
<td>Student-selected topics for course content</td>
<td>1.78</td>
<td>0.80</td>
<td>0.78</td>
<td>0.99</td>
</tr>
<tr>
<td>Reflective writing/journaling</td>
<td>1.62</td>
<td>0.87</td>
<td>1.07</td>
<td>1.37</td>
</tr>
<tr>
<td>Community service as part of coursework</td>
<td>1.29</td>
<td>0.60</td>
<td>5.38</td>
<td>2.28</td>
</tr>
<tr>
<td>Electronic quizzes with immediate feedback in class</td>
<td>1.28</td>
<td>0.65</td>
<td>6.34</td>
<td>2.56</td>
</tr>
<tr>
<td>Using real-life problems</td>
<td>2.61</td>
<td>1.04</td>
<td>-1.19</td>
<td>-0.05</td>
</tr>
<tr>
<td>Using student inquiry to drive learning</td>
<td>2.41</td>
<td>0.95</td>
<td>-0.84</td>
<td>0.27</td>
</tr>
</tbody>
</table>
**Eigenvalues and factor dimensionality.** The blueprint for determining the number of factors to extract is not at a stable or standardized exercise (Bandalos & Finney, 2010; Child, 1990). Eigenvalues indicate the amount of common variance that is uniquely explained by each extracted factor. After eliminating the three observed variables outlined above, my follow-up analysis yielded a leading eigenvalue of 3.9. This eigenvalue accounted for approximately 75% of total common variance. A sizeable initial eigenvalue encompassing a significant proportion of common variance forecasts the existence of a prevailing global or overall factor (Child, 1990). Since this evidence reinforced my prima facie assessment of uni-dimensionality, I executed an additional EFA iteration explicitly requesting a single factor extraction.

**Factor loadings and model validation.** Substantiating a factor structure’s goodness-of-fit is essential. Factor loadings inform this process by estimating the relationship between each observed variable along each extracted factor. The higher the loading value, the better that factor explains the variable in question. EFA produces two types of factor loading values: structure coefficients and pattern coefficients. However, when examining a single factor structure or an uncorrelated factor structure, both loading values are identical and reflect the simple correlation between the factor and the specified observed variable (Bandalos & Finney, 2010).

Table 4.3 contains loading values for each observed variable on the extracted factor. The customary threshold for isolating significant factor loadings ranges between .30 and .40 (Bandalos & Finney, 2010). Based on the lower bound, thirteen out of the fourteen survey
items loaded significantly. *Recitals/demonstrations* approached significance with a factor correlation of .27. When applying the higher threshold, *student-developed activities* similarly fell short but approached significance with a factor loading of .38. The majority of pedagogical items presented robust loading magnitudes stretching between .55 and .65.

Table 4.3 also includes final communality estimates for my single factor structure. The convergence of this evidence corroborated the presence of a general or overall student-centered pedagogical construct across all fourteen items. Accordingly, I employed the summative aggregation of these pedagogical items for each faculty respondent as my study’s dependent measure of efficacious teaching. Based on a possible scale range of 4 to 56, the resultant dependent variable presented a mean response of 28.7 and a standard deviation of 7.

Table 4.3

*General Student-Centered Pedagogy Factor: Factor Loadings and Communalities*

<table>
<thead>
<tr>
<th>Pedagogical Method Survey Items</th>
<th>Factor Loading</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class discussions</td>
<td>0.55</td>
<td>0.34</td>
</tr>
<tr>
<td>Cooperative learning (small groups)</td>
<td>0.66</td>
<td>0.49</td>
</tr>
<tr>
<td>Experiential learning/Field studies</td>
<td>0.56</td>
<td>0.37</td>
</tr>
<tr>
<td>Recitals/Demonstrations</td>
<td>0.27</td>
<td>0.15</td>
</tr>
<tr>
<td>Group projects</td>
<td>0.55</td>
<td>0.41</td>
</tr>
<tr>
<td>Multiple drafts of written work</td>
<td>0.47</td>
<td>0.23</td>
</tr>
<tr>
<td>Readings on racial and ethnic issues</td>
<td>0.60</td>
<td>0.79</td>
</tr>
<tr>
<td>Readings on women and gender issues</td>
<td>0.56</td>
<td>0.78</td>
</tr>
<tr>
<td>Student-developed activities</td>
<td>0.38</td>
<td>0.22</td>
</tr>
<tr>
<td>Student-selected topics for course content</td>
<td>0.52</td>
<td>0.31</td>
</tr>
<tr>
<td>Reflective writing/journaling</td>
<td>0.63</td>
<td>0.38</td>
</tr>
<tr>
<td>Community service as part of coursework</td>
<td>0.51</td>
<td>0.29</td>
</tr>
<tr>
<td>Using real-life problems</td>
<td>0.43</td>
<td>0.28</td>
</tr>
<tr>
<td>Using student inquiry to drive learning</td>
<td>0.58</td>
<td>0.37</td>
</tr>
</tbody>
</table>
**Independent Variables**

The ensuing section expounds essential considerations regarding the descriptive, diagnostic, and interpretative profile of my independent variables prior to HLM analysis. Firstly, I detail a descriptive analysis that examines the means and standard errors for all predictors measured on a continuous scale at both the individual faculty and disciplinary levels. This analysis is followed by a frequency breakdown of all categorically measured variables at both levels. My analytic models included several parallel independent measures tapping the productivity, time-investment, and motivation behind faculty work roles. For that reason, in order to protect against faulty coefficient estimates and inflated standard errors, I systematically examined my faculty work role predictors for the presence of excessive linear dependence or multicollinearity. This section concludes with a discussion of the significance of centering predictors in hierarchical linear modeling and justifies my selection of grand-mean centering.

**Descriptive Analysis**

**Continuous independent variables.** Table 4.4 presents the means and standard deviations for every continuously measured level-one and level-two independent variable. All of the survey items that I selected to quantify my faculty work role predictors of interest utilized an ordinal scale of measurement. For a detailed review of these items and their measurement scales referenced below, please consult Table 3.2. Research time investment was a summative aggregate of four ordered-category items, each measured on a 9-point ordinal scale; teaching time investment was a summative composite of three ordered-
category items, each also measured on the same 9-point ordinal scale. Their mean response values were 8.59 and 9.66 respectively.

Research productivity was the sum of two 7-point ordered category items that produced a mean of 4.33. Intrinsic research motivation and intrinsic teaching motivation were operationalized via 4-point Likert-type items. Both displayed means just under the scale maximum. Extrinsic research motivation was also measured via a 4-point Likert-type item; it presented a mean of 2.68. Extrinsic teaching motivation was operationalized through a 3-point Likert-type item; it displayed a mean of 1.85. Averaging the preceding seven level-one faculty work role predictors based on disciplinary affiliation generated their corresponding level-two values. The means of these disciplinary level variables were near identical to the means of their corresponding level-one variables; however, their markedly smaller standard deviations signaled more condensed or compressed distributions.

Categorical independent variables. Table 4.5 presents the means and standard deviations for every level-one and level-two independent variable measured on a categorical or nominal scale. Each mean corresponds to the respective predictor’s proportional representation in my analytic sample. Several demographic and background predictors were included at level-one to control for salient caches of variance in faculty utilization of student-centered pedagogy. At level-two, Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) and Holland’s work environments (1973, 1997) were categorically coded as disciplinary taxonomies within my two separate analytic models for the purpose of
predicting faculty utilization of student-centered pedagogy and exploring the presence of moderating effects on my study’s stated research-teaching relation.

Female and male respondents correspondingly represented 32.6% and 67.4% of my analytic sample. White faculty constituted the overwhelming majority of respondents (89.3%). The next largest racial/ethnic subgroup at 4.0% was Asian respondents. The proportion of Hispanic and Black respondents was identical at 1.5%. Faculty identifying as American Indian or two or more races displayed considerably low response rates. Both response options were collapsed into the Other racial/ethnic response category, producing an overall response rate of 3.7%. Full professors, associate professors, and assistant professors presented respective response rates of 41.7%, 33.9%, and 24.4%. Married faculty represented 83.6% of my analytic sample. Native English speaking faculty comprised 87.2% of respondents.

At the second or disciplinary level, pure disciplines marginally surpassed applied disciplines with a response rate of 53.1%. Soft and hard disciplines correspondingly represented 57.5% and 42.5% of my analytic sample. Non-life systems disciplines outpaced their life systems counterparts by nearly 23%. Coding disciplines according to Holland’s investigative, social, artistic, enterprising, and realistic work environments resulted in respective response rates of 44.4%, 22.1%, 17.5%, 10.2%, and 5.8%. As cited earlier, I excluded Holland’s conventional work environment given its insufficient representation in my analytic sample.
### Table 4.4

*Continuous Dependent and Independent Variables: Means and Standard Deviations*

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Pre Box-Cox Transformation</th>
<th>Post Box-Cox Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Individual Faculty Level (Level-One)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilization of Student-Centered Pedagogy</td>
<td>28.70</td>
<td>5.70</td>
</tr>
<tr>
<td>Intrinsic Research Motivation</td>
<td>3.48</td>
<td>3.00</td>
</tr>
<tr>
<td>Extrinsic Research Motivation</td>
<td>2.68</td>
<td>2.68</td>
</tr>
<tr>
<td>Intrinsic Teaching Motivation</td>
<td>3.62</td>
<td>16.51</td>
</tr>
<tr>
<td>Extrinsic Teaching Motivation</td>
<td>1.85</td>
<td>1.85</td>
</tr>
<tr>
<td>Research Time Investment</td>
<td>8.59</td>
<td>2.60</td>
</tr>
<tr>
<td>Teaching Time Investment</td>
<td>9.66</td>
<td>3.08</td>
</tr>
<tr>
<td>Research Productivity</td>
<td>4.33</td>
<td>1.55</td>
</tr>
<tr>
<td>Age</td>
<td>50.36</td>
<td>50.36</td>
</tr>
<tr>
<td>Number of General Education Courses</td>
<td>1.61</td>
<td>0.13</td>
</tr>
<tr>
<td>Number of Children</td>
<td>1.77</td>
<td>0.23</td>
</tr>
<tr>
<td><em>Disciplinary Level (Level-Two)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrinsic Research Motivation</td>
<td>3.48</td>
<td>1.15</td>
</tr>
<tr>
<td>Extrinsic Research Motivation</td>
<td>2.68</td>
<td>0.65</td>
</tr>
<tr>
<td>Intrinsic Teaching Motivation</td>
<td>3.62</td>
<td>0.33</td>
</tr>
<tr>
<td>Extrinsic Teaching Motivation</td>
<td>1.85</td>
<td>0.23</td>
</tr>
<tr>
<td>Research Time Investment</td>
<td>8.58</td>
<td>0.99</td>
</tr>
<tr>
<td>Teaching Time Investment</td>
<td>9.66</td>
<td>9.66</td>
</tr>
<tr>
<td>Research Productivity</td>
<td>4.32</td>
<td>0.47</td>
</tr>
</tbody>
</table>

