Socialization to Research: A Qualitative Exploration of the Role of Collaborative Research Experiences in Preparing Doctoral Students for Faculty Careers in Education and Engineering

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ABSTRACT

One challenge facing graduate education is the preparation of future faculty members across disciplines to assume faculty positions (Wulff & Austin, 2004). This qualitative study explored the socialization process of doctoral students in education and engineering fields committed to a career as a faculty member. Specifically, this study attempted to understand what knowledge, skills, and understandings (Weidman, Twale, & Stein, 2001; Van Maanen & Shein, 1979) are acquired during the research collaborations some doctoral students have with their faculty mentors and how this relationship prepared doctoral students for a future as a faculty member. Core elements of the Graduate and Professional Student Socialization model (acquisition of knowledge and skills, investment, and involvement) were used to explore doctoral student socialization (Weidman et al.). Semi-structured telephone interviews were conducted with forty doctoral students (20 education, 20 engineering) from four predominately White research institutions (PWRIs).

Five themes emerged from the data regarding the role research collaboration played in socializing doctoral students in education and engineering to faculty careers. First, the research collaborative process with mentors aided doctoral students in learning how to communicate research to different audiences, the realities of research, how to conduct problem solving research, and the competitive nature of research. Second, participants identified learning about the complexity of a faculty role, particularly responsibilities that extend beyond teaching and research for faculty members. Third, doctoral students reported learning about the requirements of the tenure process.

There were ways the collaborative experience positively or negatively contributed to an interest in a faculty role. Positive factors included enjoyment of research and the perceived autonomy and flexibility of research. Negative factors included the perceived low priority given to teaching and the demands placed on faculty members. Participants reported varying levels of commitment to the research collaborative relationship depending on whether they had competing interests. Exposure to the research collaborative process with a faculty mentor allowed doctoral

students to conceptualize the entire research process from beginning to dissemination and to get an intimate idea of the realities of faculty life. Implications for practice, research, and theory are outlined.

DEDICATION

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CHAPTER ONE

Introduction

Graduate education in American colleges and universities has been and continues to be a successful endeavor. It serves as a critical source of research, innovation, and economic development to society (Gaff, Pruitt-Logan, Sims, & Denecke, 2003; National Science Foundation (NSF), 2006; Kwiram, 2006). As one scholar notes, "by conducting graduate education in the same institutions where a large portion of the nation's basic research is done, our research universities have created a research and training system that is one of the nation's greatest strengths—and the envy of the rest of the world" (Duderstadt, 2001, p. 5).

Doctoral education in the United States continues to represent success largely due to the research produced by faculty and students participating in this enterprise (Duderstadt, 2001; Kwiram, 2006). The research (and teaching) missions of colleges and universities depends, in part, on the work conducted by graduate students who serve as research and teaching assistants for faculty members (Austin, 2002). In fact, a large portion of the research conducted on college and universities campuses is done by doctoral students (Gaff et al., 2003).

The doctoral degree denotes mastery and expertise in a field of study. The doctorate of philosophy (or Ph.D.), a research degree (Golde, 2006; Shulman, Golde, Bueschel, & Garabedian, 2006) "demonstrates creativity, independence of critical thought, and the ability to frame incisive questions about an issue" (Kwiram, 2006, p. 142). The holder of a Ph.D. degree should have the ability to conduct and generate original research (Richardson, 2006) and apply this knowledge to particular disciplines in an effort to expand the field (Gaff et al., 2003; Golde, & Walker, 2006).

Doctoral education dates back to the late 1800s with Yale university being the first American institution to award a doctorate in science in 1861 (Fox, 1996; 2001; Nettles & Millett, 2006). This signaled the beginning of a lasting partnership between American colleges and universities and the federal government. This social compact, charging universities with the task of conducting research on behalf of the country, emerged shortly after World War II, rapidly expanding graduate education (Bowen & Rudenstine, 1992; Gaff et al., 2003). Consequently, numerous federal agencies were established to fund university research and to maintain the United States' position as the leader in innovative science and technology (Gaff et al.). Federal

support also enabled universities, particularly research institutions, to specialize in particular areas, giving more autonomy to institutions (Fox, 2001).

Despite the success and popularity of American graduate education, it has been critiqued for having deficiencies that include under representation of ethnic minorities (Golde, 2006; NSF, 2006; Perna, 2004) and graduate student attrition (Lovitts, 2001; NSF, 2006). Many of these factors relate to the graduate students' experience in their programs.

More than one million students (1,589,562) participated in graduate education in 2006. Of this figure, 59% were women and 41% were men. Forty-two percent (42%) of these students were attending doctoral-granting institutions (Redd, 2007). Ethnic minorities, however, remain underrepresented in doctoral education. This population represented 11% of the graduate enrollment in 2004 (Brown, 2005). Fewer ethnic minorities enroll in less-than-masters, masters, and first-professional degree programs as compared to their White counterparts (Perna, 2004). The fact that ethnic minorities have not been the beneficiaries of graduate education as compared to their White counterparts and that they are not participating in doctoral education in significant rates is a concern.

Graduate student attrition has also been cited as a deficiency in graduate education. While enrollment figures continue to increase due to students requesting "mass education" (Kirwam, 2006, p. 8) and seeking rewarding opportunities after graduation, students receiving graduate degrees have not matched or come close to matching enrollment figures. For example, only 40, 000 doctoral degrees are awarded annually (Golde, 2006), despite more than 600,000 students participating in doctoral education (Brown, 2005). Attrition levels remain at 50% and in some disciplines, exceeds 50% (Duderstadt, 2001; Golde; National Research Council, 1996, Strayhorn, 2005). When looking at persistence across ethnic groups, ethnic minorities have been found less likely to persist in graduate school when compared to their White counterparts (Bowen & Rudenstine, 1992; Lovitts, 2001; National Research Council, 1996). One study found that African Americans are less likely to persist in graduate programs among all ethnic groups due to educational debt, among other factors (Strayhorn). Another study reported similar findings, citing reasons for departure from doctoral programs related to quality of life issues in addition to financial debt (Bowen & Rudenstine).

Failure to complete a doctoral degree can occur for several reasons. Some reasons might include lack of financial support (Bowen & Rudenstine, 1992), lack of emotional or social

support, lack of guidance (Lovitts, 2001) or motivation on the part of the student, or for better opportunities (Weidman, Twale, & Stein, 2001). Financial support for graduate education, particularly the doctorate, continues to pose a challenge for students across disciplines, causing them to discontinue their education.

Little guidance from graduate program faculty is also a factor contributing to attrition Weidman et al., 2001). One study found that minority students, in particular, received limited or ambiguous information about program requirements that resulted in them leaving their graduate education behind (Lovitts, 2001). Lack of support through mentoring opportunities and research collaborations during doctoral training also impacts attrition for women and ethnic minorities (Frierson, 1990). These have been cited as the experiences some doctoral students contend with that result in them ultimately leaving their programs.

The underrepresentation of ethnic minorities in graduate education, graduate student attrition, and the overall quality of the graduate education experience are significant issues facing graduate education. Such findings suggest a need that more attention should be given to the issues that limit graduate students from being successful in graduate education, with particular emphasis on the culture of disciplines and how such cultures adequately socialize students in their departments and fields.

Education

Schools, colleges, and departments of education face problems and challenges due to education being both a field of study and a formal system (Tierney, 2001). Kennedy (2001) contends that the field maintains a fragile state in the academy because it is so populous in academe. Education is the largest public enterprise found in all 50 states (Oakes & Rogers, 2001). Schools, colleges, and departments of education programs can be found in approximately 70% of all higher education institutions, including large research, comprehensive, private, and small liberal arts institutions (Kennedy).

Education programs within colleges and universities can be found in various departments and divisions. For example, education faculty have been found in colleges of liberal arts, colleges of human development, and colleges of urban and regional issues. This is problematic for the field when you compare it to other disciplines that are specialized and have special places at institutions. For example, engineering, law, and medicine are all disciplines that have schools or colleges at institutions. They are also typically located only in a particular type of institution,

for example, research institutions (Tierney, 2001). These factors contribute to the inability of education to maintain its identity as a specialized field (Kennedy, 2001; Tierney).

In addition to being highly populous and scattered among institutions, education, by headcount, is the largest field for women and African American students (Brown, 2005; Gravois, 2007; Redd, 2007; Tierney, 2001). As a field, education reported the largest enrollment of African American graduate students with 34,978 in 2006. Women represented nearly three quarters of African American graduate student enrollment (Redd).

Engineering

The United States is a leader in producing students with graduate degrees in science and engineering, awarding the highest number of doctorates in this field (Duderstadt, 2000; NSF, 2006). Research universities are a large source for granting doctorates, with 55% and more than 60% of faculty and professional staff in S&E fields working in academia (NSF). One reason the U.S. is the leader in granting so many S&E doctorates is due to its influence in producing science, engineering, and research development for the country (Fox, 1998; NSF). Academia is responsible for more than 80% of research and development that takes place on American research universities and the producers of a large percentage of academic articles and patents (NSF).

Increased enrollment in S&E undergraduate and graduate programs is another reason for the success. Science and engineering programs experienced a long growth period from 1970 to 2006. Graduate enrollment was 104,496 in 2006 (Redd, 2007). International students represented 51% (53,436) of the enrollment in S&E, outnumbering United States citizens. Of these figures, White students represented the largest racial group (37,575) enrolled in S&E, followed by Asians (7,786), Hispanics (3,382), African Americans (3,072), and American Indians (245) of international students in 2006 (Redd).

There is a shift, however, in the number of S&E Ph.D.s moving from academic jobs to postdoctoral positions and other full-time employment (Fox, 1996; NSF, 2006). Academic hiring in research universities of recent Ph.D.s also slowed during the past few decades (Fox & Stephan, 2001; NSF). This trend suggests that other factors may be present in the training of doctoral students in S&E that play into their decision to pursue a career in academia as opposed to industry.

Need to Recruit a New Generation of Faculty

There exists a growing need to recruit a new generation of faculty members due to the large percentage of faculty members reaching retirement. One third (1/3) of the faculty are 55 or above. When looking at aging faculty by disciplines, there are sharp differences in the average age of education and engineering faculty members. The average age of a professor in education is 50 whereas the average age of a professor in engineering is 35 (Duderstadt, 2000; Tierney; 2001).

On several fronts, retiring faculty members offer employment opportunities for new faculty members entering the market. The idea of bringing new ideas and energy to the academy is encouraging and promising for aspiring scholars fresh out of their doctoral programs (Wulff & Austin, 2004). On other fronts, many faculty members who are eligible to retire are delaying their retirement decision due to the financial benefits of doing so. For example, tenured faculty members have the opportunity to earn "defined contribution" benefits (Duderstadt, 2000, p.17) for each year they provide service to the institution. As their years increase, so too do their retirement packages. Consequently, faculty members past the age of 60 are not forced to leave their employment because mandated retirement policies no longer exist (AAUP, 2001; Duderstadt; Ehrenberg, 2005).

The graying of the faculty suggests an increased need to continue recruiting the best and brightest scholars. Maintaining the quality of education and scholarship is critical for higher education. This high standard is only maintained through the quality and diverse make-up of its faculty members.

Diversity

Establishing diversity in higher education has long been a national priority. Its benefits are well known—diverse faculty and students foster intellectual inquiry, offer varying perspectives on scholarly research, and overall, promote learning for students and faculty members alike (Turner, 2002; 2002a). Even still, faculty members that represent diverse ethnicities and scholarship continue to be groups not tapped into fully by institutions in an effort to create, richer, diverse environments (NFS, 2006). Ethnic minority faculty members are not only important for the scholarship they contribute to higher education, but for their potential to serve as role models and mentors to students and faculty members in fields where ethnic

minorities are underrepresented (Turner & Myers, 2000). Unfortunately, American higher education institutional leaders have not been able to meet articulated diversity goals by hiring and retaining a significant number of ethnic minority faculty members in fields across the board (Smith, 1996; Turner, 2002), but particularly in S&E fields (NSF). This finding is discouraging considering the evidence of what an ethnically diverse faculty can bring to an institution in terms of stimulating the development of college students (Smith).

Appreciation for diversity begins as members of the academic community look for aspiring, talented individuals to fill faculty positions (Wulff & Austin, 2004). It is at this level where doctoral students from diverse backgrounds, viewpoints, and interdisciplinary experiences are found that will enhance the professoriate (Antony & Taylor, 2004; Golde & Walker, 2006).

Changing Role of Faculty and Preparing Future Faculty

Several scholars contend that a mismatch exists between faculty expectations and current doctoral training in American graduate education (Duderstadt, 2001; Prewitt, 2006; Wulff & Austin, 2004). For example, research focused graduate education, growth of contingent faculty, diverse nature of colleges and universities, and the diverse roles of faculty all contribute to the changing demographics of American colleges and universities, consequently changing the face of faculty employment practices. Graduate preparation then should encompass a variety of learning objectives and experiences that prepare new Ph.D.s equipped with the knowledge and skills set and flexibility for a consistently changing environment (Austin & McDaniels, 2006; Bieber & Worley, 2006).

One area where there is a mismatch is in the research training of doctoral students. Some scholars contend that faculty members of the present are still functioning as usual. That is, faculty are training doctoral students to be researchers like themselves (or clones) (Damrosch, 2006; Duderstadt, 2000; 2001). Faculty are also training doctoral students to work in programs and institutions similar to programs and institutions from which they received their graduate training (Prewitt, 2006), and are content to use doctoral students to assist with research that further promotes the faculty member's agenda (Duderstadt). These limitations in the current system have not been projected to change much because they have worked well for tenured faculty members in the past (Damrosch, 2006).

Doctoral students are expected to connect with faculty members from the beginning of their programs. This attachment, in best case scenarios, develops into mentoring relationships

between the doctoral student and a faculty member (Duderstadt, 2000; 2001). Doctoral students usually work with faculty members on problems related to funded research projects that ultimately leads to the doctoral student's dissertation work (Duderstadt; Fox, 2000). This assumption does not consider the fact that doctoral students out number the amount of faculty members available to work closely with students to be their mentors (Johnson, 2007). This ultimately means that every doctoral student will not have a faculty member as their mentor.

In addition to there not being enough faculty members available to serve as mentors to doctoral students, disciplinary differences exist that constitute structured (or unstructured) opportunities and environments for students to work with faculty members. All disciplines are not structured in ways that afford doctoral students the opportunity to work with faculty members on funded research projects (Golde & Walker, 2006). For example, students in science and engineering fields may be courted by faculty members before entering doctoral training and work extensively with faculty members on federally or industry funded research (Fox, 2000; 2001). Doctoral students in social science fields, however, may not enter their programs with this opportunity. To be sure, most doctoral students in social science fields or doctoral students not working with research faculty members have to develop their dissertation topics on their own, which typically occurs after the student has completed course work and qualifying exams. This stage of the process has been noted as the most challenging for doctoral students because it at this point where little guidance is given on conceptualizing a dissertation topic and there is little structure as was present prior to this stage (Weidman et al., 2001). Working with faculty members on funded research from entry into doctoral programs robs doctoral students of the opportunity to broaden their research studies and dissertation topics for students training in disciplines where working with research faculty on funded projects is the norm (Duderstadt, 2000; 2001).

The research training in doctoral programs, while extremely important in continuing higher education's mission to create innovative research and knowledge, may not be entirely appropriate in the socialization process for doctoral students who will be employed in institutional types other than research universities. Stated differently, doctoral students trained in research focused institutions, who devote a considerable amount of time to research may not necessarily be equipped to be a faculty member at a different type of college or university, one that is not focused on research (Weidman et al., 2001). This is particularly true considering the

small percentage of doctoral students trained in research universities who get hired in research universities (Duderstadt, 2000; 2001). For example, approximately 30% of faculty members work in research universities, 26% work in comprehensive institutions, 20% work in community colleges, 8% work in liberal arts colleges, and the remainder work in more specialized settings (e.g., proprietary schools or as researchers in postdoctoral fellowships) (Duderstadt). Preparation for a faculty career means understanding the various institutional types that constitute the American system of higher education because the varying roles of faculty members is partly due to the diversity of colleges and universities (Duderstadt, 2000; Wulff & Austin, 2004). This suggests that new doctorate holders recruited to these types of institutions should be clear of the institution's mission and what the institution represents (Boyer, 1990).

Faculty members serve in a variety of roles depending on the institution type in which they are employed. Faculty members are expected to research, teach, and provide service to the institution, with priority given in most cases in that order (Boyer, 1990; Antonio, 2002). For example, faculty members in two year colleges teach more than faculty members in four-year institutions. The same is true for faculty members in comprehensive colleges and universities versus those at research universities. Depending on where a faculty member is employed, her or his teaching and research roles will be different (Boyer, 1990; Duderstadt, 2001).

Faculty members are also expected to be entrepreneurs, in a sense, because many are expected to garner financial resources for their research. The generation of research funds are also, in part, expected to cover their salaries (Ehrenberg, 2005). Assuming these responsibilities may prove challenging to new Ph.D.s not aware of such requirements or skills with the knowledge and experience, in for example, grant writing. Leaders in graduate education programs, therefore, have the huge task of preparing doctoral students to assume varying responsibilities of colleges and universities they will end up working (Wulff & Austin, 2004). They will also need to be equipped with the knowledge and skill set that embraces interdisciplinary and diverse scholarship paradigms. In the words of Boyer (1990), "Tomorrow's scholars must be liberally educated" (p. 65).

Increasingly, new faculty members are finding themselves with limited opportunities in terms of full-time employment and opportunities for advancement in the academy (Boyer, 1990). American colleges and universities are hiring recent Ph.D.s on a part-time, non-contractual basis due to a variety of reasons, most of which stem from fiscal constraints institutions now face.

Another reason for this trend is because of the flexibility hiring part-time faculty members gives the institution (Ehrenberg, 2005). New doctorate holders are filling positions that include postdoctoral fellowships, lecturers, instructors, research assistants, and adjunct professors, all of which are not tenure track positions. Individuals in these positions generally earn 20 to 30% of a faculty salary (Duderstadt, 2001).

Socialization in Higher Education

Several scholars have contributed to theoretical perspectives for understanding the socialization process of doctoral students. For example, social network theory (Kilduff & Tsai, 2003), professional identity development theory (Stryker, 1968), graduate student socialization theories (Weidman et al., 2001), and social exchange theory (Chadwick-Jones, 1976; Homans, 1974; Molm 2003) have all been helpful for understanding the unique experiences of graduate and professional students in higher education.

Social network theorists posit that individuals are members of one or more networks either personally or professionally. Networks can include relationships with friends, faculty, family, peers, or business associates. This theory seeks to explain how a network of individuals establishes and maintains connections within organizations and how those connections result in professional advancement, knowledge acquisition, and identity development (Kilduff & Tsai, 2003).

Professional identity development theory is another useful theory for understanding how doctoral students begin seeing themselves as professionals. It suggests that individuals develop preferences, values, skills, and motives that they carry with them throughout their lives (Ibarra, 1999; Tierney, 2002). For example, doctoral students spending most of their time on research will begin developing an identity as a researcher.

A basic assumption, pertinent to social exchange theory is that individuals enter into relationships with the hope that they will benefit or gain some type of reward (or positive outcome) (Chadwick-Jones, 1976; Homans, 1974; Zey, 1991). In mentoring relationships, the mentor, mentee, and the organization benefit from the social exchange. The mentor gains benefits that include: career enhancement, new knowledge, or information, and psychic rewards; such as feelings of pride and a sense of contributing to the organization and the individual. The mentee gains knowledge, personal support, protection, and career advancement. The

organization gains managerial succession and development, reduced turnover, and increased productivity (Zey, 1991).

The most comprehensive framework for understanding the socialization process of graduate students has been offered by Weidman, Twale, and Stein (2001). Graduate students are socialized as they learn the knowledge and skills needed in respective professions, interact with faculty and student colleagues, and engage in various activities in their fields (Weidman et al.). A large component of the socialization process for doctoral students involves their interactions with faculty members. Indeed, many of the norms and culture of the higher education organization are learned through both informal and formal interactions doctoral students have with faculty members (Weidman et al.).

Mentoring in Higher Education

The positive effects of mentoring have long been known. It has not been until the last few decades however that mentoring has been addressed in the empirical research literature. For example, the concept of mentoring has been studied in the business sector with top level executives (Mertz & Pfleeger, 2002; Zey, 1991) and in higher education as scholars describe the impact of mentoring on faculty satisfaction and faculty development (Boice, 1992; Cunningham, 1999; Luna & Cullen, 1995; Sands, Parson, & Duane, 1991; Tierney & Bensimon, 1996) and on the development and success of graduate students (Busch, 1985; Clark, Harden, & Johnson, 2000; Green & Bauer, 1995; Kelly & Schweitzer, 2005; King, 2003; Tenenbaum, Crosby, & Gliner, 2001).

Just as the concept of mentoring has been around forever, so too has varying definitions of the term. For example, the business sector tends to describe the function of mentoring as coaching, consulting, or apprenticeship in nature (Luna & Cullen, 1995). Adviser, counselor, role model, and teacher have all been terms used to describe mentors in academe. Mentoring in higher education is thought of as a socialization process that guides the individual being mentored through the culture of the organization that may be difficult to navigate without a mentor (Tierney & Bensimon, 1996; Weidman et al., 2001).

Mentoring relationships are generally characteristic of a senior scholar guiding a junior scholar in educational, career, or personal matters (Blackwell, 1989; Frestedt, 1995). Faculty development strategies that include a mentoring component have been proven to be strong institutional strategies many institutions are making the norm, rather than the exception (Luna &

Cullen, 1995). Mentoring in higher education, if performed correctly, has the potential to benefit the mentor, individual being mentored, and the organization (Johnson, 2007; Zey, 1991).

As outlined earlier, various definitions have been offered to define what mentoring relationships entail. For instance, mentoring typically involves a senior individual within an organization guiding a junior colleague with educational, career, or personal endeavors that has the potential to advance the individual. In higher education, most scholars tend to agree that faculty members are responsible for mentoring students (King, 2003; Johnson, 2007; Tierney & Rhoads, 1994; Weidman et al., 2001). This has become challenging for faculty because the responsibilities of mentoring are difficult to define. It is also true that there is confusion about what a mentor should do and the role that s/he plays in the life of a student (e.g., teacher, counselor, friend, etc.) (Johnson, 2007). What has been considered effective mentoring has often happened as a result of a faculty member receiving mentoring and passing along that experience to his or her student (Johnson).

Mentoring involves a range of activities, all of which involve teaching in some respect. Mentoring then is a more individualized form of teaching (King, 2003). The focus of the present study will be on the research collaborative mentoring relationships that exist between faculty members and doctoral students and how such collaborations prepare doctoral students for research. Research collaborations between faculty members and doctoral students provide opportunities for individual instruction through research training. Through this training, doctoral students develop not only technical skills necessary for research, but also critical thinking skills and intellectual initiative critical for scholarly work as a future faculty member (King).

Much of the debate about faculty duties has centered on the imbalance that exists between research and teaching. Most argue that teaching responsibilities have taken time away from the research activity of faculty members (Tierney, 2001; Walker, Golde, Jones, Bueschel, & Hutchings, 2008). Recent studies suggest that research training in general and the presence of an intellectual community specifically in graduate education are being slighted for the heavy re-emphasis on pedagogical training, leaving many doctoral students under prepared to design and conduct research, and most importantly to participate in intellectual communities articulating research (Walker et al.). Equally as important, research productivity is a requirement to achieve tenure in academe. Faculty members are expected to maintain a research agenda that includes publications, quite often peer-reviewed, and scholarly presentations throughout their careers.

Faculty members who are denied tenure are usually denied because they lack the scholarly productivity expected by their senior-ranking peers. This usually equates to the faculty member being considered not published enough to be awarded tenure. Stated another way, the value of published work is generally the basis of a faculty member's credentials (Tierney & Rhoads, 1994). These findings suggest that educational leaders directly involved in graduate education should rethink the research training of doctoral students, focusing more on what doctoral students are learning about research, how doctoral students conduct research, and how research collaborative training between faculty members and doctoral students frame how doctoral students might approach research as a future faculty member. Such attention will aid doctoral students in understanding the culture of research and what research activity entails.

Mentoring relationships between faculty members and doctoral students have the potential to create successful and rewarding experiences for both parties involved (Johnson, 2007; Zey, 1991). Such relationships also contribute substantially to a diverse faculty needed in higher education (Luna & Cullen, 1995; Tierney & Bensimon, 1996; Tierney & Rhoads, 1994).

Various factors in higher education and graduate school settings prevent mentoring from taking place. Such obstacles include the competitive nature graduate school environments foster, shortage of faculty members available to serve as mentors, and mismatch of goals, interests, and priorities between faculty members and doctoral students, to name a few (Johnson, 2007; Weidman et al., 2001).