### Table 4.5

*Categorical Independent Variables: Means and Standard Deviations*

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Individual Faculty Level (Level-One)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.326</td>
<td>0.47</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.015</td>
<td>0.12</td>
</tr>
<tr>
<td>Black</td>
<td>0.015</td>
<td>0.12</td>
</tr>
<tr>
<td>Asian</td>
<td>0.040</td>
<td>0.20</td>
</tr>
<tr>
<td>Other/American Indian/Two or More Races</td>
<td>0.037</td>
<td>0.19</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>0.339</td>
<td>0.47</td>
</tr>
<tr>
<td>Full Professor</td>
<td>0.417</td>
<td>0.49</td>
</tr>
<tr>
<td>Not Married</td>
<td>0.164</td>
<td>0.37</td>
</tr>
<tr>
<td>English Not Native Language</td>
<td>0.128</td>
<td>0.33</td>
</tr>
<tr>
<td><em>Disciplinary Level (Level-Two)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pure Discipline (Biglan)</td>
<td>0.531</td>
<td>0.50</td>
</tr>
<tr>
<td>Hard Discipline (Biglan)</td>
<td>0.425</td>
<td>0.49</td>
</tr>
<tr>
<td>Life Discipline (Biglan)</td>
<td>0.387</td>
<td>0.49</td>
</tr>
<tr>
<td>Realistic Discipline (Holland)</td>
<td>0.058</td>
<td>0.23</td>
</tr>
<tr>
<td>Enterprising Discipline (Holland)</td>
<td>0.102</td>
<td>0.30</td>
</tr>
<tr>
<td>Artistic Discipline (Holland)</td>
<td>0.175</td>
<td>0.38</td>
</tr>
<tr>
<td>Investigative Discipline (Holland)</td>
<td>0.444</td>
<td>0.50</td>
</tr>
</tbody>
</table>
Assessing Multicollinearity

My analytic model regressed faculty utilization of student-centered pedagogy on several analogous predictors measuring the productivity, time-investment, and motivation behind the research and teaching roles. Cronbach’s alpha (α = .61) linked my research productivity, time-investment, and motivation items in operationalizing the faculty research role context. The same could not be said of my teaching motivation and time-investment items (α = .11). Given the conceptual commonality underlying these predictors, it was critical to assess if this perceived correlation rose to a level of redundancy in which one predictor could be significantly predicted from the others. Such undue linear dependence or multicollinearity between predictors threatens the precision of coefficient estimation and inflates standard errors (Farrar & Glauber, 1967).

Multicollinearity offers no definitive standards of detection. Principal component analysis does provide diagnostic tools for identifying where multicollinearity levels warrant inspection and thoughtful methodological judgments. Tolerance is a diagnostic that measures the proportion of variance in a given predictor that is not explained by the remaining predictors under analysis (Hair, Anderson, Tatham, & Black, 2006). High tolerance signals an inconsequential manifestation of linear dependence between predictors. The reciprocal of tolerance or variance inflation factor (VIF) indicates the factor by which the variance of an estimated coefficient is multiplied due to multicollinearity (Hair et al., 2006). The prevalent margin is a tolerance of 10% or VIF of 10. Tolerance scores around this checkpoint mandate scrutiny of adverse multicollinearity. Table 4.6 contains tolerance...
and VIF diagnostics for my faculty work role predictors. Not only did all predictors
prominently surpass the 10% tolerance threshold, but they also exceeded the less common
yet more stringent 20% checkpoint. This evidence supported the absence of harmful
multicollinearity.

Table 4.6
*Faculty Work Role Independent Variables: Multicollinearity Diagnostics*

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Tolerance</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual Faculty Level (Level-One)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Motivation (Intrinsic)</td>
<td>72%</td>
<td>1.39</td>
</tr>
<tr>
<td>Research Motivation (Extrinsic)</td>
<td>86%</td>
<td>1.16</td>
</tr>
<tr>
<td>Teaching Motivation (Intrinsic)</td>
<td>93%</td>
<td>1.08</td>
</tr>
<tr>
<td>Teaching Motivation (Extrinsic)</td>
<td>96%</td>
<td>1.04</td>
</tr>
<tr>
<td>Research Time Investment</td>
<td>75%</td>
<td>1.34</td>
</tr>
<tr>
<td>Teaching Time Investment</td>
<td>90%</td>
<td>1.11</td>
</tr>
<tr>
<td>Research Productivity</td>
<td>70%</td>
<td>1.43</td>
</tr>
<tr>
<td><strong>Disciplinary Level (Level-Two)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disciplinary Research Motivation (Intrinsic)</td>
<td>53%</td>
<td>1.89</td>
</tr>
<tr>
<td>Disciplinary Research Motivation (Extrinsic)</td>
<td>67%</td>
<td>1.49</td>
</tr>
<tr>
<td>Disciplinary Teaching Motivation (Intrinsic)</td>
<td>62%</td>
<td>1.61</td>
</tr>
<tr>
<td>Disciplinary Teaching Motivation (Extrinsic)</td>
<td>90%</td>
<td>1.12</td>
</tr>
<tr>
<td>Disciplinary Research Time Investment</td>
<td>46%</td>
<td>2.18</td>
</tr>
<tr>
<td>Disciplinary Teaching Time Investment</td>
<td>46%</td>
<td>2.18</td>
</tr>
<tr>
<td>Disciplinary Research Productivity</td>
<td>50%</td>
<td>2.01</td>
</tr>
</tbody>
</table>
Centering Independent Variables

It is commonplace within social science research to utilize arbitrary scales lacking a meaningful zero point to measure psychological constructs (Enders & Tofighi, 2007). This methodological constraint applied to the Likert scale items that I employed to quantify faculty work role motivation, time investment, and productivity. Centering of predictor variables provides a means for establishing an improvised yet interpretable zero point on such scales (McCoach, 2010). Centering around a predictor’s overall or grand mean is the standard approach in ordinary least squares regression; however, in a two level hierarchical linear model, level-one predictors can also be deviated around their level-two or cluster mean.

The grand mean and cluster mean approaches produce parameter estimates that most often differ in size and meaning; in particular, grand mean centering ignores cluster level affiliation and generates level-one parameter estimates that blend both level-one and level-two variance (Enders & Tofighi, 2007; McCoach, 2010). Accordingly, the most apt centering method should be chosen based upon the substantive nature of one’s research focus (Enders & Tofighi, 2007). This choice is not always obvious given that research is seldom singular in purpose. Enders and Tofighi (2007) developed guiding principles to inform this decision-making process. My primary scholarly purpose targeted the differential individual and disciplinary level influence of faculty research role predictors in predicting the utilization of student-centered pedagogy. My analytic model can be classified as contextual since it enabled this exploration by averaging level-one research role predictors within their affiliated
disciplinary grouping and including these means as corresponding level-two variables.

Enders and Tofghi (2007) asserted that contextual model analysis employing either centering approach produces equivalent parameter estimates. Specifically, when level-one variables are grand mean centered in a contextual model, their corresponding level-two predictors successfully partial out level-two variance from level-one parameter estimates.

As an ancillary focus, I also examined the incidence of same and cross level interactions as moderating effects in predicting the research-teaching relation outlined in my primary research focus. Grand mean centering produces level-one variables that are correlated with variables at both levels of analysis; cluster mean centering produces level-one values that are orthogonal to or independent of all level-two variables (Enders & Tofghi, 2007). Accordingly, cluster mean centering is most appropriate for interactions involving a pair of level-one predictors; whereas, grand mean centering is best for interactions involving a pair of level-two predictors. With respect to cross level interaction, cluster mean centering normally yields a purer estimate of the moderating effect since it removes between-cluster variation from the level-one predictor of interest. However, when analyzing a contextual model, grand mean centering’s specious estimation of a cross level interaction’s moderating effect can be corrected by partialling out between-cluster variation with an accompanying interaction involving the level-two predictor of interest and the level-one predictor’s corresponding level-two variable (Enders & Tofghi, 2007). Weighing Enders and Tofghi’s (2007) guidelines given my study’s contextual model, no centering method presented a clear advantage. I chose to grand mean center all predictors at both levels of analysis.
Evaluation of Fundamental Distributional Assumptions

In the same vein as other parametric statistical techniques, it is essential to scrutinize key distributional assumptions associated with HLM (McCoach, 2010). The validity of any understanding that results from HLM analysis depends on the extent to which distributional assumptions have been examined and addressed (Raudenbush & Byrk, 2002). Ordinary least squares (OLS) mandates that a regression model’s error terms must be independent, normally distributed, linear, and homoscedastic.

In the given study, a proffered terminal violation of independence of observations supplied my rationale for HLM analysis at both the individual faculty and disciplinary levels. While the latter three OLS assumptions still necessitate attention, the multilevel nature of HLM analysis complicates their evaluation. It is probable that this added intricacy has largely contributed to a broad inadequate assessment of fundamental distributional assumptions within the HLM literature (Bell, Schoeneberger, Morgan, Kromrey, & Ferron, 2010). In the balance of this section, within the context of my study, I address considerations of normality, linearity, and homoscedasticity unique to HLM and present the use of Box-Cox transformations as a means for improving their measurement and subsequent model results.

Initial Evaluation of Normality, Linearity, and Homoscedasticity

The assumptions of normality, linearity, and homoscedasticity still apply within HLM, but they must be accounted for at each level of analysis (McCoach, 2010). Normality within HLM implies the extent to which the distribution of errors terms at each level of analysis adheres to the normal or bell-shaped curve. Violations can distort variance
components and misestimate significance testing, especially at level-two (Bell et al., 2010; Osborne & Waters, 2002). This assumption can be examined via the distribution of overall model residuals within histograms or box-and-whisker plots. Normality can also be inspected by the extent to which standardized residuals plotted by their normal scores follow a diagonal line (Bell et al., 2010). Figure 4.1 details the distribution of my level-one model residuals via a histogram. Figure 4.2 illustrates the distribution of level-two model residuals in all three graphic formats. The distribution of residuals at both levels exhibited strong normality.

The linearity assumption within HLM dictates a linear relationship between dependent and independent variables at each level of analysis, and the assumption of homoscedasticity holds that variance of errors is constant across the range of predicted values at each level of analysis. Non-linearity and heteroscedasticity amplify the risk of a Type I or Type II error (Bell et al., 2010; Osborne & Waters, 2002). Both assumptions can be explored via a scatter plot of predicted values against overall model residuals (Bell et al., 2010). In particular, assumptions can be verified by the extent to which a matching number of points lie above and below a residual value of 0 with no defined shape or pattern (Bell et al., 2010; Osborne & Waters, 2002).

With respect to the given study, Figure 4.3 displays the predicted values of faculty utilization of student-centered pedagogy plotted against their level-one residuals. Figure 4.4 presents the predicted disciplinary means for faculty utilization of student-centered pedagogy plotted against their corresponding level-two residuals. The linearity assumption was
confirmed given the visible absence of a curvilinear relationship in either scatterplot. Figure 4.3 illustrated fairly clear adherence to homoscedasticity at level-one; although, a minor fanning effect was discernible with movement along the horizontal axis. This observation suggested a faint negative relationship between homoscedasticity and predicted values of faculty utilization of student-centered pedagogy. Figure 4.4 also provided reasonable support for homoscedasticity at level-two. However, the fanning effect perceivable at level-one was somewhat more pronounced with a slight downward orientation.
Figure 4.1. Distribution of level-one model residuals

Figure 4.2. Distribution of level-two model residuals
Figure 4.3. Predicted student-centered pedagogy by level-one residuals (pre Box-Cox)

Figure 4.4. Predicted student-centered pedagogy by level-two residuals (pre Box-Cox)
Box-Cox Series of Transformations

Distributional diagnostics for my model exhibited a robust degree of normality and linearity at both the individual faculty and disciplinary levels of analysis. While such diagnostics also displayed sufficient homoscedasticity, a minor yet discernable fanning of model residuals took shape at level-one and grew a bit more prominent at level-two. No matter how slight, the presence of heteroscedasticity increases the chance of a Type I error and should not be ignored (Osborne, 2013; Osborne & Waters, 2002). Moreover, addressing the distributional assumptions of your data, regardless of the extent of their robustness, only serves to improve the precision of your analysis (Osborne, 2013).

Transformations offer a statistical means for targeting the distributional shortcomings that plague data analysis in quantitative research. A data transformation reflects the application of a specified mathematical function to all data values of a continuous variable in order to optimize its normality; in turn, the collective mass of such univariate modifications frequently enhances overall model normality, linearity, and homoscedasticity (Osborne, 2013). The Box-Cox series of transformations embraces the understanding that standard data transformations are all power transformations, meaning they raise data values to a specified exponent power (Osborne, 2013). To this point, Box-Cox series analysis produces a continuum of power transformations that enables selection of the power value that best corrects a given variable’s normality.
Table 4.7 presents the skew and kurtosis normality diagnostics for my model’s continuously measured variables both before and after applying the Box-Cox transformation of best fit. With perfect normality defined by skew and kurtosis measures of 0, the ideal values for both diagnostics should fall between -1.0 and 1.0 (Osborne, 2013). Skew measures the extent of asymmetric deviation from the normal distribution. Kurtosis assesses the extent to which a distribution’s peakedness differs from the normal curve. The Box-Cox transformation coefficient ($\lambda$) identifies a variable’s power transformation of best-fit; variables absent a $\lambda$ value indicate no transformation improved normality.

Post Box-Cox transformation, all variables displayed skew within the ideal range, and nearly every kurtosis diagnostic either closely approached or fell within the desired band of values. Table 4.4 includes the new means and standard deviations for all transformed variables. Figures 4.5 and 4.6 reproduce the plots from Figures 4.3 and 4.4 after reconfiguring my analytic model with the Box-Cox transformed continuous variables. A comparison of both sets of plots indicates the transformed variables improved model homoscedasticity by reducing the fanning effect at both levels and removing the slight downward orientation of residuals at level-two. Consequently, final model analyses in the ensuing section incorporated all transformed variables.
Table 4.7
Continuous Variable Normality Diagnostics (Pre and Post Box-Cox Transformation)

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Pre Box-Cox Transformation</th>
<th>Post Box-Cox Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kurtosis</td>
<td>Skew</td>
</tr>
<tr>
<td>Utilization of Student-Centered Pedagogy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual Faculty Level (Level-One)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrinsic Research Motivation</td>
<td>0.85</td>
<td>-1.28</td>
</tr>
<tr>
<td>Extrinsic Research Motivation</td>
<td>-0.73</td>
<td>-0.08</td>
</tr>
<tr>
<td>Intrinsic Teaching Motivation</td>
<td>0.63</td>
<td>-1.18</td>
</tr>
<tr>
<td>Extrinsic Teaching Motivation</td>
<td>-0.65</td>
<td>0.15</td>
</tr>
<tr>
<td>Research Time Investment</td>
<td>1.76</td>
<td>0.90</td>
</tr>
<tr>
<td>Teaching Time Investment</td>
<td>2.65</td>
<td>0.83</td>
</tr>
<tr>
<td>Research Productivity</td>
<td>2.08</td>
<td>0.97</td>
</tr>
<tr>
<td>Age</td>
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<td>Number of General Education Courses</td>
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<td>Number of Children</td>
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<td>1.27</td>
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<td>Disciplinary Level (Level-Two)</td>
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</tr>
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</tr>
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</tr>
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<td>Extrinsic Teaching Motivation</td>
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</tr>
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<td>Teaching Time Investment</td>
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<td>-0.04</td>
</tr>
<tr>
<td>Research Productivity</td>
<td>9.13</td>
<td>2.55</td>
</tr>
</tbody>
</table>
Figure 4.5. Predicted student-centered pedagogy by level-one residuals (post Box-Cox)

Figure 4.6. Predicted student-centered pedagogy by level-two residuals (post Box-Cox)
Hierarchical Linear Modeling Results

My study’s research purpose was multifaceted. First, I sought to examine the differential individual and disciplinary influence of faculty research motivation, productivity, and time investment on the utilization of student-centered pedagogy at research universities. Second, I incorporated Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) and Holland’s Theory of Careers (1973, 1997) within the preceding purpose as separate disciplinary taxonomies for elucidating the potential disciplinary influence in predicting faculty utilization of student-centered pedagogy. Anticipating an intricate interplay between the individual faculty and disciplinary levels of analysis, I also systematically examined the presence of moderating effects via same level and cross level interactions. Hierarchical linear modeling and its partitioning of variance at multiple levels of analysis facilitated investigation of the foregoing research agenda based on data from the 2007 Higher Education Research Institute (HERI) Faculty Survey administered by the University of California, Los Angeles.

Tables 4.8 and 4.9 present the results of my study’s model building process. Separate HLM analyses integrating Biglan’s and Holland’s disciplinary taxonomies prevented any potential deleterious multicollinearity and offered a means for comparing their model fit. Each table contains six progressions in the model building process. Model 1 displays the null model or results absent any predictors; it enables a clean estimate of level-two variance via the intra-class correlation (ICC). Model 2 includes all of my delineated level-one predictors. A systematic consideration of random slopes concerning my primary faculty work role
variables indicated no level-one predictors varied by discipline. Model 3 presents statistically significant level-one interactions involving my primary faculty work role variables. Model 4 continues model development with the inclusion of all designated level-two disciplinary predictors. At this point, the two result tables diverge with the addition of the separate disciplinary taxonomies. Model 5 identifies significant interactions exclusively involving disciplinary level predictors. Model 6 includes significant cross level interactions that illustrate the role of disciplinary affiliation in moderating how faculty work role values and behaviors predict the utilization of student-centered pedagogy. Model 6 constitutes the final full model.

Each progression in the model building process also provides parameter estimates for unencumbered level-one and level-two variance. These variance estimates enabled successive evaluations of my model’s predictive ability via calculation of the intraclass correlation coefficient (ICC) and proportional reduction in variance at both levels of analysis. The latter statistic computes the proportion of variance in the null model that is accounted for by a more parameterized model (Raudenbush & Byrk, 2002). Of note, this statistic reflects more of a quasi $R^2$ measurement in that it compares a more complex model to the baseline model but does not explicate any absolute amount of variance in the dependent variable (McCoach, 2010). Finally, given its nested nature, overall model fit was judged by confirming that further parameterization during the model building process resulted in a statistically significant reduction of log-likelihood deviance (-2LL) or departure from a model of perfect data fit.
Interpreting Results

Null model. Interpreting the null model (Model 1) is essential to detecting potential non-independence of individual faculty responses due to disciplinary affiliation and, in so doing, validating my selection of hierarchical linear modeling over standard multiple regression. The null model’s estimated level-one or within discipline variance ($\sigma^2 = 2.72$) approximated the variance in my dependent variable that was accounted for by individual faculty respondents irrespective of disciplinary affiliation. The estimated level-two or between discipline variance ($\tau^2 = .78$) uncovered the variance that was attributable to respondents’ disciplinary affiliation. Based on these estimates, the ICC indicated 23% of the variability in faculty utilization of student-centered pedagogy was accounted for by disciplinary affiliation. This sizeable variability justified my choice of HLM.

Interpretation of the null model and all succeeding stages of the model building process must reflect the data cleaning decision to transform my dependent variable. Applying the Box-Cox transformation coefficient of best fit ($\lambda = .5$) meant my model did not predict respondents’ raw scores on utilization of student-centered pedagogy but rather the square root of these scores. Accordingly, the null model’s intercept of 5.96 corresponds to the average of the mean disciplinary level square root scores on faculty utilization of student-centered pedagogy for the 69 disciplines in my analytic sample. In this same vein, both individual faculty (within-cluster) and disciplinary (between-cluster) variance approximations were estimated based on the variance observed in said square root scores.
**Full model.** Greater parameterization consistently yielded improved overall model fit due to significant decreases in log-likelihood deviance (-2LL) at each stage in the model building process. Consequently, the ensuing parameterization breakdown is based on results from my final full model located in model 6 of Tables 4.8 and 4.9. Before explicating these results, it is necessary to address how both Box-Cox transformed predictors (see Table 4.7) and grand mean centering influenced the interpretation of model results.

*Interpreting results after transforming predictors.* While transforming my dependent measure slightly altered the null model’s interpretation, the inclusion of transformed predictors in order to improve HLM distributional assumptions greatly complicated subsequent model interpretations. For example, since faculty research time investment was transformed by a Box-Cox best fit coefficient of $\lambda = .5$, its parameter coefficient estimate approximates the linear relationship between the square root scores of faculty respondents’ research time investment in predicting their respective square root scores regarding utilization of student-centered pedagogy while holding other model predictors constant. However, given that my main faculty work role predictors were already measured on inexact ordinal scales, precise substantive or practical interpretation of my model’s parameter coefficients was never a practical or intended purpose. Rather, assessing their general nonrandom predictive influence at both the individual faculty and disciplinary levels of analysis was my primary scholarly interest.

*Interpreting results after grand mean centering.* The ability to partition my dependent measure’s variance at the individual faculty and disciplinary levels is the crux of
HLM. This partitioning is accomplished by allowing the intercept to randomly vary across disciplines. It follows that the intercept for a given discipline is the predicted square root score on utilization of student-centered pedagogy for a faculty member belonging to said discipline whose observed predictor values are all defined at zero. However, my main faculty work role predictors were measured on ordinal scales lacking a meaningful zero point, thereby leaving the random intercept and its resultant disciplinary (between cluster) variance estimate without practical interpretability. For reasons detailed earlier, I selected grand mean centering as a solution to this interpretability dilemma. All predictors were grand mean centered post Box-Cox transformation.