Statement of the Problem

Research conducted during the past few decades on graduate education has brought attention to the critical role graduate education plays in American society. Important issues about graduate student experiences have also been addressed. It is clear that graduate education is a successful enterprise because of the research produced by its faculty and graduate students (Duderstadt, 2000; 2001; NSF, 2006).

It is also clear that while graduate education has experienced success, there exists a few deficiencies that merit attention. The underrepresentation of ethnic minorities continues to be a concern considering the large numbers of students enrolling annually (Brown, 2005). Low graduate student persistence and attrition rates are disturbing as it relates to overall educational attainment and factors contributing to earning the degree.

There is a pressing need to recruit new scholars in academe who will contribute to a diverse professoriate and maintain the quality level of higher education. The need to recruit a new generation of faculty also stems from the realities that current faculty members considered baby boomers are now aging and retiring (Duderstadt, 2000; 2001). Deans of graduate schools and other university administrators interested in diversifying the professoriate and replenishing faculty positions seek recent doctorate holders to fulfill this goal.

One of the challenges graduate education is currently faced with is preparing future faculty members across disciplines to assume these soon to be vacant positions and varying roles faculty now face (Wulff & Austin, 2004). New faculty members will not only be faced with multiple responsibilities in addition to traditional teaching, research, and service roles, but have to be technologically savvy, be effective communicators, and take on more leadership roles (Austin & McDaniels, 2006; Wulff & Austin).

Mentoring, it appears, is critical to this learning (or socialization) process. Additional research is needed on the role faculty mentoring plays in the socialization of doctoral students to faculty careers. Data are needed on what specifically doctoral students are learning from faculty mentors about research and faculty careers. Are the socialization experiences of education and engineering doctoral students preparing for a faculty role different? Examining the research collaborations doctoral students and faculty mentors engage in will shed light on the key experiences that equip doctoral students to the faculty research role. The present study is designed to elicit such data.

Purpose Statement

The purpose of this qualitative study was to explore the socialization process of doctoral students committed to a career as a faculty member in education or engineering fields. For purposes of this study, socialization refers to the process by which individuals acquire knowledge and skills necessary to become members of the academic community. It involves engagement with faculty members and engagement in scholarly activities in their respective fields (Austin, 2002; Weidman & Stein, 2003). Core elements (acquisition of knowledge and skills, investment, and involvement) of the Weidman et al. (2001) model were used to explore doctoral student socialization. For purposes of this study, faculty mentor was defined as the person who collaborated with the doctoral student on a research project and who the doctoral student identified as the person having the most significant role in helping to prepare the doctoral

student for a faculty role. Doctoral students were defined as graduate students at four research universities who were enrolled full time and who had finished their course work. Research collaboration activities included a range of activities that involved participating in the research process with a faculty member. For example, conducting research, writing for scholarly publication, and presenting at professional meetings with faculty mentors were considered research collaborative experiences.

Research Questions

This research is guided by the question: What contribution does research collaboration with a faculty member play in the socialization of doctoral students in education and engineering committed to a career as a faculty member? The following sub-level questions further explored the overall research question:

1. What do doctoral students perceive they learn about research through the process of collaboration with faculty mentors and how do these vary in engineering and education fields?
2. What do doctoral students learn about faculty careers through their research engagement with faculty mentors?
3. In what positive and negative ways has the mentoring relationship as defined as collaborative research experiences affected doctoral students' interest in faculty roles?
4. How do doctoral students describe their own investment in their mentoring experience?

Significance of the Study

The present study was significant for future practice, research, and policy. In terms of practice, several groups might benefit from the results of this study. For example, academic administrators, such as graduate school deans and department heads, might use results from this study to evaluate the training they offer graduate students. Faculty members might use findings from this study to evaluate their engagement with doctoral students. Doctoral students might use these findings to gain a better understanding of the competencies they need to have that are valued in the academy.

Graduate school deans and department heads involved in designing graduate education curriculum can offer courses on techniques for conducting research and teaching research methods for doctoral students interested in pursuing faculty roles at research universities. They

might also provide workshops on preparing for the job market. Such courses on interviewing for faculty positions, preparing a curriculum vita, or searching for faculty positions could be integrated in the curriculum that doctoral students interested in faculty career may elect to enroll in during the course of their graduate training.

Faculty members directly involved with doctoral students might benefit from the findings of this study. This study provided information on the research related activities doctoral students participate in that socialize them to careers as faculty members. Faculty members and advisors might examine specific activities characteristic of doctoral programs that socialize students effectively or ineffectively as a graduate student, to the discipline, and to the professional field. For example, informal (e.g., informal conversations and interactions, social engagements, etc.) and formal activities (e.g., research meetings, classroom instruction, conducting research, etc.) can be monitored to assess how best to maximize interactions and engagement with doctoral students as it relates to expanding opportunities for research with a faculty member.

Graduate faculty members could also use findings from this study to examine specific aspects of the socialization process essential for doctoral students to master. For example, this study focused on the core elements of socialization: knowledge acquisition, investment, and involvement. Faculty members can focus on specific activities that could potentially prepare doctoral students in these three areas. Faculty members might also examine the dimensions of organizational socialization (collective vs. individual, formal vs. informal, random vs. sequential, fixed vs. variable, serial vs. disjunctive, investiture vs. divestiture) to better understand how doctoral students transition from one role to another in their programs. Faculty members might also examine the stages of socialization (anticipatory and organizational socialization) or other elements (peer, family, and professional communities) that impact the socialization of doctoral students. This might add more to our understanding of the socialization process as it relates to acquiring research skills and competence in preparation for a faculty career.

Doctoral students might benefit from findings from this study. This study focused specifically on the research experiences of doctoral students that prepare them for faculty roles. Doctoral students understanding the importance of research competency might use these findings to concentrate on understanding the research process (e.g., research design, analysis, reporting) early in their graduate training experience. Doctoral students might also focus on other research

related activities (e.g., professional presentations and scholarly writing) that socialize them to the research role.

This study also had significance for research. I explored research-related activities that contribute to the socialization process for doctoral students in select disciplines. Additional studies might explore socialization experiences of doctoral students with regard to research collaboration with faculty mentors in other disciplines (other than education and engineering) to make findings more generalizable.

Finally, my study has significance for future policy. I focused on the importance of faculty mentoring relationships to the socialization of doctoral students. The mentoring relationship is not one-dimensional as has been presented in the literature. This one-dimensional model of mentoring may not be relevant for today's doctoral students and faculty members due to the multiple needs of doctoral students, interdisciplinary interests of students, and the learning process that occurs for both the doctoral student and faculty mentor. More of a multiple-mentoring or advising type of model that incorporates the core elements of socialization, may be more appropriate to cater to the interests and needs of a diverse doctoral student demographic. A new mentoring model could be one that also embraces the two-dimensional process of the relationship. When the relationship works well there are rewards for both the doctoral student and the faculty mentor. Faculty mentors can learn (knowledge, skills, and ideas) just as much from their doctoral students as students can learn from their faculty mentors.

Delimitations

As with all research, this study was not without delimitations. The first set of delimitations dealt with the sample. Doctoral students were asked to volunteer for an interview for this study. Those who volunteered might have differed in some important way from those who did not volunteer to participate in this study. If that was the case, findings might have been influenced.

Doctoral students who identified having a faculty mentor participated in this study. This was based on the assumption that faculty mentors might have a significant role in socializing doctoral students to research, more so than a faculty member who was not considered a mentor to the student. Those students without faculty mentors could very well have had positive research collaboration experiences with their faculty advisors, individuals not considered the student's mentor. Stated another way, faculty advisors could have been influential in the socialization

process, but were not included in this study because of their title as “advisor.” This sampling technique could have influenced my findings.

Finally, this study was conducted over a four to five month period of time. Future studies might incorporate a longitudinal examination of students’ collaboration in research with faculty mentors in their programs and again during the first year of their faculty appointment. A study of this nature might assess whether the research collaboration experiences in doctoral training actually translate into research productivity as a faculty member during the individuals’ first year.

Organization of the Study

This study is organized around five chapters. Chapter One introduced the topic of the study, doctoral student socialization and the importance of faculty mentoring in this process. Research questions and the significance of the study followed. The second chapter provides a review of the literate related to doctoral student socialization, the relevant conceptual framework, and the literature related to graduate education and academic discipline characteristics, graduate student socialization, and mentoring. Chapter Three details the methodology of the study, including sampling techniques and procedures employed to collect and analyze the data. The fourth chapter describes the findings of this study from doctoral student participants. Chapter Five outlines results and key implications for practice, research, and policy.

CHAPTER TWO

Literature Review

The purpose of this study was to explore the socialization process of doctoral students to faculty careers. Special emphasis was given to the research collaborations between doctoral students and faculty members. I examined three bodies of work that focused on the experiences of doctoral students preparing for research roles in the professoriate: literature addressing doctoral training in graduate education by disciplines; socialization theory and the role of socialization in the doctoral student experience; and mentoring in higher education and the role of collaboration among graduate students and faculty members in higher education in the mentoring process.

First, the literature addressing graduate education is discussed in terms of characteristics of doctoral training in education and engineering disciplines. Graduate student socialization theory is presented next. Central to the study was the use of socialization theory to examine the research collaborative relationship between doctoral students and faculty members. Specifically, socialization theory is presented in terms of how socialization impacts the graduate student experience in higher education and the acquisition of research skills and knowledge doctoral students acquire that prepare them for faculty research roles. Social exchange theory is presented as a part of socialization being a two-way process, benefiting the doctoral student and faculty member. The third section examines the mentoring literature, focusing on the relationship between faculty members and graduate students. Disciplinary, gender, and ethnic differences in mentoring are highlighted. Collaboration is discussed as a form of mentoring that members of the academy participate in to accomplish scholarly goals.

For purposes of this study, doctoral student socialization refers to the process by which individuals acquire knowledge and skills necessary to become members of the academic community. It involves engagement with faculty members in scholarly activities (Austin, 2002; Weidman, Twale, & Stein, 2001). Doctoral students were defined as graduate students at four research universities who were enrolled full-time in a doctoral program and who had completed their course work. Faculty mentors were defined as the faculty member who collaborated with the doctoral student on a research project and who the doctoral student identified as the person having the most significant role in helping prepare the student for a faculty career. Lastly,

research collaboration was defined as any research related activity (e.g., conducting research, scholarly writing for publication, or presenting research at professional meetings) both the faculty mentor and doctoral student participated in together.

Graduate Education

American graduate education has been critiqued for not producing effective research scholars and individuals prepared for professional roles (Gelso, 1993; Golde & Walker, 2006; Levine, 2001; Weidman et al., 2001; Wulff & Austin, 2004). For example, schools, colleges, and departments of education have been critiqued for not producing research on important issues facing education (Levine, 2001; 2005). Disciplines such as educational psychology, for example, have struggled with the notion of peaking doctoral students' interest in research, enough so that students develop the attitude and investment for such a scholarly endeavor (Gelso). Still others argue that once doctoral students have completed their programs, they enter fields unprepared for the varied responsibilities that are required of them (Golde & Walker; Weidman et al.). For example, Wulff and Austin (2004) state that doctoral students are not aware or prepared for the diverse work environments that have developed due to economic and societal pressures. In addition, they argue a need for doctoral students to be prepared for and in most cases expect part-time, non-contractual faculty positions (Wulff & Austin, 2004). Issues related to the preparation of doctoral students as research scholars and professionals prepared for a changing society merits attention. Such findings suggest that scholarly inquiry and research training and engagement are critical elements in doctoral education. Findings also suggest that scholarly inquiry and training vary by programs and disciplines.

Doctoral Training in Education

Education as a discipline has unique characteristics that differentiate it from other disciplines. Education means both a field of study and a formal system (Golde & Walker, 2006; Richardson, 2006). As a field of study, scholars generate and apply theory to the discipline. As a formal system, education consists of three main categories of disciplines: traditional disciplines (e.g., mathematics education, science education, history education, English education, and the education of philosophy), special interest fields (e.g., policy studies, teacher education, curriculum, educational administration, higher education, special education, and early childhood

education), and cross-disciplinary programs (e.g., social, cultural, critical studies in education) (Richardson, 2006).

Education programs that award Ph.D.s have been critiqued for not developing effective researchers (Berliner, 2006; Levine, 2001; 2005; Shulman et al., 2006). Doctoral students, as found in one study, felt that they did not develop the adequate research skills necessary to be successful in their professional careers (Austin, 2002). In addition, doctoral students reported receiving mixed messages about the importance of research in a qualitative study investigating how graduate students become teachers (Nyguist, Manning, Wulff, Austin, Sprague, Fraser, Calcagno, & Woodford, 1999).

Perhaps the research productivity of faculty in education plays into the notion that effective researchers are not being produced from doctoral programs in education. Tierney (2001) posits that research productivity among faculty members in education is low, significantly contributing to the limited research training doctoral students receive. To ensure that doctoral students develop critical thought while in their programs, Richardson (2006) offers a comprehensive blueprint for colleges, schools, and departments of education that will equip doctoral students with the knowledge and skills to conduct high quality, important and useful research on issues to improve the education field.

Effective research training, then, involves the development of research skills and gaining the importance and value of research for doctoral students. The present study contributes to the knowledge base of graduate education relative to how doctoral students gain research knowledge and skills that in turn prepare them for the research role of faculty careers.

Doctoral Training in Engineering

Doctoral programs in science and engineering (S&E) provide research essential for innovation and a labor force equipped with the skills needed to compete globally (NSF, 2006). A number of elements make doctoral education, particularly in science, technology, engineering, and mathematics (STEM) fields, unique from other disciplines. These include the demographics of the field and doctoral programs, characteristics of graduate programs, and the current challenges facing graduate education in STEM fields.

Graduate education in science and engineering fields is highly decentralized (Fox, 2000). This is because teaching and learning vary by departments within institutions. Science and engineering programs are unique from other disciplines, in that, they provide significant amounts

of funding for their students. Students mainly hold research assistanships (RAs), teaching assistanships (TAs), fellowships, and traineeships (NSF, 2006). In addition, faculty members maintain their own labs where doctoral students conduct research, making science and engineering fields even more decentralized (Fox). It is also important to note that science and engineering doctoral students work closely with faculty members on funded research projects that generally end up being the student's dissertation project. This characteristic appears different from doctoral students in other disciplines, namely education. In the case of doctoral advising in engineering, the doctoral student's research advisor determines what work is considered sufficient for a Ph.D. (Fox, 2000; 2001).

Graduate education in engineering has been cited for being inadequate in a few areas. For example, the discipline has not been able to track employment rates and patterns of its graduates. This is due to increasing trends of unemployment and delayed employment of engineering Ph.D.s. Still other reasons are because national surveys tracking employment patterns of recent engineering graduate are years behind (National Academy of Sciences (NAS), 1995). Consequently, it has been difficult to determine how many Ph.D.s in engineering go into academe or industry after doctoral training. These dilemmas have also made it difficult to determine if enough Ph.D.s are being produced and if the current structure and function of engineering graduate education is sufficient (NAS, 1995).

Socialization Theory

Despite when the actual process of socialization begins, a graduate student's understanding of a faculty career begins before she or he enters the profession (Austin, 2002). Most scholars suggest that a faculty career begins with the socialization process that is initiated during graduate study (Tierney & Rhoads, 1994; Weidman et al., 2001; Wulff & Austin, 2004). Others posit that the socialization process begins at the undergraduate level when students begin to see themselves in a faculty role due to interactions and conversations with professors (Bieber & Worley, 2006). These experiences in undergraduate and graduate education influence perceptions of and actual experiences with faculty life (Austin; Bieber & Worley; Tierney & Rhoads). It is during this period that the individual learns faculty expectations. Faculty members learn these roles and responsibilities through informal and formal socialization experiences in their doctoral programs (Tierney & Rhoads; Weidman et al.).

Socialization is the process through which individuals acquire the values, attitudes, norms, knowledge, and skills needed to exist within society (Merton, 1957). The individual being socialized becomes a part of a group, community, or organization (Austin, 2002). Socialization at the organizational level, in the case of higher education, is the same process (Tierney & Rhoads, 1994). Weidman et al. (2001) examined the socialization process of masters, doctoral, and professional students that prepare them for future professional roles. They built a conceptual framework for understanding the socialization process by stating that three essential elements are present: knowledge acquisition, investment, and involvement. These elements lead to identification and commitment to a professional role. Identity and commitment change over time, depending on the stage (of socialization) in which an individual is operating.

The Graduate and Professional Student Socialization Model (Weidman et al., 2001) was derived, in part, from the work of Van Maanen and Schein (1979) on the socialization of individuals in organizations and Stein and Weidman's (1989) undergraduate socialization frame. In addition to the core elements identified by Weidman et al. (2001), the socialization process occurs in stages: anticipatory, formal, informal, and personal stages (Tierney & Rhoads, 1994; Tierney & Bensimon, 2002). Anticipatory socialization takes place before a faculty member begins his or her work on campus. In the case of doctoral students, the individual becomes aware of the behavior, attitudes, and cognitive expectations of being a faculty member (Weidman et al.). In the formal stage of socialization, role expectations are idealized. Individuals receive formal instruction on role requirements and expectations. The informal stage involves learning the expectations for a role that are communicated through interactions with others. In the personal stage, the role is internalized (Tierney & Rhoads; Tierney & Bensimon).

In addition to the stages of socialization, Van Maanen and Schein (1979) suggest that there are six dimensions of socialization that occur within organizations: (a) collective versus individual, (b) formal versus informal, (c) random versus sequential, (d) fixed versus variable, (e) serial versus disjunctive, and (g) investiture versus divestiture. Individuals can experience any one of the dimensions at varying points of their experience in an organization.

Collective versus individual socialization involves the extent to which newcomers have common experiences (Van Maanen & Schein, 1979). Graduate students may experience collective socialization when they participate in orientations or core courses with their peers. Graduate students might experience individual socialization when they participate in activities

individually such as writing their dissertations and working individually with their major professors (Weidman et al., 2001).

The next dimension of socialization is formal versus informal socialization. Formal socialization involves specific activities designed to “shape” (Austin & McDaniels, 2006, p. 405) the junior person in certain ways (Van Maanen & Schein, 1979). Graduate students experience formal socialization, for example, when they participate in preliminary, qualifying, or comprehensive exams or dissertation defenses (Austin & McDaniels; Weidman et al., 2001). Informal socialization involves unstructured activities, some of which occur by trial and error. Graduate students experience informal socialization when they internalize experiences in different ways. Observations of the faculty and peer culture help the student navigate during the formal socialization process (Weidman et al.).

Random socialization occurs through activities performed that lead to an end goal, but are not clearly defined. Such activities for graduate students that may be considered occurring randomly might be research, teaching, or mentoring experiences (Austin & McDaniels, 2006). Random socialization could also occur as the student develops opinions about courses or faculty members (Weidman et al., 2001). Sequential socialization includes clearly defined activities and is a more ordered process. Sequential socialization occurs when doctoral students follow specific steps in their programs, such as following examination or dissertation procedures (Austin & McDaniels; Weidman et al.).

Fixed and variable pace describe the fourth dimension of socialization. These two terms denote the specialized and unclear timeline for activities to occur within an organization (Tierney & Rhoads, 1994). Doctoral students for the most part experience variable socialization because activities and stages of completion in a doctoral program vary from student to student, making the process more individualized (Austin & McDaniels, 2006).

Serial versus disjunctive socialization characterize the fifth dimension. This type of socialization occurs when doctoral students are given specific (i.e., step by step) advice by faculty members or are in engaged in planned experiences. Doctoral students working under the guidance and tutelage of a faculty mentor experience serial socialization. For example, doctoral students serving as teaching assistants, research assistants, or otherwise collaborating with faculty mentors is considered serial socialization. Disjunctive socialization, on the other hand, occurs when individuals do not have the specific guidance of faculty members or veteran

students. Doctoral students who do not have role models such as faculty mentors experience disjunctive socialization (Weidman et al., 2001).

The sixth dimension of socialization involves the experiences of an individual that help shape her or his perceptions, attitudes, and beliefs about the organization or an experience (Tierney & Rhoads, 1994). Investiture socialization occurs when beliefs about an experience or an organization are confirmed. The individual characteristics are also accepted by the organization. For example, if doctoral students trained in research universities assume faculty positions at an institution they will believe that faculty life will include research. Divestiture socialization, on the other hand, occurs when an individual has to change their beliefs to conform to the culture of the organization. Using the same example, if a doctoral student trained at a research institution assumed a faculty position at a different institutional type (e.g., liberal arts institution), the student may still have the expectation to produce research, finding it challenging to conform to the values and traditions of the liberal arts institutions (Tierney & Rhoads).

Key to the socialization process is the acquisition of knowledge, investment, and involvement of the student; core elements of the graduate and professional student socialization model. These core elements are achieved through involvement with peers, the program, and becoming invested in the knowledge, skills and abilities necessary for effective professional practice. In addition to the stages and core elements of the socialization process, four factors influence the student's socialization process: prospective students, professional communities, personal communities, and novice practitioners (Weidman et al., 2001). The core elements of the model: knowledge acquisition, investment, and involvement, are the most useful elements in this study. Knowledge acquisition involves acquiring cognitive knowledge and affective knowledge. Affective knowledge includes awareness of professional role expectations and an assessment of one's ability to perform successfully in a professional role (Stein, 1992). Investment means committing something of personal value (e.g., time, alternative career choices, self-esteem, social status) to preparing for a professional role (Weidman et al.). Involvement also involves participating in any activity that prepares one for a professional role. Such activities could include involvement with student peers or faculty members in research activities, taking exams, or being involved in professional organizations. These activities help develop the identity of the individual being socialized. Involvement varies by activities and level of intensity (Weidman et al.). A detailed description of the graduate student socialization model is presented in Figure 1.

Role of Socialization in the Doctoral Student Experience

Adapting to the norms and values of graduate school for doctoral students typically is an experience of discovery. Many students entering higher education at the doctoral level may not be fully aware of the academy's value systems. Developing an understanding of the academic norms and culture is but one aspect of a doctoral student's socialization into the process (Lindholm, 2004; Nyguist et al., 1999). Sometimes the values and expectations of the academic culture mesh well, complementing the student's values and expectations, allowing the student to be successful in their doctoral programs. In other instances, values and expectations are not internalized and accepted, causing the student to experience disillusionment and further causing the student to struggle in their program. The complications of accepting the academy's values may cause the struggling student to not finish the program or to adapt bitterness and disappointment (Nyguist et al.).

To be sure, the socialization process is more of a two-way exchange than has been presented in the literature. Socialization theory is helpful for understanding how doctoral students develop research knowledge and skills in preparation for faculty careers. Using socialization theory alone, however, is not enough. Incorporating social exchange theory as a subset of socialization is another way to understand how and why research relationships occur between faculty members and doctoral students and why these relationships are important.

Social exchange theory, a term first coined by Homans (1974), assumes that reward (or punishment) and value are important elements in social behavior (Chadwick-Jones, 1976; Emerson, 1976). Social exchange theory essentially involves the relationships that develop among individuals that result in benefits and costs they provide each other (Molm, 2003). The most basic form of social exchange involves two actors, both of whom possess some resource the other person values. Actors can be individuals, groups of people, or specific entities. Resources are also varied. They can include tangible goods and services, behavioral capabilities as well as socially valued outcomes, such as approval or status (Molm). The exchange occurs when actors seek to obtain the outcomes they value that others possess. Actors engage in exchange relations (or networks) of mutual dependence either directly or indirectly. Direct exchanges depend on the outcome of the other actor's behavior. For example person A provides a value (tangible good, service, behavioral capability, or socially valued outcome) to person B and person B does