Grand mean centering my continuously measured predictors adjusted the interpretation of a given discipline’s intercept to the predicted square root score on utilization of student-centered pedagogy for a faculty member belonging to said discipline whose respective continuous predictor values were all defined at their grand mean. My binary measured categorical predictors were also grand mean centered. The mean of a binary dummy variable is the proportion of observations in the comparison group; hence, grand mean centering a categorical predictor adjusts the random intercept for differences in the proportion of comparison group observations across all level-two clusters (Enders & Tofighi, 2007). Accordingly, grand mean centering my categorical predictors also altered the interpretation of a given discipline’s intercept to the predicted square root score on utilization student-centered pedagogy for a faculty member affiliated with said discipline where, for every categorical predictor, the proportion of comparison group observations matched the
overall comparison group proportion across all disciplines. The ultimate benefit of grand mean centering all of my predictors was that the disciplinary (between-cluster) variance estimate now captured variance in the adjusted random intercept. Specifically, my final full model’s disciplinary variance quantifies the remaining variance in the mean disciplinary square root scores on faculty utilization of student-centered pedagogy after partialling out the effect of every predictor defined at its grand mean.

**Within discipline model results.** Within discipline model results include all specified level-one predictors and significant level-one interactions. Significant predictors and interactions were consistent across both model analyses. All of my faculty work role predictors, save intrinsic research motivation, displayed significant positive relationships with faculty use of student-centered pedagogy. However, intrinsic research motivation approached a significant negative relationship with student-centered pedagogy. This finding is noteworthy because the near significant link was directionally opposite the other faculty work role predictors. A few control predictors also exhibited significance. A larger general education course load was consistent with greater use of student-centered pedagogy. Female respondents and Hispanic faculty, as compared to their Caucasian peers, were more disposed to student-centered pedagogy.
### Table 4.8

**Two Level Model Predicting Utilization of Student-Centered Pedagogy: Biglan’s Model**

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
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<td>Intercept</td>
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<td>0.11</td>
<td>5.94***</td>
<td>0.10</td>
<td>5.94***</td>
<td>0.10</td>
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<td>-0.01</td>
<td>0.03</td>
<td>-0.005</td>
<td>0.03</td>
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<td>0.03</td>
<td>0.07**</td>
<td>0.03</td>
<td>0.07**</td>
<td>0.03</td>
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<td>0.03</td>
<td>0.04***</td>
<td>0.03</td>
<td>0.04***</td>
<td>0.03</td>
</tr>
<tr>
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<td>0.03</td>
<td>0.11***</td>
<td>0.03</td>
<td>0.11***</td>
<td>0.03</td>
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<tr>
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<td>0.02</td>
<td>0.15***</td>
<td>0.02</td>
<td>0.15***</td>
<td>0.02</td>
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<tr>
<td>Teaching Time Investment</td>
<td>0.25***</td>
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<td>0.24***</td>
<td>0.02</td>
<td>0.24***</td>
<td>0.02</td>
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<tr>
<td>Research Productivity</td>
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<td>0.18***</td>
<td>0.03</td>
<td>0.18***</td>
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<td>0.09</td>
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<td>0.31**</td>
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<td>-0.09</td>
<td>0.06</td>
<td>-0.09</td>
<td>0.06</td>
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<td>0.09</td>
<td>0.03</td>
<td>0.09</td>
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<td>-0.06</td>
<td>0.07</td>
<td>-0.04</td>
<td>0.07</td>
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<td>(Intrinsic Teach Mot)*(Res Time Invest)</td>
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<td>0.01***</td>
<td>0.03</td>
<td>0.01***</td>
<td>0.03</td>
</tr>
<tr>
<td>(Teach Time Invest)*(Res Time Invest)</td>
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<td>0.02</td>
<td>0.06**</td>
<td>0.02</td>
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<td>0.02</td>
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<tr>
<td>(Extrinsic Research Mot)*(Assoc Prof)</td>
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<td>0.06</td>
<td>-0.16*</td>
<td>0.06</td>
<td>-0.16*</td>
<td>0.06</td>
</tr>
<tr>
<td>(Extrinsic Research Mot)*(Full Prof)</td>
<td>-0.23***</td>
<td>0.06</td>
<td>-0.23***</td>
<td>0.06</td>
<td>-0.23***</td>
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<tr>
<td>(Research Productivity)*(Female)</td>
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<td>-0.14*</td>
<td>0.06</td>
<td>-0.14*</td>
<td>0.06</td>
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<td>-0.07</td>
<td>0.17</td>
<td>-0.07</td>
<td>0.17</td>
</tr>
<tr>
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<td>0.23</td>
<td>0.08</td>
<td>0.25</td>
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<tr>
<td>Intrinsic Teaching Motivation</td>
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<td>0.46</td>
<td>0.72</td>
<td>0.44</td>
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<td>-2.29**</td>
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<td>Research Time Investment</td>
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<td>-0.49**</td>
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<td>-0.50*</td>
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<tr>
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<td>0.03</td>
<td>0.13</td>
<td>0.03</td>
<td>0.13</td>
</tr>
<tr>
<td>Research Productivity</td>
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<td>0.66</td>
<td>0.96</td>
<td>0.59</td>
<td>0.87</td>
<td>0.61</td>
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<tr>
<td>Pure Discipline</td>
<td>-0.35*</td>
<td>0.17</td>
<td>-0.31*</td>
<td>0.15</td>
<td>-0.30+</td>
<td>0.16</td>
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<td>Hard Discipline</td>
<td>-0.85***</td>
<td>0.17</td>
<td>-0.82***</td>
<td>0.15</td>
<td>-0.82***</td>
<td>0.15</td>
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<tr>
<td>Life Discipline</td>
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<td>0.13</td>
<td>0.61***</td>
<td>0.12</td>
<td>0.63***</td>
<td>0.13</td>
</tr>
<tr>
<td>(Intrinsic Research Motivation)*(Hard)</td>
<td>1.08***</td>
<td>0.29</td>
<td>1.17***</td>
<td>0.30</td>
<td></td>
<td></td>
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<td>(Teaching Time Investment)*(Pure)</td>
<td>0.57**</td>
<td>0.20</td>
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<td><strong>Cross Level Interactions</strong></td>
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<td>(Disc Extrn Teach Mot)*(Disc Res Prod)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Disc Extrn Teach Mot)*(Res Prod)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(Disc Intrn Res Mot)*(Intrn Res Mot)</td>
<td>-0.02**</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Error Variance &amp; Model Fit</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level-One (within cluster variance)</td>
<td>2.72***</td>
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<td>2.47***</td>
<td>0.05</td>
<td></td>
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<tr>
<td>Level-Two (between cluster variance)</td>
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<td>0.14</td>
<td>0.59***</td>
<td>0.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deviance (-2LL)</td>
<td>22260.3</td>
<td>21692.7***</td>
<td>21647.1***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportional variance reduct (Level-One)</td>
<td>9.2%</td>
<td>9.9%</td>
<td>9.9%</td>
<td>9.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportional variance reduct (Level-Two)</td>
<td>24.4%</td>
<td>25.6%</td>
<td>75.6%</td>
<td>82.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICC</td>
<td>22.3%</td>
<td>19.3%</td>
<td>19.1%</td>
<td>7.2%</td>
<td>5.4%</td>
<td>5.4%</td>
</tr>
</tbody>
</table>

**Note:** + p<.10, * p<.05, ** p<.01, *** p<.001, N=5745 (Level-1), N=69 (Level-2)
Table 4.9
Two Level Model Predicting Utilization of Student-Centered Pedagogy: Holland’s Theory

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
</table>
Within an interaction, a moderating variable impacts the direction and/or strength of the relationship between another “focal” predictor and the dependent measure of interest (Baron & Kenny, 1986). Given the explanatory value of such moderating effects in expounding the relation between faculty research and teaching, I systematically examined the extent to which interactions involving my main faculty work role predictors rose to statistical significance. Several of said level-one interactions exhibited significant moderating effects in explicating faculty utilization of student-centered pedagogy. Figures 4.7 through 4.11 present effect plots illustrating each of these interactions. Figure 4.7 displays that greater levels of respondent intrinsic teaching motivation predicted a stronger positive relationship between research time investment and utilization of student-centered pedagogy. Respondent teaching time investment presented a similar moderating effect (Figure 4.8) in explicating the positive relation between research time investment and utilization of student-centered pedagogy.

Figures 4.9 and 4.10 demonstrate that faculty rank moderated the relation between faculty extrinsic research motivation and student-centered pedagogy. Assistant professors presented a slight positive relationship while full professors displayed a slight negative relationship. More specifically, at low levels of extrinsic research motivation, full and assistant professors utilized the same approximate amount of student-centered pedagogy; however, at high levels, assistant professors demonstrated greater use of student-centered pedagogy. A similar moderating effect was observed when comparing associate and assistant professors. Finally, Figure 4.11 reveals that a faculty member’s gender served as a
moderating influence between faculty research productivity and student-centered pedagogy. Female respondents’ clear tendency towards student-centered pedagogy remained fairly static regardless of research productivity; whereas, male professors displayed a steady increase in student-centered pedagogy with greater levels of research productivity. Consequently, despite an unequivocal gender gap at low levels of research productivity, at high levels, male professors nearly erased the student-centered pedagogical advantage presented by their female counterparts.

Figure 4.7. Level-one interaction between faculty research time investment & faculty intrinsic teaching motivation
Figure 4.8. Level-one interaction between faculty research time investment & faculty teaching time investment

Figure 4.9. Level-one interaction between faculty extrinsic research motivation & associate professor rank
Figure 4.10. Level-one interaction between faculty extrinsic research motivation & full professor rank

Figure 4.11. Level-one interaction between faculty research productivity & gender
**Between discipline model results.** Between discipline model results include all specified level-two predictors, significant level-two interactions, and significant cross level interactions. Only two faculty work role predictors exhibited significance at the disciplinary level. Disciplinary extrinsic teaching motivation presented a significant negative relationship with faculty utilization of student-centered pedagogy in both model analyses. More specifically, heightened efforts within a discipline to reward teaching predicted lower levels of student-centered pedagogy for faculty in said discipline. This disciplinary level effect was directionally opposite its corresponding effect at the individual faculty level. In the Biglan model, disciplinary research time investment displayed a significant negative association, suggesting disciplines marked by more robust research time investments contain faculty who employ less student-centered pedagogy.

At this point, predictors delineating Biglan’s dimensions and Holland’s work environments differentiated the separate analytic models in Tables 4.8 and 4.9. With respect to Biglan’s schema, faculty within hard disciplines employed significantly less student-centered pedagogy than faculty in soft disciplines. As compared to their nonlife systems colleagues, academics in life systems disciplines utilized more student-centered pedagogy. Lower use of student-centered pedagogy by pure disciplines compared to applied disciplines approached significance. As to Holland’s work environments, faculty within both investigative and enterprising disciplines employed significantly less student-centered pedagogy than academics in social disciplines. Realistic faculty neared this same results.
The complexities of the relation between research and teaching in elucidating utilization of student-centered pedagogy are not solely the jurisdiction of the individual academic. Disciplinary norms and traits are also moderating influences. Accordingly, I systematically examined the extent to which my disciplinary level work role and taxonomy predictors interacted together or with an individual level work role predictor to significantly explicate faculty utilization of student-centered pedagogy.