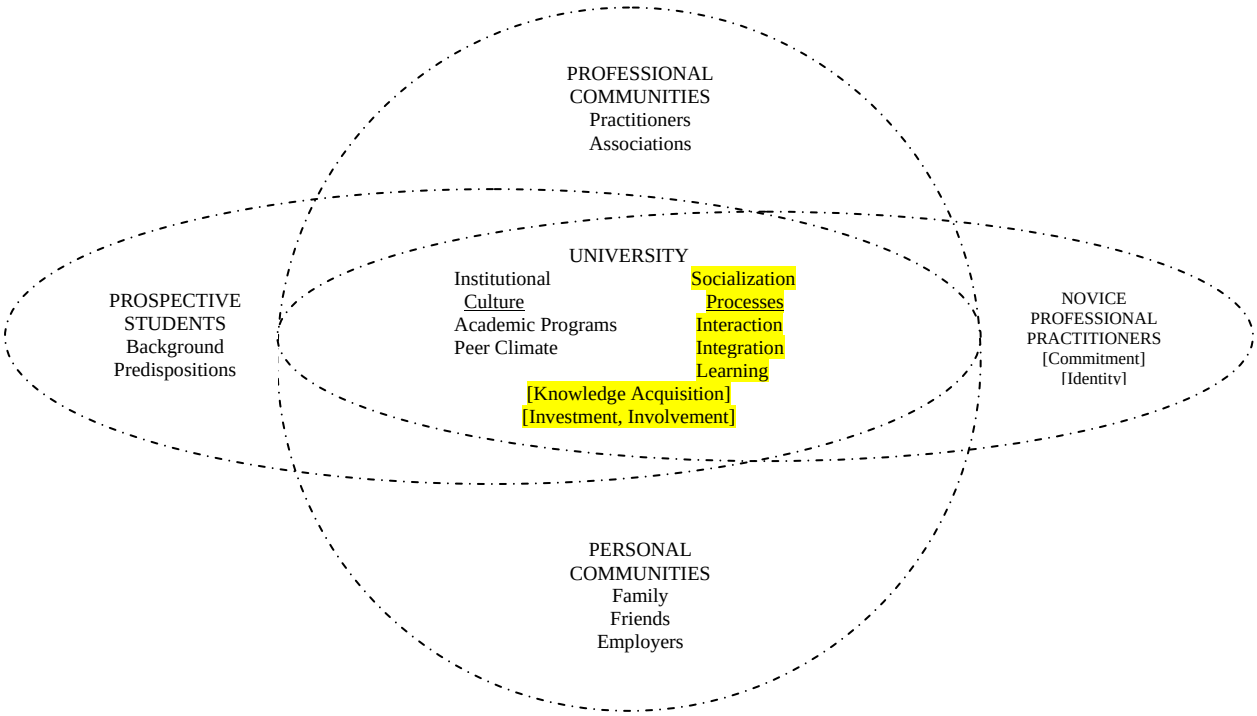

Figure 1. Conceptualizing graduate and professional student socialization. Reprinted with permission from Weidman, Twale, & Stein, *Socialization of Graduate and Professional Students in Higher Education: A Perilous Passage?* (2001). Modified (highlighted area) to show study focus.

the same for person A (Molm). Applied in higher education, social exchange is evident in the interactions and exchanges that take place between doctoral students and faculty members involved in research collaborations. For example, a doctoral student might enter into a research collaborative relationship with a faculty member for the perceived research experience, potential publication, or professional presentation she or he will gain from the experience. The student might also enter into the relationship based on the prestige of the faculty member in the field. For the doctoral student, the perceived benefits included increased research skills and professional recognition. For the faculty member, the perceived benefits are personal and professional. Personal gratification is received from helping a doctoral student and there are professional

rewards (i.e., presentation, publication, and assistance with conducting research) from engaging in the research collaboration.

It is in everyone's benefit to engage in social exchanges. Faculty members and doctoral students benefit. The process is not entirely altruistic. Figure 2 presents a reciprocal or mutual exchange between actors. The arrows in the figure represent the exchanges that are transferred by both actors.

Acquisition of Research Knowledge and Skills

This section discusses why the acquisition of research knowledge and skills is important for doctoral students to achieve. The implications of not gaining research knowledge and skills will be shared. Lastly, how doctoral students gain such skills will be discussed, highlighting the role of faculty members in this development.

Graduate research training should produce scholars who are competent, able to conduct independent, original, and ethical research (King, 2003). These skills are essential for doctoral students pursing faculty careers because research is an essential aspect of faculty life. Maintaining an active research agenda is necessary for the success of faculty members. Faculty members are expected to maintain a research agenda that is in line with the mission of their institution, despite the institutional type (Adams, 2002).

Not gaining research knowledge and skills causes rippling effects that limit doctoral students' opportunities. For example, several studies have shown the link between research engagement with faculty members and successful progression through doctoral training. Roaden and Worthen (1976) found that doctoral students involved in research projects had more interactions and engagement with faculty members. These students consequently were more productive in their doctoral programs. In another study, scholars found that limited research knowledge and experiences limited opportunities for intellectual growth during doctoral training. Limited intellectual growth caused difficulty in the dissertation study and reduced employment opportunities after doctoral training (Maher, Ford, & Thompson, 2004; Weidman et al., 2001). Completion of a doctorate from a research university does not necessarily equate to the development of the skills necessary for publishing one's research as found in a qualitative investigation by Creamer and McGuire (1998). Adequate preparation in scholarly writing appears to be equally as important as gaining research skills during doctoral training.

Figure 2. Reciprocal or mutual exchange between two actors.

The development of research knowledge and skills typically occurs as an integral part of doctoral training under the guidance of faculty members (Weidman et al., 2001). Faculty mentors, individuals who take responsibility for training the doctoral student through research collaboration, have the task of helping students make the transition from course work to writing the dissertation, a world often uncertain for many doctoral students (King, 2003; Weidman et al.). Doctoral students gain these skills through graduate assistantships, teaching assistantships, and research assistantships under the careful instruction of faculty members (Brown-Wright, Dubick, & Newman, 1997; King).

Understanding the research process is a critical component of doctoral training (King, 2003; Austin & McDaniels, 2006). It involves the doctoral student observing faculty members, serving as research assistants on projects, and ultimately designing their own research study. One clear outcome of the research socialization process is the doctoral student's ability to "frame appropriate questions", "design and implement scholarly projects", "collect and analyze data", "present results", and to "give and receive feedback" (Austin & McDaniels, pp.424-426). Having these skills equip doctoral students to be competent, knowledgeable faculty members.

Acquisition of research knowledge and skills, along with ethical research behavior are important issues facing institutions. Academic disciplines play a major role in socializing doctoral students to the values, beliefs, and customs of a specific field. The socialization to research experiences of doctoral students, therefore, will vary depending on the culture of the discipline. Doctoral students in social science fields, for example, tend to work more independently on research projects. Students in science and engineering fields work more collaboratively in labs with other students or in collaboration with faculty members (Anderson, Louis, & Earle, 1994).

Research experiences in graduate training "set the stage for standards and conduct" (Fox & Braxton, 1994, p.376). In a qualitative study examining the effects of departmental and disciplinary contexts of graduate students' exposure to research misconduct, Anderson et al. (1994) found that departmental climate was the strongest predictor of research misconduct. In addition, over half of doctoral student respondents indicated being aware of research academic misconduct within their departments, but not reporting it. Respondents also reported that their departments were not active in preparing them to recognize and handle ethical issues (Anderson et al.).

Fox and Braxton (1994) suggest that universities and federal funding agencies are in key positions to sanction both positive and negative research incidents. That is, both parties can reward scientists for appropriate research behavior and ban scientists for inappropriate research behavior. These findings suggest that research misconduct is an experience of graduate students in all disciplines and that attention is needed on how graduate students are socialized to the ethical behaviors needed to conduct and report research, behaviors learned from faculty members with whom doctoral students conduct research or from whom they learn about research.

The Council of Graduate Schools suggests that the faculty mentor is the research mentor. In this role, faculty members give the right attention and right empowerment to the student, and conducts themselves in an ethical manner (King, 2003). Understanding that doctoral students emulate the behaviors that faculty members model, particularly faculty mentors, it is imperative that doctoral students see faculty members conducting research ethically and responsibly. If not, doctoral students more than likely will exhibit unethical and irresponsible research behavior as well.

Research training and the expectations of research vary from institution to institution and from discipline to discipline as discussed earlier (Adams, 2002; Golde, 2006). Despite institutional and disciplinary differences in the acquisition of research knowledge and skills, it is clear the responsibility lies with both the doctoral student and the faculty member.

Mentoring

Supporting and adjusting the development of faculty members' practical knowledge while in the profession has been sited as one argument for the importance of mentoring in doctoral education (Richardson, 2006). This is due to the limited amount of practical knowledge most doctoral students will gain while in their programs. Learning the skills and knowledge

necessary to contribute to the profession is one thing, actually putting those skills and knowledge to practice is another. Therefore, a faculty member who also serves as a mentor gives attention to, helps, advices, informs, and encourages doctoral students (King, 2003). Effective mentoring then, improves the likelihood of doctoral students completing their program and in successfully negotiating the job market.

This section reviews the scholarly literature on mentoring in higher education. I present literature related to faculty mentoring and professional development and graduate student development. Particular attention is given to the contribution of research on mentoring graduate students, specifically doctoral students and the role of collaboration in the mentoring process.

Multiple definitions of mentoring in higher education exist. Johnson (2007) defines mentoring as an enduring personal and reciprocal relationship. Mentoring, overall, has a positive connotation. A mentor is known as one who offers advice, counseling, and aids in the overall personal, professional, and social development of the mentee. A mentoring relationship is characteristic of an experienced member of an organization who provides information, support, and guidance to a less experienced member, usually a new member, of an organization (Campbell & Campbell, 1997; Tierney & Rhoads, 1994). Some of the functions mentors carry out include protection, coaching, information, modeling, sponsorship, and counseling. Mentors have also been cited as challenging their mentee, which can later result in identity transformation (Johnson). Still others suggest that mentors serve roles that are almost spiritual in nature because they guide individuals along a particular journey (Lyons, Scroggins, & Rule, 1990).

Mentoring and academic advising have often been used in the higher education literature interchangeably. While the functions of mentoring and advising overlap, the terms are not synonymous (Lyons, Scroggins, & Rule, 1990; Johnson, 2007). Faculty advising does not mean that mentoring is taking place, nor does it mean that mentoring is not present (Johnson). What makes mentoring distinctly different from advising is the structure under which advising operates. For example, academic advising is more formal, structured, and unavoidable in the academy. Both undergraduate and graduate students are typically assigned to a faculty advisor. Mentoring, on the other hand is less frequent, less formal, and develops over time between a student and faculty member (Johnson; Mertz; 2004).

Despite the different ways the term has been operationalized, what is characteristic of all definitions is that mentoring involves a senior and a junior person within an organization. This

senior person plays an active role in the growth and development of the mentee. Development can be in the form of career, academic, personal, or social (Campbell & Campbell, 1997; Johnson, 2007; Luna & Cullen, 1995). Lastly, mentoring is an intentional and reciprocal relationship (Johnson; Mertz, 2004; Zey, 1991).

Several studies have addressed mentoring in faculty development. Luna and Cullen (1995) offer an extensive synopsis of the literature on the topic, discussing how mentoring empowers faculty, why mentoring is necessary for women and minority faculty members, and provides mentoring frameworks currently available. Authors suggest raising campus awareness about the importance of mentoring by establishing mentoring programs, providing recognition to faculty who participate in such programs, and by providing financial support and other institutional support (Luna & Cullen).

Mentoring Women and Minorities

Mentoring has also been cited as benefiting particular groups. For example, some scholars contend that support through peer mentoring is essential because, unfortunately, without such support women and ethnic minorities in particular may experience less collegial (Kadar, 2006) and chilly environments (Turner & Myers, 2000). In addition, without mentoring, women and ethnic minorities may not experience upward mobility in their careers that is considered one of the benefits of mentoring (Tierney & Bensimon, 1996; Tierney & Rhoads, 1994; Tillman, 2001). Still others have shown that mentoring in higher education is not just beneficial to women and ethnic minority faculty members or faculty members is specific disciplines, but that mentoring benefits all faculty members (Johnson, 2007; Saddler & Creamer, 2006).

Tierney and Bensimon (1996) examined how the dimensions of socialization were interpreted by faculty members during the course of two years, finding that a variety of individuals are instrumental in aiding in the development of new faculty members. Women and ethnic minorities' socialization experiences were different from men's, confirming the need for these groups to have faculty mentors. Ethnic minority faculty members, in particular, expressed a need for mentoring during their first years in their positions. Scholars contend that mentoring is indeed a socialization process that occurs informally and formally with mentoring being an important component (Tierney & Bensimon).

Examining the impact of mentoring in science and engineering fields, Sonnert and Holton (1995) found mentoring graduate students to publish and network in their field was a great

predictor of success, career wise. Networking and publishing were viewed as helping the doctoral student achieve visibility among colleagues in the field, contacts, and information flows (Sonnert & Holton). These findings suggest that highly ranked graduate schools and well established mentoring relationships could predict an individual's success in graduate study and the future of an individual's career in science.

Mentoring Doctoral Students

Mentoring greatly enhances the doctoral student experience, playing a critical role in the success of the student (King, 2003; Milem, Sherlin, & Irwin, 2001; Weidman et al., 2001; Wulff & Austin, 2004). Some of the outcomes of mentoring for doctoral students include serving as an information source and providing intellectual and career guidance. One scholar states, "The heart of Ph.D. training is the relationship between mentors and students" (Damrosch, 2006, p.38).