Both Biglan’s dimensions and Holland’s work environments demonstrated moderating effects in explicating significant disciplinary level interactions. Figure 4.12 indicates that Biglan’s hard/soft dimension moderated the relation between disciplinary intrinsic research motivation and student-centered pedagogy - hard disciplines presented a markedly positive relationship while soft disciplines displayed a similarly negative relationship. At low levels of disciplinary intrinsic research motivation, soft disciplines displayed a sizable student-centered advantage; however, at high levels, this breach was flipped to the slight advantage of hard disciplines. As detailed in Figure 4.13, Biglan’s pure/applied dimension produced a comparable moderating effect when interacted with disciplinary teaching time investment. Figure 4.14 illustrates the only significant interaction incorporating Holland’s work environments. Compared to investigative disciplines, social disciplines employed distinctly more student-centered pedagogy when they avowed lower inherent interest in research, but this chasm steadily disappeared with progression along the disciplinary intrinsic research motivation continuum.
Figure 4.12. Level-two interaction between disciplinary intrinsic research motivation & Biglan’s hard-soft dimension

Figure 4.13. Level-two interaction between disciplinary teaching time investment & Biglan’s pure-applied dimension
Figure 4.14. Level-two interaction between disciplinary intrinsic research motivation & Holland’s social and investigative work environments

Figure 4.15. Cross level interaction between disciplinary extrinsic teaching motivation & faculty research productivity
Two cross level interactions involving my faculty work role predictors rose to significance and teased out further nuance in faculty utilization of student-centered pedagogy. Figure 4.15 exhibits the interaction between faculty research productivity and disciplinary extrinsic teaching motivation. Specifically, the positive effect of research productivity at the individual faculty level decreased with increased disciplinary extrinsic teaching motivation. Figure 4.16 reveals that respondent intrinsic research motivation’s relation with utilization of student-centered pedagogy varied as a function of its parallel level-two predictor, disciplinary intrinsic research motivation. Disciplines marked by a high
intrinsic research drive predicted a weak negative relation while disciplines defined by low intrinsic research motivation presented a weak positive relation. Disciplines displaying intrinsic research motivation near the mean approximated a null association.

**Assessing model fit.** Changes in the proportional variance reduction estimates and ICC throughout the model building process offer a means for evaluating the explanatory power of my model at both the individual faculty and disciplinary levels of analysis (Tables 4.8 and 4.9). They also enabled a comparison of Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) and Holland’s Theory of Careers (1973, 1997) as distinct disciplinary taxonomies for explicating faculty utilization of student-centered pedagogy. Although my level-one predictors (Model 2) and interactions (Model 3) each significantly improved model fit, they collectively accounted for only 10% of the total explainable variance observed in student-centered pedagogy at the individual faculty level. Model 3 also indicates my level-one predictors accounted for roughly 25% of the explainable variance in student-centered pedagogy at the disciplinary level. This result might seem confounding; however, as discussed earlier, grand mean centering my main level-one faculty work role predictors in the absence of their corresponding mean disciplinary level predictors produced level-one parameter estimates that mixed both within and between discipline variance.

The inclusion of all level-two faculty work role predictors (composed of disciplinary means) produced separate model fit estimates based on the included disciplinary taxonomy (Model 4). Specifically, analyses employing Biglan’s dimensions and Holland’s work
environments respectively accounted for 75% and 64% of the explainable variance in student-centered pedagogy at the disciplinary level. These results indicate Biglan’s dimensions accounted for an additional 11% of the explainable disciplinary variance above and beyond Holland’s work environments. The next step in the model building process called for the inclusion of significant disciplinary level interactions. Two significant interactions involving Biglan’s dimensions accounted for an additional 6% of the explainable between discipline variance; whereas, a single interaction incorporating Holland’s investigate environment explicated roughly 8% more disciplinary variance in its respective model. Lastly, despite their significance, inclusion of the same two cross level interactions in both models explained only an additional 0.5% of level-one or within discipline variance.

In sum, three conclusions concerning the explanatory power of my model analyses are evident. First, given that it accounted for only 10% of the explainable variance, my within discipline model did not represent a substantial means for elucidating faculty utilization of student-centered pedagogy at the individual faculty level of analysis. Second, given that they both accounted for over 70% of the explainable variance, my between discipline models presented considerable explanatory power in elucidating faculty utilization of student-centered pedagogy at the disciplinary level of analysis. Third, given that its respective analytic model accounted for 82% of the explainable variance or 10% more the model incorporating Holland’s work environments, Biglan’s three-dimensional model represented a slightly stronger disciplinary taxonomy for explaining faculty utilization of student-centered pedagogy at the disciplinary level of analysis.
Integrating My Results & Research Questions

My research questions constitute a framework for summarizing and synthesizing the preceding results. Each research question is itemized below and followed by a focused response based on the results of my HLM analyses.

1. *How much of the variance in faculty utilization of student-centered pedagogy at research universities lies within and between disciplines?*

My null model’s estimated level-one or within discipline variance ($\sigma^2 = 2.72$) indicated that 77% of the explainable variance in faculty utilization of student-centered pedagogy was attributable to individual faculty respondents irrespective of disciplinary affiliation. Hence, the estimated level-two or between discipline variance ($\tau^2 = .78$) indicated that the remaining 23% of explainable variance in faculty utilization of student-centered pedagogy was accounted for by respondents’ disciplinary affiliation. After full parameterization, my within discipline model accounted for approximately 10% of the explainable variance at level-one, and my between discipline models incorporating Biglan’s dimensions and Holland’s work environments respectively accounted for 82% and 72% of the explainable level-two variance.

2.a. *To what extent do full-time, tenured or tenure-track faculty members’ levels of research productivity, research time investment, and research motivation predict their utilization of student-centered pedagogy at research universities?*
Faculty respondents’ research productivity, research time investment, and extrinsic research motivation all displayed significant positive relationships with their utilization of student-centered pedagogy. Respondents’ ascribed intrinsic research motivation approached a significant negative relationship with utilization of student-centered pedagogy. Several significant level-one interactions explicated greater variance in how these faculty research role measures predicted the utilization of student-centered pedagogy. The positive relationship displayed by faculty research time investment was moderated in a similar fashion by both faculty intrinsic teaching motivation and teaching time investment. Specifically, greater faculty attributions concerning these teaching role measures predicted a stronger positive link between respondent research time investment and student-centered pedagogy.

The effect of faculty extrinsic research motivation was moderated by faculty rank. While all three academic ranks employed near identical student-centered pedagogy at lower levels of extrinsic research motivation, assistant professors presented a gradual yet clear student-centered pedagogical advantage over their tenured colleagues with greater asserted levels of faculty extrinsic research motivation. Finally, the effect of faculty research productivity was moderated by gender. At low levels of faculty research productivity, female respondents displayed a distinct student-centered pedagogical advantage; however, with greater respondent ascribed levels of research productivity, this gender gap steadily dissipated to a marginal female edge. Overall, it is of particular consequence that the entire
level-one or within discipline model accounted for only 10% of the total explainable variance observed in student-centered pedagogy at the individual faculty level.

2.b. To what extent does a discipline’s level of research productivity, research time investment, and research motivation predict full-time, tenured or tenure-track faculty members’ utilization of student-centered pedagogy at research universities?

Neither disciplinary research productivity nor disciplinary extrinsic or intrinsic research motivation displayed a significant relationship with faculty utilization of student-centered pedagogy. Directionally opposite its corresponding level-one predictor, disciplinary research time investment presented a significant negative relationship within the analytic model incorporating Biglan’s dimensions. The only disciplinary level faculty work role predictor that exhibited significance across both analytic models was disciplinary extrinsic teaching motivation. The collective inclusion of all disciplinary level faculty work role predictors accounted for 23% of the explainable level-two or between discipline variance observed in faculty utilization of student-centered pedagogy. It should also be noted that disciplinary extrinsic teaching motivation and disciplinary intrinsic research motivation respectively moderated research productivity and intrinsic research motivation at the individual faculty level of analysis; however, these significant cross level interactions elucidated merely an additional 0.5% of the explainable level-one or within discipline variance.
3.a. To what extent does Holland’s (1973, 1997) career choice theory and its distinct model environments explain disciplinary level variance in faculty members’ utilization of student-centered pedagogy at research universities?

Based on related scholarship, social disciplines served as the comparison group for Holland’s work environments at the disciplinary level of analysis. No statistical student-centered pedagogical difference was observed between respondents from Holland’s artistic and social disciplines. Respondents from Holland’s enterprising and investigative disciplines both employed significantly less student-centered pedagogy than their colleagues in social disciplines. A similar relation between Holland’s realistic and social disciplines approached but did not break the significance threshold.

Holland’s investigative and social disciplines also interacted with disciplinary intrinsic research motivation to significantly expound greater disciplinary level variance in respondents’ utilization of student-centered pedagogy. Specifically, respondents from social disciplines employed markedly more student-centered pedagogy at lower disciplinary levels of inherent research motivation. This sizeable gap steadily reversed to the advantage of investigative disciplines at higher disciplinary levels of inherent research motivation. The inclusion of Holland’s work environments as a disciplinary taxonomy within my final full model further elucidated 23% of the explainable level-two or between discipline variance.
3.b. To what extent does Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) explain disciplinary level variance in faculty members’ utilization of student-centered pedagogy at research universities?

Respondents from hard disciplines utilized significantly less student-centered pedagogy than their counterparts in soft disciplines; likewise, respondents from life systems disciplines employed significantly less student-centered pedagogy than their peers in non-life systems disciplines. As compared to applied disciplines, respondents from pure disciplines appeared to utilize less student-centered pedagogy, but this differential did not quite reach statistical significance.

Biglan’s dimensions also served as moderators in two significant disciplinary level interactions. In predicting faculty utilization of student-centered pedagogy, the hard-soft dimension moderated disciplinary intrinsic research motivation while the pure-applied dimension moderated disciplinary teaching time investment. At low levels of disciplinary intrinsic research motivation, soft disciplines displayed a comfortable student-centered advantage; however, at high levels, this difference was reversed to the slim advantage of hard disciplines. Similarly, at low levels of disciplinary teaching time investment, applied disciplines employed more student-centered pedagogy; yet, with greater levels, this differential eventually flipped to the slight benefit of pure disciplines. The inclusion of Biglan’s three-dimensional model as a disciplinary taxonomy within my final full model further expounded 33.5% of the explainable level-two or between discipline variance.
CHAPTER FIVE: SYNTHESIZING RESULTS & IDENTIFYING IMPLICATIONS

My study examined the relationship between the faculty research and teaching roles. It has been widely argued that academics align their professional priorities and loyalties along disciplinary lines more than any other affiliation (Becher & Trowler, 2001; Smart, Feldman, & Ethington, 2000; Clark, 1987, 1989). Yet, insufficient scholarly attention has been afforded to understanding how disciplinary cultures act as a differentiating force in the execution of research and teaching (Becher & Trowler, 2001; Smart, Feldman, & Ethington, 2000). Accordingly, understanding how disciplinary affiliation informs the relation between the research context of academic work and good instructional practice constituted the defining contribution of my study.

To this purpose, my study incorporated two central methodological specifications. First, I departed from the prevalent tactic of operationalizing instructional effectiveness via student ratings of instruction. Faculty self-reports of student-centered pedagogy offered a more compatible means for capturing the normative disciplinary values and behaviors that potentially differentiate the interplay between research and teaching. Second, I limited my analysis to faculty from research universities. Disciplinary boundaries, communications, networking, ethics, conflicts, and priorities are largely research driven (Becher & Trowler, 2001; Smart, Feldman, & Ethington, 2000). With an emphasis on research activity, scholarly specialization, and graduate education, research universities foster an environment where diverse disciplinary cultures are most salient and potent (Austin, 1990, 1996; Clark, 1980, 1989). This disciplinary-based research prioritization has served as a seeping source of
imitation throughout higher education sector (Fairweather, 1993; Massy & Zemsky, 1994; Milem, Berger, & Dey, 2000).

Detecting disciplinary variation in faculty utilization of student-centered pedagogy via hierarchical linear modeling (HLM) was central to my research design. I identified only one other study (Hattie & Marsh, 1996) that utilized HLM to account for the disciplinary level of analysis when examining how faculty research impacts teaching. Hattie & Marsh’s null model found no significant disciplinary level variance in teaching; however, their study’s limited disciplinary sample at a single Australian research institution informed my research design to more thoroughly account for disciplinary variation based on greater disciplinary groupings across a broader mass of research institutions.

My null model attributed 22% of the observed variance in faculty utilization of student-centered pedagogy to respondent disciplinary affiliation. This significant and, from a social science standpoint, fairly robust proportion of level-two or between discipline variance represented my study’s foremost finding. It justified my use of HLM and presented tangible evidence of the potential deleterious effect of standard OLS regression that fails to account for disciplinary level variation when studying faculty and their academic work roles. The absence of significant disciplinary variance in faculty utilization of student-centered pedagogy would have jettisoned the need for my disciplinary level of analysis. As such, the observed between discipline variance set the stage for all of my subsequent findings. The ensuing sections synthesize these results at the individual faculty and disciplinary level of analysis and articulate their implications for theory, policy and practice, and future research.
Individual Faculty Level of Analysis

Research Role Context: Productivity, Time Investment, & Motivation

Just as student instructional ratings reflect the norm for quantifying teaching effectiveness, publication productivity represents the corresponding scholarly archetype for measuring faculty research efficacy. Prominent scholarship (Braxton, 1996; Feldman, 1987; Hattie & Marsh, 1996) synthesizing the relation between these conventional constructs suggests that faculty research output presents a weak positive to null impact on teaching effectiveness. Even studies that operationalized teaching efficacy via faculty instructional values (Braxton & Smart, 1996), ethical norms (Sullivan, 1996), and practices undergirding a student-centered pedagogical philosophy (Olsen & Simmons, 1996) all supported a weak complementary to null relationship with scholarly production.

The faculty research role is not simply a function of output; the context of its performance carries certain engagement and motivational components (Hattie & Marsh, 1996; Marsh, 1984, 1987). My study’s more encompassing conception of the faculty research role supported the foregoing relational inference at the individual faculty level of analysis. Not only scholarly productivity but both research time investment and extrinsic research motivation also presented a significant positive relationship with faculty utilization of student-centered pedagogy. Intrinsic research motivation did not display a non-random relationship. These results advanced a comprehensive notion of the faculty research role context in which scholarly engagement (time investment), reinforcement (extrinsic motivation), and productivity (publication output) each separately predicted greater use of
student-centered pedagogy; though, a pure preference for the research role measured via faculty intrinsic research motivation did not imply such pedagogical practice.

**Moderating Effects: Intrinsic Teaching Motivation & Teaching Time Investment**

Student-centered pedagogy stresses the centrality of student engagement, empowerment, collaboration, and diversity (Barr & Tagg, 1995; Lea, Stephenson, & Troy, 2003; O’Neill & McMahon, 2005). Such an instructional ethos demands extensive and ongoing faculty commitment; accordingly, I deemed it critical to include predictors controlling for motivational and engagement manifestations of the faculty teaching role. Not surprisingly, faculty teaching time investment and teaching motivation, both intrinsic and extrinsic, presented positive relationships with utilization of student-centered pedagogy. One might expect such investments in teaching to complement good instructional practice.

These teaching role predictors also offered a means for teasing out more nuanced understanding of the faculty research role’s link with utilization of student-centered pedagogy. Existing research presented strong evidence of a pattern based on Carnegie classification. Movement up the Carnegie classification continuum coincided with a sharp decline in faculty manifestations of the teaching role. In particular, faculty at research universities asserted a decidedly low preference for teaching in terms of time invested, rewards and promotion criterion, and the role in general (Blackburn & Lawrence, 1995; Boyer, 1990; Finkelstein, Seal, & Schuster’s, 1998; Leslie, 2002; Milem, Berger, & Dey, 2000). The opposite was true for faculty at community colleges. Research also suggested this pattern paralleled the entrenched organizational faculty work prioritization at said
institution types (Boyer, 1990; Finkelstein, Seal, & Schuster, 1998; Leslie, 2002). Since my study was restricted to research universities where the above evidence indicates a research role emphasis, differing individual motivational and engagement levels for teaching may impact the nature of the relationship between the faculty research context and utilization of student-centered pedagogy.

To this supposition, two such occurrences emerged from my analysis. Both faculty intrinsic teaching motivation and teaching time investment presented a significant positive interaction with faculty research time investment. Greater levels of faculty ascribed intrinsic teaching motivation and teaching time investment each predicted a stronger positive link between faculty research time investment and utilization of student-centered pedagogy. In other words, the positive fixed effect of faculty research time investment on utilization of student-centered pedagogy can be more tellingly scrutinized by the extent of respondents’ commitment to the teaching role. At low levels of both intrinsic teaching motivation and teaching time investment, I observed an approximate null relationship between faculty research time investment and utilization of student-centered pedagogy; whereas, at high levels, a positive relationship was more distinctly predicted. This finding supports the notion that the epistemological knowledge and skills gained through greater faculty research time investment translates into utilization of student-centered pedagogy at a greater rate the more academics already assert a firm commitment to the teaching role.
Moderating Effects: Gender & Academic Rank

I also observed several significant findings concerning demographic and background variables that are customary yet essential to predicting and explicating the execution of academic work. Existing broad-based research suggests female academics and faculty of color are more likely to employ student-centered pedagogy than their male and Caucasian counterparts (Milem, 2001; Pascarella & Terenzini, 2005; Umbach, 2006, 2007). My findings reinforced a student-centered pedagogical advantage for female academics. Only faculty of Hispanic descent employed significantly more student-centered pedagogy than their Caucasian peers. A predilection for student-centered pedagogy by assistant professors over their more senior colleagues approached but did not reach significance. Of particular note, general education course load displayed a significant positive relationship. This finding might appear perplexing given that the large class size and breadth of content commonly associated with general education courses at research universities tends to present certain student-centered pedagogical obstacles. On the other hand, research university faculty might select a large general education course load based on a passion for expanding the reach of their discipline’s subject matter to a wider spectrum of students. Such a passion for reaching students is certainly consistent with the tenets of a student-centered pedagogical practice.

Similar to the above teaching commitment predictors, gender and academic rank interacted with research productivity and extrinsic research motivation, respectively, to uncover greater relational nuance. The robust level of student-centered pedagogy employed by female academics remained largely static regardless of the extent of their research
productivity. The level of student-centered pedagogy predicted by male academics displayed positive growth with greater ascribed research productivity to the point of nearly closing the gender gap at the highest levels of research productivity. The idea that greater scholarly output may inform a more efficacious instructional style is a potential consideration for initiatives targeting the quality of the classroom experience at research universities, especially for departments or disciplines heavily populated by males.

A heightened desire to receive scholarly recognition from their peers (extrinsic research motivation) predicted a modest student-centered pedagogical advantage for assistant professors over their more senior colleagues. This finding may be associated with strong initial career zeal as assistant professors explore their work role identities and pursue tenure. Research driven assistant professors are likely more open to pedagogical innovation given that they are still exploring and defining their own instructional philosophies; whereas, veteran academics still focused on their scholarly reputation may have more rigid and established instructional philosophies that are less receptive to new student-centered pedagogical methods.

**Level-One Conclusions**

My level-one or within discipline model certainly offered some meaningful and informative findings; nevertheless, it must be also be tempered with the fact that, in full, my model’s level-one findings accounted for only 10% of the individual respondent variance observed in faculty utilization of student-centered pedagogy. This note of caution does not discount the statistical significance of the above findings or their explanatory relevance. It
does suggest that other unspecified predictors offer the potential for explaining a more
sizeable portion of the unaccounted for level-one variance in faculty utilization of student-
centered pedagogy. Lastly, in terms of my focus on the research-teaching relation, while
significant effects concerning the faculty research role context coupled with a marginal
proportion of observed variance accounted for buttressed the scholarly record’s inference of a
slight positive link, moderating effects based on intrinsic teaching motivation, teaching time
investment, academic rank, and gender untangled more detailed understanding of the
individual faculty dynamics that ground this seemingly overarching weak complementary
relation.

**Disciplinary Level of Analysis**

Accounting for diverse disciplinary cultures provides the means for discovering
nuanced understanding of the normative patterns and relationships that inform the
performance of academic work (Becher & Trowler, 2001; Lattuca, Terenzini, Harper, & Yin,
2010; Smart, Feldman, & Ethington, 2000). My level-two or between discipline model
included predictors aimed at explicating the significant disciplinary variance observed in
faculty utilization of student-centered pedagogy. Mean disciplinary composite measures for
my level-one faculty work role predictors were computed based on respondent self-selected
disciplinary affiliation. These predictors enabled an examination of the extent to which a
discipline’s research context measured via its mean level of respondent publication
productivity, intrinsic motivation, extrinsic motivation, and time-investment predicted faculty
utilization of student-centered pedagogy. Biglan’s dimensions and Holland’s work
environments also offered recognized taxonomies for unearthing disciplinary differentiation in this research-teaching relation.

**Research Role Context: Productivity, Time Investment, & Motivation**

My disciplinary composite measures for intrinsic research motivation, extrinsic research motivation, and research productivity displayed no significant relationships. While their analogous level-one predictors signaled more of a weak complementary relation, these findings posited a null relationship between a given discipline’s research role context and faculty utilization of student-centered pedagogy. My disciplinary composite measures for intrinsic teaching motivation and teaching time investment also exhibited no significance. On the whole, the above findings initially suggested the student-centered pedagogical salience of my faculty research role predictors favored the individual faculty level of analysis.

Despite this preliminary supposition, my disciplinary block of faculty work role predictors yielded noteworthy results concerning research time investment and extrinsic teaching motivation. Both disciplinary composite predictors presented significant negative relations. Although it exhibited significance in only one of my two analytic models, the former suggested the greater the mean time invested in research pursuits within a disciplinary community the lower the predicted level of faculty student-centered pedagogy. The latter predictor proffered the greater the mean ascribed reward level for good teaching within a discipline the lower the predicted level of faculty student-centered pedagogy. This negative relation might initially seem perplexing; however, given the cross-sectional nature of the
2007 HERI Faculty Survey data, it is reasonable to conjecture that greater perceived extrinsic teaching motivation efforts within disciplinary communities might have reflected an intentional response to a poor state of instructional practice and the need for improvement.