Nettles and Millett (2006) found in their quantitative study that mentoring relationships developed between the doctoral students and faculty members positively impacted students' progression toward the doctorate and completion of the degree. Using path analysis to investigate the mentoring process of Ph.D. and Ed.D. students, Lyons et al. (1990) found that mentored doctoral students have a more fulfilling educational experience that is directly linked to socialization into their discipline. Having a mentor significantly improved the perceptions of academic climate for doctoral students in a study of 670 masters and Ph.D. students, most of whom were minority students (Kelly & Schweitzer, 2005). Bargar and Duncan (1982) contend that doctoral students particularly need guidance after completing their course work and exams, stating that despite this success, most students still possess a naïve understanding of the research process. This is where faculty mentoring can be instrumental. The joint analytical exchanges that take place between the student and faculty member prove beneficial to both parties (Zey, 1991).

Faculty members and graduate students alike are encouraged to find mentors (Cunningham, 1999). Unfortunately, in most cases, too few individuals are available (and sometimes willing) to serve as mentors (Turner & Myers, 2000; Tierney & Rhoads, 1994). Johnson (2007) contends that while mentors have been found to be extremely beneficial, mentors are "all too infrequent" (p. 22). In addition, due to the disproportionate gender make up in the academy, most faculty members who do serve as mentors usually are men, as was the case in a study conducted by Cunningham.

Other View Points

Mentoring, while proven to be beneficial, competes with some of the values, priorities, and cultures existing in higher education. For example, most departments do not reward faculty members for providing such service to students. Mentoring then becomes an individual choice out of some personal need or motivation on behalf of the faulty member (Johnson, 2007). Another competing notion is the idea that mentoring is not needed in the academy. Sands et al. (1991) discovered that faculty members are assumed to have the ability to work autonomously, operating under the notion that support is no longer needed as it was in graduate school.

There is some evidence that suggests that mentoring relationships also have the potential to be unsuccessful or have negative aspects as well. For example, a mixed methods study by Eby, McManus, Simon, and Russell (2000) revealed 15 negative mentoring experiences that ranged from a mismatch in values, work styles, and personality to manipulative behavior (i.e., position power), inappropriate delegation, deception, and personal problems in mentoring relationships. Negative mentoring in this study was defined as "specific incidents that occur between mentors and protégés, mentors' characteristic manner of interacting with protégés, or mentor's characteristics that limit their ability to effectively provide guidance to protégés" (Eby et al., 2000, p. 3).

Mentoring relationships can also be abusive or dysfunctional when faculty mentors use their power as professionals (i.e., professional rank and status with the university) to take advantage of students (Johnson, 2007). For example, Heinrich (1995), found power, both legitimate and personal, to be a key issue in the advisement of 22 female doctoral students and 15 faculty advisors. In most cases, advisors used their power to assist the doctoral student network or find employment. In other cases, advisors disowned their legitimate (i.e., power vested by virtue of faculty rank or status) and personal power (i.e., power from within), consequently leaving some doctoral students feeling unsupported and abandoned (Heinrich, 1995). Other scholars have noted the harmful effects of male faculty advisors or mentors who enter into intimate relationships with their female advisees or mentees (Bartell & Rubin, 1990; Heinrich, 1991; Johnson). Sexual involvement with students has been noted to further a human relationship at the expense of the professional relationship by violating trust (Bartell & Rubin). All of these examples of dysfunctional mentoring relationships have been said to occur because

the mentor may become jealous of the mentees achievements, interests of the mentor and mentee may change over time, or there may exist differences in styles (Johnson).

Experiences of Women in Engineering

Graduate education in engineering has gained attention because of its direct and indirect links to professional participation and performance in the field, particularly for women (Fox, 1996; 1998). Women have been found to experience inequality in status and rewards in science and engineering. Fox (2001) contends that women's status is characteristic of inequalities because science "shapes the American university," in the way science "reflects and reinforces gender stratification" (p. 655). Women scientists and engineers have been cited to experience the field individually, meaning, women have been found to publish at different rates than men, have less interaction with colleagues, and receive less recognition for accomplishments than their male counterparts in the field. These experiences begin during the graduate training process (Fox, 2001). Having fewer publications when compared to male engineers puts women engineers at a disadvantage in terms of upward mobility (Fox, 1996). In addition, publishing is a social process that is the main venue through which research findings are "communicated and verified" (Fox, 1996, p. 275). Fox (1996) was unable to report on why such publication differences existed between men and women.

Once in the field, women and men experience different opportunities. For example, in a study involving 5,000 students and faculty members, researchers found women less likely to participate in research groups, collaborate, or describe faculty and student relationships as mentoring relationships (Fox, 2001). To explain why women experience differing opportunities in science and engineering, Sonnert and Holton (1995) offer two models: the deficit and difference models. The deficit model simply implies that women are treated differently in the field, while the difference model states that women act differently in the field. Women have been found to hold lower academic ranks in physical sciences, mathematics, and engineering when compared to their male counterparts (Fox, 1996; Sonnert & Holton).

Adviser-advisee relationships were found to be the core of the science and engineering graduate education programs as conditioned expectations and individual inclinations about the field are developed in ones' program (Fox, 1998; 2001). Consistent with earlier findings, Fox (1998; 2001) found that career aspirations and socialization into the field was determined by the adviser-advisee relationship developed in graduate school. Organizational factors such as these

are essential to understanding the elements that foster (or hinder) success in graduate education in engineering fields for all students, despite gender or ethnic differences. These relationships may or may not meet the definition of a mentoring role.

These factors, along with others have been attributed to the current condition of women in engineering graduate education, the field in general and the attitudes, beliefs, values, and behaviors developed about the field. More understanding of research publications differences between women and men merits more attention. These findings suggest that I am likely to find publication and collaborative differences between male and female doctoral students in engineering disciplines.

Mentoring as a Form of Collaboration

This section reviews the literature available on collaboration in higher education. Collaboration is addressed in terms of an activity faculty members participate in as a means to accomplishing scholarly goals. Perceived advantages and disadvantages of collaboration are highlighted. Where available, literature addressing collaborative activity between faculty members and doctoral students is presented.

Faculty members conduct much of their teaching, research, and writing in collaboration with other faculty. Collaboration is a purposeful activity individuals participate in to accomplish a common goal. Individuals engage in collaborative activities because they believe that productivity will be greater, learning and motivation will increase, and shared creativity will be beneficial to all involved (Austin & Baldwin, 1991). Collaboration has been viewed as a way to divide the work load and to increase publication productivity (Dickens, 1993). Although, there is no direct evidence that links faculty productivity with collaboration, it has been suggested in several studies that research productivity is increased through collaborative efforts (Austin, 2001; Austin & Baldwin; Creamer, 2001; Dickens; Dickens & Sagaria, 1997; Loeb, 2001). Creamer (2004a) discovered in a qualitative study of 19 collaborative faculty pairs that collaboration increased efficiency, advanced thinking about complex issues, enabled experts to merge ideas to develop a bigger picture, and invited experimentation between colleagues.

Opinions surrounding the success rate and difficulties of collaborating among faculty vary (Kezar, 2005; Hafernik, Messerschmitt, &Vandrick, 1997). Many scholars agree that there are indeed benefits to such activities for the institution and faculty members involved (Kezar, 2005; Austin & Baldwin, 1991). Faculty members also cite gaining a sense of academic

community as another advantage of joining collaborative teams. In this sense, collaboration creates a sense of interpersonal energy. Faculty members mention the energy they receive from other collaborators as another added benefit (Fox & Faver, 1984).

Along with the advantages mentioned, collaboration has the potential to bring with it disadvantages as well. For example, developing teams and negotiating exchanges take time, and in most cases, extra time out of a faculty member's already busy schedule (Austin & Baldwin, 1991; Fox & Faver, 1984). Long distance collaborators have to incur expense in long distance telephone calls, postage costs in mailing material, and travel expenses for periodic meetings with team members (Fox & Faver). In addition to time and financial costs, personal and socioemotional costs have been identified with collaborating. For example, working in collaborative teams creates a loss of autonomy for individuals involved (Austin & Baldwin, 1991) and maintaining and developing good working relationships taps the emotional energy of individuals. Conflict is also an element in collaborative relationships. In a study of long term senior faculty collaborators who worked together on publications, conflict was found to play a role in both learning and knowledge construction (Creamer, 2004b). The key to successful collaborative relationships is "the extent collaborators engage in dialogue about different and sometimes contradictory explanations for the phenomenon under study" (Creamer, 2004b, p. 568).

Collaboration is an aspect of social exchange in that more than one individual is involved in the process and a perceived benefit is assumed. Similar to mentoring relationships, collaborative relationships are initiated strategically and intentionally (Austin & Baldwin, 1991). For example, most individuals examine the benefits each has to offer before deciding to engage in collaborative activities. There is also the assumption that individuals enter collaborative relationships to achieve career success (Gersick, Bartunek, & Dutton, 2000). Dickens and Sagaria (1997) contend that one type of collaborative relationship is interested in the professional nurturance and growth of a less experienced junior colleague who is guided by a senior colleague.

Most of the literature has addressed collaboration among faculty members broadly (Austin & Baldwin, 1991; Carlton-Drakes & Sanders, 1998; Kezar, 2005; Hafernik et al., 1997; McNenny & Roen, 1992; Johnston & Kerper, 1996). Few studies have addressed collaborating as unique experiences that benefit all individuals involved. In a round about way, the literature

highlights the interactions doctoral students have with their faculty members in terms of there being little to no guidance, particularly in research endeavors (Bargar & Duncan, 1982).

Frierson (1990) addressed the serious research limitation faculty of color are faced with when they enter the professoriate. He contends that ethnic minority faculty members are at a disadvantage when coming up for tenure because their research skills are limited, due to the limited research collaborative experiences they had in doctoral training. He further recommends formalized mentoring and collaborative efforts in doctoral programs to provide research opportunities to students, particularly doctoral students of color (Frierson, 1990). While these studies are informative, they have offered limited insight into the unique relationship, specifically, the exchanges that take place between not only faculty members, but faculty members and doctoral students. The present study contributes to this knowledge base.

As stated previously, mentoring greatly enhances the experiences of doctoral students in their training. It is also clear that mentoring relationships in graduate education are characteristic of benefits or advantages gained by both the graduate student mentee and faculty mentor. Unfortunately, mentoring research in graduate education has not been driven by theory that considers the social nature of the relationship and the two-way process of mentoring. For example, most of the literature assumes that individuals serving as mentors teach, serve as role models, or engage in mentoring to satisfy personal needs (Johnson, 2007; Zey, 1991). This assumption does not consider other motivators or benefits individuals consider before entering into mentoring relationships. It is therefore appropriate to examine mentoring through the lens of socialization using social exchange as a subset of this relationship to not only make sense of this act that appears to happen sporadically, intentionally, and informally, but to make conclusive statements about how such relationships impact doctoral student socialization to the research role of faculty careers.

Conclusions

Literature on graduate education, socialization theory, and mentoring contribute to our understanding of the experiences graduate students go through within higher education and how those experiences prepare them for professional roles (Weidman et al., 2001). This review has explored the literature on doctoral training in education and engineering, socialization theory as it relates to the graduate student experience, focusing on how research knowledge and skills are acquired and how doctoral students display characteristics of investment and involvement during

the research process, and mentoring in higher education. What is unknown is what doctoral students are learning about research and about faculty careers through collaborative and mentoring relationships with faculty members.

Two conceptual models have examined the social nature of experiences of individuals in organizations: graduate student socialization theory developed by Weidman et al. (2001) and social exchange theory developed by Homas (1974). The core elements of the graduate student socialization model are appropriate for the present study: knowledge acquisition, investment, and involvement. These elements are appropriate because the researcher intends on examining how doctoral students in education and engineering disciplines acquire the knowledge that socializes them to faculty roles and what level of involvement and investment doctoral students are engaged in during the research process. Social exchange is examined as a sub-set of socialization theory for understanding the research collaborations (or exchanges) that take place between doctoral students and faculty mentors. Such an examination should shed light on motivations, benefits, and actual outcomes that result from collaborative research exchanges that occur between doctoral students and faculty members and how such experiences prepare doctoral students for the research role of faculty careers. Figures 1 and 2 present the models proposed for this study.

Chapter 3 provides a detailed description of the methodology employed in this study. The chapter describes the samples, instrumentation, trustworthiness procedures, data collection procedures, and the data analysis used in the study. Results from this study are presented in Chapter 4, followed by a discussion of results in Chapter 5.

CHAPTER THREE

Methodology

The purpose of this qualitative study was to explore the socialization process of doctoral students in education and engineering fields committed to a career as a faculty member. This study was specifically designed to identify the factors that research collaboration with a faculty mentor have in contributing to the socialization of doctoral students to the faculty research role. This study uses socialization theory for understanding these relationships. For purposes of this study, faculty mentor was defined as the person who collaborated with the doctoral student on research projects and who the doctoral student and faculty member identify as the person having the most significant role in helping to prepare the doctoral student for a faculty role. Thus, the main research question for the study was: What contribution does research collaboration with a faculty mentor play in the socialization of doctoral students in education and engineering committed to a career as a faculty member? The following sub questions guided the overall research question:

1. What do doctoral students perceive they learn about research through the process of collaboration with faculty mentors and how do these vary in engineering and education fields?
2. What do doctoral students learn about faculty careers through their research engagement with faculty mentors?
3. In what positive and negative ways has the mentoring relationship as defined as collaborative research experiences affected doctoral students' interest in faculty roles?
4. How do doctoral students describe their own investment in their mentoring experience?

In this chapter, the research design of the proposed study is described. Specifically, details about the sample selection, instrumentation, data collection procedures, data analysis procedures, and trustworthiness of data are provided.

Sample Selection

To collect data, I selected two samples. First, I identified six research universities, from the Northeast, Midwest, and Southwestern regions of the United States. Second, full-time doctoral students who had completed their course work in education or engineering fields at the selected research universities were identified. Selected doctoral students also identified wanting

to pursue a faculty career after graduation. The following section provides greater detail about the selection of participating institutions and participants.

I selected six predominately White research institutions (PWRIs) in the Northeast, Midwest, and Southwestern regions of the United States for three reasons. Institutions were selected from a list of accredited, degree-granting colleges and universities in the United States represented in the National Center for Education Statistics IPEDS system as classified by the Carnegie Foundation for the Advancement of Teaching. In this case, all institutions were selected based on their level (four-year or above), control factor (public or private institution), enrollment figures, and classifications (undergraduate instructional program, graduate instructional program offerings, enrollment profile, size and setting, and institution type). It was important in this study to select institutions that offered four-year degrees and above, included professional and arts and science programs with a high graduate coexistence, consisted of full-time four-year, mostly selective enrollment profiles, and were research universities. It was also important that these universities hold institutional membership with the Council of Graduate Schools (CGS), a national non-profit organization dedicated to the advancement of graduate education and research. Member institutions are engaged in graduate education, research, and scholarship offering master's or doctoral degrees. These institutions, because of their research focus and commitment to graduate education, are likely to have graduate students interested in faculty careers.

Participating Institutions

Based on these criteria, six institutions were selected-five public and one private. The first PWRI (University A) was established in 1751 as an Ivy League school. The university enrolls approximately 23,704 students, of whom, 10,422 are enrolled in undergraduate programs and 9,349 are enrolled in graduate/professional programs. Approximately 429 doctoral students are enrolled in education programs and 390 doctoral students are enrolled in engineering programs at the university. The mission of this private institution is to serve as innovators of knowledge and interdisciplinary education. The university is comprised of 12 graduate and professional schools, offering academic programs in communication, arts and sciences, medicine, education, engineering, and law.

The second PWRI (University B) was established in 1855 as a multi-campus land-grant university. The university enrolls approximately 42,914 students, of whom 10,979 are enrolled in

graduate and professional programs. Approximately 637 doctoral students are enrolled in education programs and 851 doctoral students are enrolled in engineering programs at the university. The mission of the university is to promote human and economic development through the expansion of knowledge and its application in the natural and applied sciences, social sciences, arts, humanities, and the professions. This is accomplished through research, scholarship, and creative activities. The multi-campus university is comprised of more than 20 smaller campuses and multi-campuses, offering programs in architecture, agriculture, business, communication, education, engineering, and liberal arts.

The third PWRI (University C) was established in 1855 as a major land-grant university. The university enrolls approximately 45,520 students of whom 9,699 are enrolled in graduate and professional programs. Approximately 472 doctoral students are enrolled in education programs and 365 doctoral students are enrolled in engineering programs at the university. As a research and teaching, land-grant university, University C is committed to intellectual leadership and excellence in developing and conveying knowledge to its students and the public. The university is comprised of more than 200 programs of study offered by 14 degree-granting colleges, including law.

The forth PWRI (University D) was established in 1817 as a coeducational research university. The university enrolls approximately 39,533 students, of whom 25,555 are enrolled in undergraduate programs and 14,470 are enrolled in graduate and professional programs. Approximately 160 doctoral students are enrolled in education programs and 1,383 doctoral students are enrolled in engineering programs at the university. The mission of University D is to serve the citizens of the state and the world through creating, communicating, preserving, and applying knowledge, art, and academic values to future leaders. The university is comprised of 600 academic programs.

The fifth PWRI (University E) was established in 1885 as the state's first land-grant research university. The university enrolls approximately 37,200 students, of whom 29,070 are enrolled in undergraduate programs and 8,147 are enrolled in graduate and professional programs. Approximately 304 doctoral students are enrolled in education programs and 315 doctoral students are enrolled in engineering programs at the university. The mission of University E is similar to missions of most research universities—to provide excellent leadership

in research, teaching, and service. The university offers more than 150 undergraduate programs and more than 200 graduate programs.

The sixth PWRI (University F) was established in 1885 as a public research university. The university enrolls approximately 58,782 students, of whom 46,806 are enrolled in undergraduate programs and 11,976 are enrolled in graduate and professional programs. Approximately 597 doctoral students are enrolled in education programs and 712 doctoral students are enrolled in engineering programs at the university. The mission of University F is to become a national comprehensive research and outreach university, offering access and quality education to a diverse population. The university offers 250 undergraduate programs and more than 100 graduate programs. In the event I was not able to obtain the needed sample from the first four institutions, the fifth and sixth institutions were identified as alternates for recruiting sample participants. Table 1 presents the key characteristics of participating institutions.

Doctoral Student Participants

The student sample was selected next. Because I wanted to examine research collaborations of doctoral students and faculty mentors, I included only doctoral students who had research experience with a faculty member who they had identified as being their mentor. Doctoral students, for purposes of this study were defined as graduate students who were enrolled full-time at a research university and who had completed their course work and preliminary examination.

A total of 40 students (N=40) participated in this study, 5 of whom were enrolled in Ph.D. engineering programs and 5 were enrolled in Ph.D. education programs at each of the first four PWRIs (10 doctoral students per institution). Four doctoral students from the fifth university and one doctoral student from the sixth institution were only recruited to participate. Students were randomly selected from a diverse pool (gender and ethnicity) of applicants.

The final criteria for the doctoral student sample involved the student identifying his or her desire to be a faculty member after graduation from their doctoral program. Students indicated this information on a brief pre-screening questionnaire delivered by electronic mail. If it was clear that the doctoral student did not want to pursue a faculty career or was unsure about their intent to be a faculty member, the student was no longer considered a potential participant for the study.

The researcher contacted the department chairpersons in education and engineering schools and colleges at all institutions asking for their assistance identifying full-time doctoral students who had completed their course work and preliminary exam. The researcher also asked department chairpersons to identify students who (to their knowledge) expressed an interest to be a faculty member or were participating in a preparing future faculty (PFF) program. This nomination process resulted in a list of names and e-mail addresses the researcher could use to initiate initial contact with potential participants.

After department chairpersons at all institutions identified potential doctoral students from a variety of programs in education and engineering to participate in the study, the researcher sent an e-mail to potential participants describing the purpose of the study. The researcher then administered (via e-mail) the pre-screening questionnaire to participants accepting the invitation to participate in the study to ensure students were eligible to participate in the study. Data gathered during the pre-screening interview were not used for any other purpose than to pre-screen potential participants. Forty students were then randomly selected (5 from engineering and 5 from education) from four PWRIs to achieve a diverse mix of gender and ethnicity within the sample pool. Participants were then contacted a second time by e-mail to seek participation in the study. Doctoral students who were willing to participate, were promised a $10 gift card to a local retail store. See Appendix A for a copy of the participant invitation letter.

Participants were telephoned shortly after the pre-screening process based on the day and time they indicated being available for an interview. If after the pre-screening process a doctoral student declined to participate, the researcher went back to the original pool of potential participants to randomly select a replacement, again taking into account the students' gender and ethnicity. This process was repeated until a sample size of 5 from engineering and 5 from education (N=10) from all four PWRIs was achieved (Total N=40).

Table 1

Key Characteristics of Sample Institutions

	University A	University B	University C	University D	University E*	University F*
Institution Demographics						
Location	Northeast	Northeast	Midwest	Midwest	Southwest	Southwest
Year established	1751	1855	1855	1817	1885	1885
Institution type	Private/Research	Public/Land-grant/Research	Public/Land-grant/Research	Public/Research	Public/Research	Public/Land-grant/Research
Member of CGS*	Yes	Yes	Yes	Yes	Yes	Yes
Member of AAU*	Yes	Yes	Yes	Yes	No	Yes
Enrollment						
Total	23,704	42,914	45,520	39,533	58,782	37,200
Graduate	9,349	10,979	9,699	14,470	11,976	8,147
Education doctoral	429	637	472	160	597	304
Engineering doctoral	390	851	365	1,383	712	315

Note. Member of CGS*-Council of Graduate Schools
Member of AAU*-Association of American Universities
University E & F*-Institutions used if additional participants were needed.

Instrumentation

The researcher developed two instruments for this study: a pre-screening instrument and an interview protocol. The first instrument, the pre-screening instrument, was designed to gather basic information about the doctoral student to see if they would be eligible to participate in the study. Data gathered during the pre-screening process was only used for pre-screening purposes. See Appendix A for a copy of the pre-screening instrument developed for the doctoral student sample.

The second instrument, the interview protocol, was designed to elicit data that directly related to the study's research questions: (a) doctoral students' perceptions of what is important to learn through research collaboration with a faculty mentor, (b) what doctoral students learn about faculty careers through research collaborations with faculty mentors, (c) how mentoring relationships affect interest in faculty careers either positively or negatively, and (d) levels of investment of doctoral students in the mentoring experience. Interview questions were purposely designed to illicit data related to core elements (e.g., knowledge acquisition, investment, involvement) of the Graduate and Professional Student Socialization Model (Weidman et al., 2001). See Appendix A for a copy of the interview protocol.

Data Collection Procedures

I first gained approval from the Institutional Review Board (IRB) on Human Subjects at my home institution. It was determined that this study qualified as an expedited study with minimal risks involved. In addition, IRB offices were contacted at each of the participating schools to explain the purpose of the study and to seek clearance to recruit participants. After approval was received, the data collection process began.

Telephone interviewing was used as the technique for gathering data for several reasons. First, telephone interviewing was most convenient because the researcher and study participants were located in different regions of the United States. Second, due to the sample size, arranging face-to-face interviews was challenging because of each of the participants' varying schedules. Third, telephone interviewing was a fast and efficient way to collect data for purposes of this study. This technique allowed the researcher to probe the participants for satisfactory responses. Fourth, telephone interviewing was cost efficient. The researcher only incurred long distance

telephone costs. This expense was much less than the travel cost either the researcher or participant would have incurred if face-to-face interviewing was used.

Data from doctoral student participants were collected from in-depth interviews using a telephone-recording device connected to the telephone. Each interview lasted approximately 50 to 60 minutes. All participants were telephoned using the preferred contact number given to the researcher prior to the interview. Permission was granted to record each interview by participants as part of the IRB process and prior to conducting the interview. Informed consent was secured from each participant via electronic mail prior to conducting the interview. A consent form explaining the purpose of the research and potential risks involved was sent to each participant using the e-mail address provided prior to each interview. Participants electronically signed and returned consent forms to me prior to the interview using e-mail.

Audiocassette tapes were tested before each interview to ensure that the tape was recording properly and to make sure data recorded could be heard clearly. Interview tapes were then transcribed verbatim by a second party who is a trained transcriber. All identifying information for participants, advisors, and faculty members were removed, and each participant was assigned a pseudonym to maintain confidentiality.

Data Analysis Procedures

The central assertion of this study was that research collaboration with faculty mentors is an important element of the socialization of doctoral students to a faculty career. It was important to understand what doctoral students perceived was important for them to learn, what they learned, what they perceived they acquired during the research collaboration process with faculty mentors, the level of investment in the mentoring experience for doctoral students, and what impact the mentoring relationship had on doctoral students' interest in faculty careers. Data analysis was driven by the research questions, the participants' responses, and the frequency of responses.