Both of these level-two effects are striking because they are directionally contrary to their corresponding level-one effects. An individual academic’s level of research time investment and extrinsic research motivation both positively predicted his or her utilization of student-centered pedagogy; whereas, a discipline’s mean level of member research time investment and extrinsic research motivation both negatively predicted faculty utilization of student-centered pedagogy. These divergent findings demonstrate how analysis at the individual faculty level, without regard for disciplinary affiliation, can potentially mask or overlook disciplinary dynamics that reveal the complexities within the research-teaching relation specifically and faculty work generally. Such disciplinary dynamics should not be ignored given prominent research that posits academics, particularly at research universities, largely identify disciplinary affiliation as their leading source of professional allegiance (Becher & Trowler, 2001; Clark, 1987, 1989; Smart, Feldman, & Ethington, 2000).

**Moderating Effects: Biglan’s Three-Dimensional Model & Holland’s Theory of Careers**

The estimation of my disciplinary block of faculty work role predictors assumed the nature of their relation with faculty utilization of student centered pedagogy remained constant across disciplinary clusters. However, the normative influence of disciplinary cultures constitutes a powerful force in the proliferation of different patterns of faculty values and behaviors (Becher, 1981, 1987; Becher & Trowler, 2001; Smart, Feldman, & Ethington,
These differential patterns potentially impacted the nature of the relation between faculty research and utilization of student-centered pedagogy. To this contention, Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) and Holland’s Theory of Careers (1973, 1997) served as lenses for detecting such disciplinary differentiation.

In Biglan’s analytic model, respondents in soft and life systems disciplines utilized significantly more student-centered pedagogy than respondents in hard and nonlife systems disciplines, respectively. Greater student-centered pedagogical levels displayed by respondents in applied disciplines, as compared to pure disciplines, approached statistical significance. In Holland’s analytic model, respondents in social disciplines utilized significantly more student-centered pedagogy than respondents in both investigative and enterprising disciplines. Respondents in social disciplines exhibited no statistical difference when compared to respondents in artistic and realistic disciplines.

Both disciplinary taxonomies produced substantive interactions that teased out meaningful nuance in the research-teaching relation under investigation. These interactions provided clear evidence that nature of the research-teaching relation differs across disciplinary boundaries and cultures. Biglan’s hard/soft dimension moderated the relation between disciplinary intrinsic research motivation and student-centered pedagogy. Holland’s social and investigative disciplinary environments also interacted with disciplinary intrinsic research motivation to produce the near same results. This was not surprising given that the
vast majority of investigative and social disciplines fall within the hard and soft classifications, respectively.

For academics in hard and investigative disciplines, although they utilized less student-centered pedagogy on average when compared to soft and social disciplines, increased disciplinary levels of intrinsic research motivation were consistent with greater use of good instructional practice. More specifically, higher levels of disciplinary intrinsic research motivation predicted growth to the student-centered pedagogy mean across all disciplinary clusters. Such a complementary research-teaching relation by no means affirmed an ideal state of student-centered pedagogical practice in hard or investigative disciplines, but it did contradict the common perception of STEM fields where cultures steeped in strong intrinsic motivation for research yields instructional neglect and disregard. Quite oppositely, it suggests the robust intrinsic scholarly drive present within STEM fields represents a potentially powerful resource for strengthening the state of teaching and learning.

For academics in soft and social disciplines, while they utilized more student-centered pedagogy on average when compared to hard and investigative disciplines, increased disciplinary levels of intrinsic research motivation were consistent with lower use of good instructional practice. More specifically, higher levels of disciplinary intrinsic research motivation predicted decline to the student-centered pedagogy mean across all disciplinary clusters. This antagonistic research-teaching relation does not refute well-known research (Braxton & Hargens, 1996; Braxton, Olsen, & Simmons, 1998) that classified soft disciplines
as “affinity” disciplines based on their strong commitment to teaching and overall student-centered orientation. Rather, it does suggest that this label is not necessarily universal. Soft disciplines defined by high levels of intrinsic research motivation may be utilizing insufficient levels of student-centered pedagogy to warrant the “affinity” title.

Biglan’s pure and applied categorizations also uncovered variation in how disciplinary levels of teaching time investment predict faculty utilization of student-centered pedagogy. For pure disciplines, increased disciplinary levels of ascribed teaching time investment were consistent with greater use of good instructional practice. The converse relation was true for applied disciplines. The modest student-centered pedagogical advantage demonstrated by applied disciplines at low levels of disciplinary teaching time investment nearly flipped to the same advantage for pure disciplines at high levels of disciplinary teaching time investment. The design, implementation, and evaluation of student-centered pedagogy are time intensive. Thus, the slight negative relation predicted by applied disciplines is somewhat counterintuitive.

My teaching time investment predictor was a summative composite of three distinct charges: classroom instruction, instructional preparation, and advising. Descriptive analysis of these charges suggested applied disciplines were more proportionally disposed to student advising. Specifically, 45% of applied disciplines presented advising levels above the overall disciplinary cluster advising mean; whereas, only 30% of pure disciplines did so. Although student-centered in spirit, as a non-instructional teaching duty, heightened advising efforts
are not directly consistent with the classroom focused instructional strategies comprising my dependent measure.

**Cross Level Moderators: Disciplinary Extrinsic Teaching & Intrinsic Research Motivation**

Predicting and explaining faculty utilization of student-centered pedagogy necessitated integrating my individual faculty and disciplinary levels of analysis. The dependence observed at a lower level of analysis is not solely a function of grouping into larger, affiliated clusters; some lower level characteristic or experience based on this grouping may also represent a relevant source of dependency (Aguinis, Gottfredson, & Culpepper, 2013). As such, in predicting utilization of student-centered pedagogy, individual academics within disciplines may be more alike regarding certain level-one variables compared to academics across all disciplines based on a disciplinary feature or context. My results detected two such cross level interaction effects. Before discussing both, any practical significance must be balanced by their collective capacity to account for less than one percent of the disciplinary variance observed in respondent utilization of student-centered pedagogy.

At level-one, faculty research productivity exhibited a positive relation with utilization of student-centered pedagogy. Disciplinary extrinsic teaching motivation interacted with individual faculty research productivity and moderated this positive relation. Specifically, increasing disciplinary levels of extrinsic teaching motivation predicted a weaker positive relationship for affiliated faculty respondents. Two alternatives offer some potential reconciliation to this moderating effect. To the extent that higher levels of disciplinary extrinsic teaching motivation reflected fresh interventions to substandard
disciplinary states of instruction, they may not have had sufficient time to leverage greater student-centered pedagogical practice among prolific researchers. Whereas, disciplines marked by a culture or atmosphere where individual faculty more inherently perceive and embrace a synergistic relationship between research productivity and good pedagogical practice may not have warranted broad external initiatives or policies targeting improved instructional practice. Another proposition holds that the presence of heightened external disciplinary interventions aimed at faculty instructional practice may have weakened the positive spillover from faculty research productivity to student-centered pedagogical practice based on a perceived affront to academic freedom.

Although neither alone displayed significant direct effects, disciplinary intrinsic research motivation interacted with respondent intrinsic research motivation to uncover a subtle yet meaningful moderating effect. The level of importance that a discipline assigned to the faculty research role differentiated the direction of the association between the corresponding level of importance that its affiliated academics ascribed to their own research pursuits and their utilization of student-centered pedagogy. At the mean of disciplinary intrinsic research motivation, an approximate null relation was observed. High and low levels of disciplinary intrinsic research motivation predicted slight negative and positive relations, respectively, that were near symmetric around said null relation. Accordingly, predicting an academic’s use of good instructional practice based solely on the individual’s intrinsic passion for research potentially overlooks telling disciplinary informed nuance. The presence of a disciplinary culture demarcated by either robust or limited intrinsic research
motivation may forecast a respectively slight antagonistic or complementary relationship for the academics within its disciplinary boundaries. This finding suggests the coalescing of individual and disciplinary motivational forces around a strong intrinsic research impulse may foster an instructional environment that inhibits worthwhile utilization of student-centered pedagogy.

**Level-Two Conclusions**

My level-two or between discipline model enabled an examination and integration of the student-centered pedagogical predictive ability of research productivity, research time investment, and research motivation at both the individual faculty and disciplinary levels of analysis. At level-two, save research time investment, these predictors averaged by respondent ascribed disciplinary affiliation all presented a null relation; whereas, at level-one, their analogous predictors principally exhibited a weak complementary relation. On balance, these findings suggested the association between the research context of academic work and faculty utilization of student-centered pedagogical was most salient at level-one or the individual faculty level of analysis.

However, in isolation, the estimation of my level-two faculty work role predictors not only assumed the nature of their relation with faculty utilization of student centered pedagogy remained constant across disciplinary cultures but also played no factor in differentiating the predictive ability of the research context at the individual faculty level of analysis. To the former, categorizing disciplines along Biglan’s hard-soft dimension and Holland’s investigative and social work environments each predicted more fine-tuned if not
conflicting relations between a discipline’s overall level of intrinsic research motivation and faculty utilization of student centered pedagogy. To the latter, variant disciplinary levels of extrinsic teaching motivation and intrinsic research motivation respectively calibrated the extent to which an individual academic’s research productivity and intrinsic research motivation predicted their utilization of student-centered pedagogy. In sum, it is imprudent to conceptualize the relation between the faculty research context and efficacious instructional practice as purely a manifestation of the individual academic devoid of disciplinary influence. The diversity and resultant differentiation that defines the disciplinary spectrum furnishes more nuanced and gradated understanding to this relation as a complex phenomenon within the study of academic work.

Implications for Theory

I employed Biglan’s three-dimensional model (Biglan, 1973a, 1973b; Smart & Elton, 1975) and Holland’s Theory of Careers (1973, 1997) as taxonomies for exploring disciplinary variation in academic work. Both not only predicted a robust proportion of disciplinary level variance in faculty utilization of student-centered pedagogy, but the hard-soft dimension and the social and investigative work environments also interacted with disciplinary intrinsic research motivation to tease out substantive, nuanced understanding in the research-teaching relation of interest. A natural implication promotes employing these disciplinary taxonomies to delve deeper into the how and why behind the normative values, behaviors, and structures that yielded said variant disciplinary patterns in my presenting
research-teaching relation. Theory provides a systematic means for comprehensively yet cogently executing such a scholarly pursuit.

Holland’s Theory of Careers (1973, 1997) constitutes a conceptually derived and thoroughly developed theoretical lens that extensive empirical evidence has shown to be applicable to the disciplinary context of academic work (Smart, Feldman, & Ethington, 2000). Fundamental to my findings is the recognition that the complex interplay between the research context of academic work and faculty utilization of student-centered pedagogy was subject to individual faculty and disciplinary influences, and these influences were by no means mutually exclusive. Holland’s theory posited people fall along six individual personality types and work within six corresponding environments. The match between analogous personality types and work environments is not failsafe; however, people seek out environments congruent with their personality types, and environments reinforce and reward different patterns of abilities, interests, and behaviors. Holland’s theory includes conceptual definitions, operational definitions, and functional relationships that exhaustively explicate this interdependence between person and environment.

Based on espoused student competencies, undergraduate education goals, and instructional strategies; the scholarly record posits that faculty from social disciplines are more strikingly prone to a strong student-centered pedagogical practice than their peers from investigative disciplines (Milem & Umbach, 2003; Morstain & Smart, 1976; Peters, 1974; Smart, Feldman, & Ethington, 2000; Smart & Thompson, 2001; Smart & Umbach, 2007; Thompson & Smart, 1999; Umbach, 2005, 2006, 2007; Umbach & Milem, 2004). My
findings supported this existing research; moreover, they also highlighted the value of Holland’s environments as moderators for understanding how academics differ in their utilization good instructional practice within the context of a discipline’s intrinsic motivation for research. With greater levels of disciplinary intrinsic research motivation, faculty utilization of student centered pedagogy within social disciplines declined to the overall disciplinary cluster mean; whereas, faculty utilization of student centered pedagogy within investigative disciplines converged upwards to the overall disciplinary cluster mean. The implications for theory are twofold. First, the interrelatedness of Holland’s person-environment structure offers a worthy lens for illuminating the disciplinary moderating effects that inform the relationships between faculty research and teaching. Second, given its theoretical maturity and robust delineation, Holland’s theory also warrants greater inclusion as a means for understanding how disciplinary affiliation differentially moderates the study of phenomena throughout faculty work and faculty life.

Although its student-centered pedagogical predictive ability slightly surpassed Holland’s theory during the model building process, Biglan’s three dimensional model lacks a substantive theoretical grounding. The absence of systematic definitions, relationships, and propositions delineating Biglan’s dimensions inhibits their utility as a true theoretical lens for exploring academic disciplinary variation. The mass of research that has incorporated Biglan’s dimensions constitutes more of a disjointed, undeveloped classification schema for detecting disciplinary variation (Becher & Trowler, 2001; Umbach, 2007). To the extent one’s research purpose centers on exploring a nuanced understanding of how disciplinary
affiliation explicates variation in the performance of academic work, Holland’s theory offers a fitting theoretical lens. To the extent one’s research purpose narrowly targets partitioning and mapping differences in the performance of academic work along the disciplinary spectrum based on fundamental binary axioms of disciplinary identity, Biglan’s three dimensional model provides an established schema.

**Implications for Policy & Practice**

The policy and practice implications from my findings encompass the differentiating influence of diverse disciplinary cultures on the performance and interplay of academic work. My initial implication concerns the agent of policy or practice action. Faculty instructional interventions are traditionally enacted at the institutional level. Broad campus-wide policy initiatives and faculty development programming represent typical sources of institutionally driven pedagogical reform efforts. Disciplines, via their respective formal and informal professional networks, may constitute more fitting channels for cultivating efficacious pedagogical practice. It has been argued that disciplinary affiliation embodies the primary spring of professional loyalty for academics, particularly at research universities where disciplines are largely shaped by their research ethos (Becher & Trowler, 2001; Smart, Feldman, & Ethington, 2000; Clark, 1987, 1989). To this assertion, significant disciplinary effects concerning my research-teaching relation of interest suggest that disciplinary-based faculty networks are uniquely positioned to leverage the research context and broader agenda within their academic borders to increase utilization of student-centered pedagogy.
My disciplinary level findings also tend to challenge uniform, generic institutional policies or programs targeting increased utilization of student-centered pedagogy that cast a broad net without consideration of the intended disciplinary audience. A more optimal design of such institutional interventions requires attention to disciplinary environments and conditions that differentiate the relation between the research context of academic work and utilization of student-centered pedagogy. I observed several significant disciplinary moderators that informed this relation. The most far-reaching of these moderating effects involved Holland’s social and investigative environments and Biglan’s hard-soft dimension. While all disciplines possess a hard or soft label, Holland’s social and investigative environments also dominate the disciplinary spectrum – two-thirds of my disciplinary clusters subsumed these categorizations.

On average, hard and investigative disciplines utilized less student-centered pedagogy when compared to soft and social disciplines; however, increased disciplinary levels of intrinsic research motivation within hard and investigative disciplines predicted greater utilization of student-centered pedagogy. Policy and programmatic interventions targeting good instructional practice might be customized to this finding given that hard and investigative disciplinary cultures defined by a strong intrinsic research motivation are more open and disposed to student-centered pedagogy. Leveraging this synergistic relation, offices charged with faculty instructional development might design student-centered pedagogical programs and resources that demonstrate connections between research activity and classroom learning. Investigative environments emphasize analytical or intellectual
activities aimed at the creation and use of knowledge (Smart, Feldman, & Ethington, 2000). Faculty instructional development initiatives tailored to the hard and investigative disciplines should embrace this emphasis - the student is the scientist and the classroom is her or her laboratory. From a policy frame, the design and implementation of interventions targeting student-centered pedagogy via increased disciplinary levels of intrinsic research motivation should embody the behavioral profiles that demarcate investigative environments. Investigative environments are more likely to internalize policies and practices that exemplify thoughtfulness, intricacy, precision, and rationality as opposed to appeals based on persuasion, passions, and simplicity (Smart, Feldman, & Ethington, 2000).

Although they were more significantly prone to student-centered pedagogy overall, soft and social disciplines displayed a negation relation between disciplinary intrinsic research motivation and utilization of student-centered pedagogy. The robust level of student-centered pedagogy utilized across all soft and social disciplines suggests that academics within these disciplinary boundaries possess a more natural penchant for student-centered pedagogy. However, at the highest of disciplinary intrinsic research motivation levels, utilization of student-centered pedagogy declined to the overall disciplinary cluster mean. Soft and social disciplinary cultures marked by a strong internal research impulse might incur barriers that inhibit faculty from maximizing their penchant for student-centered pedagogy. Accordingly, policy and programmatic interventions targeting student-centered pedagogy might focus on strategies and initiatives for removing said barriers. Social environments embrace activities that involve mentoring, treating, healing, and teaching
others (Smart, Feldman, & Ethington, 2000). Instructional mentoring programs and peer forums represent compatible faculty development initiatives where academics from social and soft disciplines can learn best practices for utilizing student-centered pedagogy while navigating a disciplinary climate informed by a strong intrinsic research impulse.

**Implications for Future Research**

My study, both in its design and findings, presents several directions for future research. My dependent measure capturing faculty utilization of student-centered pedagogy and my core predictors targeting the research context of academic work were all measured on ordinal scales that potentially masked critical respondent variation. Concealing respondent variation potentially underestimated or even negated significant nonrandom relationships.

Three scale of measurement critiques warrant consideration. First, my intrinsic and extrinsic research motivation predictors were measured on a 4-point Likert type scale of importance. The middle two response options were *somewhat important* and *very important*. These quite distant response options may not have sufficiently accounted for the complexity and ubiquity of research activity at research universities and may have forced response selections that did not reflect respondents’ varied research motivational profiles. Measuring intrinsic and extrinsic motivation on a more expansive Likert type response scale offers a prudent design modification.

Second, research productivity and research time investment were summative composite predictors measured on respective 7-point and 9-point ordered category scales. The fixed numeric range options on these scales became very broad, particularly in the
research productivity and time investment zones were one might anticipate research university respondents. For example, research productivity included response options of 5-10 and 11-20. Summing research productivity and time investment items measured on such wide numeric ranges served to potentially further exacerbate the masking of respondent variation. Measuring research productivity and time investment based on respondent entered estimates may supply more precise data on which to reproduce my analysis.

The research implications of my findings are not removed from their policy and practice implications. The moderating role of disciplinary conditions or environment types in differentiating the studied research-teaching relation provides actionable information on which to design and implement policies or faculty development initiatives. Any or all of the observed moderating effects can inform customization to the intended disciplinary audience. However, the role of research in informing instructional policy or practice initiatives does not culminate at their conception. A longitudinal research design focused on the implementation and execution of such a student-centered pedagogical intervention offers a valuable source of panel data for tracking the effectiveness of a disciplinary specific approach to faculty instructional development.

The observed disciplinary moderating effects that differentiated the studied research-teaching relation at both the individual faculty and disciplinary levels of analysis constituted my study’s seminal scholarly contribution. Biglan’s hard-soft dimension and Holland’s social and investigative environments both differentiated the relation between disciplinary intrinsic research motivation and utilization of student-centered pedagogy. Disciplinary
extrinsic teaching motivation and disciplinary intrinsic research motivation levels correspondingly differentiated the student-centered pedagogical predictive ability of individual faculty research productivity and individual faculty intrinsic research motivation. Each moderating effect represents a complex phenomenon that merits in-depth investigation. The motivational dynamics that dominate these disciplinary moderating effects offer a focal point for such thorough delineation. In particular, as a multidimensional construct, motivation has behavioral, cognitive, social, and affective roots that a qualitative research design can most richly and exhaustively explicate at the individual faculty and disciplinary levels of academic work.

**Conclusion**

It is widely asserted that contemporary higher education has prioritized research at the expense of instructional commitment and efficacy. Other voices contend that the knowledge and skillset gained through research activity transfers to good instructional practice in a form of work role spillover. Bolstering such a “spillover effect,” scholarly consensus largely posits a weak positive relationship between research and teaching at the individual faculty level. However, it would be imprudent to assume the performance of these work roles is uniform across academic life. Academic disciplines represent a governing source of normative influence over the values and behaviors that drive research and teaching. This influence is especially acute at research universities where vibrant disciplinary cultures and robust research agendas are inextricably linked.
My study examined how disciplinary affiliation informed the relationship between the research context of academic work and faculty utilization of student-centered pedagogy at research universities. Supporting the scholarly record’s suggestion of a “spillover effect,” my findings detected the presence of a weak positive relationship at the individual faculty level of analysis. My findings also signaled that this positive relationship does not exist in a disciplinary vacuum. Rather, variant disciplinary environments and work role climates served to differentiate the relation between the research context of academic work and utilization of student-centered pedagogy, both within and between disciplines. Two consequential implications are evident. First, disciplinary variation observed in my studied research-teaching relation offers a nuanced source of customization for instructional policy and programmatic efforts targeting student-centered pedagogy. Second, future research would be well served to consider and account for the differential effect that disciplinary cultures potentially exert on all facets of academic work.
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APPENDICES
Appendix A: 2007 HERI Faculty Survey - Discipline Designation List

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<th>Code</th>
<th>Discipline</th>
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<td>Environmental Science</td>
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<tr>
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<td>Marine (life) Sciences</td>
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## Appendix B: Final Disciplinary Clusters - Size and Classifications

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<th>Holland Classification</th>
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### Appendix B: Final Disciplinary Clusters - Size and Classifications (continued)

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