To analyze the qualitative data, I read the transcripts several times. Data were analyzed using the constant comparative method (Glaser & Strauss, 1967). I referred to the Anfara, Kathleen, Brown, and Mangione (2002) iterative data analysis process as a guide to develop relationships between the data, codes, categories, and themes that are then formed to interpret meaning of the data. The first iteration involved the use of both deductive and inductive coding. Deductive codes were first established from themes identified in the literature and key terms or

phrases derived from the pilot interviewing process. These included codes related to doctoral student socialization process and relationships doctoral students have with their faculty advisors and/or faculty mentors. The inductive phase of the initial coding involved open coding for new issues that were not anticipated. Axial coding was then used to group the data into categories to analyze the meanings and relationships among categories (Charmaz, 2006). The next iteration of data analysis involved developing focused categories from initial categories. The next iteration of data brought the analysis to the development of themes. The last iteration of data analysis involved developing an overarching theme or conclusion.

To describe the data analysis process in more detail, I will give examples by research question. The first research question asked: What do doctoral students perceive they learn about research through the process of collaboration with faculty mentors and how do these vary in engineering and education fields? This question related to the first core element of the Graduate and Professional Student Socialization Model (Weidman et al., 2001): knowledge acquisition. Interview questions relevant to this sub-question also elicited data about the participants' involvement in the mentoring relationship, the third core element of the socialization model. For example, the fist interview question asked participants to describe their research collaborative experiences with their mentors. To analyze data, first I developed initial codes from data gathered from several questions. For example, one interview question asked participants to describe what they know about research now that they did not know before. Initial codes form this interview question included: (a) being flexible, (b) embracing personal contribution, (c) research passions changing, and (d) appreciation of research. From these codes, I identified a category describing the research process as "internal" for participants. Internal in this case was defined as personal characteristics (e.g., developing research identity, research passions, being flexible) participant's described as important aspects of the research process. This same method was performed with all interview questions to arrive at a theme for the research question.

The second research question asked: What do doctoral students learn about faculty careers through their engagement with faculty mentors? This question also related to the first core element of the Graduate and Professional Student Socialization Model (Weidman et al., 2001): knowledge acquisition. Again, I developed initial codes from data gathered from several questions. For example, one interview question asked participants to describe what they know about faculty careers now that they did not know before. Initial codes included: (a) varying

research expectations, (b) social skills required, (c) work-life balance as challenging, (d) time management as challenging, and (e) continuous rigorous work. From these codes, I identified two categories that describe the stress of faculty life and challenges and costs of the promotion and tenure process. This same method was performed with all interview questions to arrive at a theme for that research question.

The third research question asked: In what positive and negative ways has the mentoring relationship, as defined as collaborative research experiences, affected doctoral students' interest in faculty roles? For example, one interview question asked participants to describe what they know now about faculty careers that they did not know before. Some responses included: (a) autonomy with research, (b) flexibility of faculty role, (c) expectations of faculty, (d) competitive field, and (e) mentoring not valued. First I labeled responses from this interview question as "positive," "negative," or "mixed" for both education and engineering participants. This made comparison between disciplines fairly simple. I then followed the same procedure used for research questions one and two in developing initial codes, categories, and one overall theme to describe the impact (either positive or negative) mentoring had on influencing the participants' interest in a faculty role.

The fourth research question asked: How do doctoral students describe their own investment in their mentoring experience? This question elicited data related to the participants' investment in the mentoring relationship, the second core element of the Graduate and Professional Student Socialization Model (Weidman et al., 2001). Investment refers to the amount of effort or engagement students have in their experience. Engagement or investment can vary from membership in professional organizations, to amount of publications and presentations, to commitment (i.e., time and effort) to teaching or research activity level. To analyze this question, I first developed a table using the Likert scale response each participant supplied for one interview question where students rated their level of motivation/investment in the mentoring relationship on a scale of 1 to 10, with 1 meaning little to no investment and 10 meaning high level of investment. I then asked participants to explain what the number they suggested meant.

Trustworthiness

Trustworthiness in qualitative research refers to the quality and rigor of the investigation, including the study's findings. This is achieved using four criteria: creditability, transferability,

dependability, and confirmability (Guba & Lincoln, 1994). To enhance trustworthiness in this study, the researcher employed several steps using each of the four criteria outlined by Guba and Lincoln (1994).

Credibility is concerned with how believable a study's findings are (Schwandt, 2001). Stated another way, credibility is concerned with how trustworthy the conclusions are that are drawn from the data and the match of those conclusions with reality. Member checking (Creswell, 2003) was employed during and after the interview process to ensure the researcher was accurately restating and interpreting participants' experiences. For example, during the interview process, the researcher restated participant's comments or clarified statements made by participants to ensure statements were interpreted accurately. After the interview, transcripts were then shared with participants for them to verify accuracy. After the analysis was complete, findings were shared with participants so that they could verify (or confirm) if findings reflected their experiences. This ensured that there was congruence between the participant's views of their experiences and the researcher's interpretation and representation of those experiences.

Transferability refers to how well conclusions can be generalized to a larger population (Schwandt, 2001). This was achieved by using purposeful sampling, thick description, and piloting the study. To obtain a purposeful sample, the researcher intentionally sought doctoral students in education and engineering fields who worked with faculty mentors and who expressed a desire to be a faculty member after completion of their doctorate degree. Thick description was achieved by gathering background demographic information (e.g., discipline and program area, number of years in program, gender, ethnicity, age, amount of time in mentoring relationship, rank of mentor) about each participant during the pre-screening process to help the outside reader gain some context of the type of participant being represented in the data.
A pilot study was conducted using a smaller sample of doctoral students from education and engineering graduate education programs at a similar institution type (PWRI). The pilot study procedures and findings are discussed in a separate section following this section.

Dependability in qualitative studies is concerned with how reliable the research process is. The researcher, in this case, ensures that there is a logical, traceable, and documented research process (Creswell, 2003; Schwandt, 2001). This was achieved by developing and maintaining an audit trail (Anfara et al., 2002). An expert reviewer, trained in qualitative research, examined every aspect of this research process. For example, the expert reviewer examined (a) the purpose

statement and research questions, (b) the interview protocol, (c) the theoretical frames, and (d) the data and notes relevant to the data analysis process to see how the researcher moved from data, to codes, to themes, and to overarching themes. A coding matrix was prepared to show the relationship between codes, themes, and conclusions. An expert reviewer examined the questionnaire and results from that instrument to see how the researcher arrived at results.

In addition, a third-party auditor (independent reviewer) reviewed the audit trail conducted by the researcher to determine judgment about research procedures and interpretation of findings (Schwandt, 2001). In this case, the third-party auditor reviewed ten transcripts (5 education, 5 engineering). The auditor noted the number of times participants spoke about a topic, for example, the "research process." The auditor also noted a distinct difference in the language used by education and engineering participants. The auditor was able to cross reference the category (e.g., research process, communicating research, realities of research) with the source (name of participant making a statement about that topic). The final matrix of findings reflecting the study's themes and overall conclusions were then reviewed. There were no concerns from the auditor about the analysis process and interpretation of findings. The auditor verified my interpretations.

Confirmability refers to measures that control the introduction of biases or selective perception (Schwandt, 2001). The researcher, in this case, is concerned with linking assertions and interpretations to the data. The researcher is also concerned with bracketing his or her own biases and judgments that may get in the way of the researcher developing objective findings. This was achieved throughout the research process in collecting, analyzing, and reporting data from this study. I had to remove my notions and ideas of what I thought graduate education would be like in education and engineering from the start of the research process. I also had to remove myself as a doctoral student in an education program from this process so that I would not let my experiences influence my interpretations of the findings. The researcher kept a journal during the data collection process. In addition, throughout the data collecting process, participants were asked to verify the accuracy of statements made.

Pilot Study

A pilot version of this study was conducted to test the interview protocol. The sample consisted of 10 doctoral students from education and engineering disciplines at the home institution of the researcher. Five doctoral students were identified from each discipline (e.g.,

n=5 from education and n=5 from engineering). Because the researcher was interested in learning about the research collaborations in which doctoral students engage with their faculty mentors, only doctoral students who had research experience and an identified faculty mentor were included in the sample.

Interviews were conducted during a two month time period in two focus groups. Focus group interviews were designed to last for approximately two hours. Participants in the focus groups answered questions about their doctoral student experience related to research with their faculty mentors. For example, research questions explored what education and engineering doctoral students perceived was important for them to learn by collaborating with their faculty mentors on research, what they learned about faculty careers, and what they perceived were the benefits and motivations for engaging in research collaborations with faculty mentors. The interview protocol served as a guide, but participants had the freedom to discuss anything about their experience they wished to share.

Participants described the collaborative experience as aiding in their understanding the research process. Specifically, education participants felt comfortable reading about research in journals or having conversations about research, and understanding what a particular study was about because of their experiences in the research collaborative relationship. Engineering participants learned how to simplify their research to make it understandable to others. Participants also described learning that social skills are needed to foster intellectual community in the academy based on their experiences. Personal motivators and benefits were reasons given for engaging in research collaborative experiences. Education participants were motivated by the idea of gaining or improving research skills. Engineering participants were motivated by the idea of working with prestigious faculty members. Most participants considered funding and networking opportunities benefits of working with faculty mentors on research projects.

These findings helped the researcher develop initial codes and expectations for the present study. Used together, some initial codes (e.g.., conducting research, communicating research, creative thinking, etc.) from the pilot study coupled with deductive coding (i.e., language used in literature) gathered from the literature on socialization served as indicators of codes and categories I might find in the larger study. In addition, research methods (e.g., research questions, interview protocol, sampling techniques) were refined based on the experience with focus group participants. For example, the research questions from the pilot study asked general

questions about what doctoral students perceive their learn through the process of collaborating with faculty mentors, what doctoral students learn about faculty careers, and if the research collaborative relationships vary by the amount of investment of the doctoral student and faculty member. I revised the first research question to make it clearer and focused on what doctoral students learn about “research” through the process of collaborating with their faculty mentors. The question in the larger study read: What do doctoral students perceive they learn about research through the process of collaboration with faculty mentors and how do these vary in engineering and education fields? The second question remained relatively the same: What do doctoral students learn about faculty careers through the process of collaborating with faculty mentors on research? The third question was revised to reflect how doctoral students describe their own investment in the mentoring relationship. For example, the question about investment in the larger study read: How do doctoral students describe their own investment in their mentoring experience. A fourth question was added that asked doctoral students to describe how the mentoring relationship has affected their interest in a faculty role either positively or negatively. A question of this nature was not asked of pilot study participants. Overall, conducting this pilot study gave significant direction to the methodological procedures used in the main study and gave some insight on what I might hear from participants about their research collaborative experiences.

CHAPTER FOUR

Findings

This chapter describes findings of the study. The first section reviews the purpose of the study and research questions guiding this study. The second section provides a description of the sample participants. The third section reports themes that emerged from interviews with doctoral student participants. Similarities and differences in findings by education and engineering participants are then discussed. The terms “participants,” “respondents,” and “interviewees” are used interchangeably throughout the chapter.

Purpose and Research Questions

The purpose of this study was to explore the socialization of doctoral students in education and engineering to faculty careers. I specifically examined the role research collaborative experiences with faculty members had in contributing to this socialization process for doctoral students committed to pursuing a faculty career. A structured and open ended interview protocol was used to illicit these data. For purposes of this study, faculty mentor was defined as the person who collaborated with the doctoral student on research projects and who the doctoral student identifies as the person having the most significant role in helping to prepare the doctoral student for a faculty role. Mentoring was defined as meaningful research collaborative experiences that took place between a faculty member and a doctoral student. Participants in both disciplines used the term “mentoring” and “advising” to both mean that meaningful, research collaborations were taking place. These terms are therefore used interchangeably throughout this chapter. The main research question for this study was: What contribution does research collaboration with a faculty mentor play in the socialization of doctoral students in education and engineering committed to a career as a faculty member? Four sub questions guided the main question:

1. What do doctoral students perceive they learn about research through the process of collaboration with faculty mentors and how do these vary in engineering and education fields?
2. What do doctoral students learn about faculty careers through their research engagement with faculty mentors?

3. In what positive and negative ways has the mentoring relationship as defined as collaborative research experiences affected doctoral students' interest in faculty roles?
4. How do doctoral students describe their own investment in their mentoring experience?

Description of Sample

Forty (N=40) doctoral students participated in this study. Table 2 represents a summary of all participants. Participants were recruited from two disciplines, education (n=20) and engineering (n=20). Twenty-three (n=23) male doctoral students and 17 (n=17) female doctoral students were interviewed. In terms of ethnicity, the sample was diverse. Caucasian/European American doctoral students (n=22) represented a majority of the sample participants, followed by a large representation of ethnic minority doctoral students that included seven (n=7) Hispanic/Latino(a), three (n=3) Black/African American, and four (n=4) Asian/Pacific Islander doctoral student participants. One (n=1) participant identified as an international student and one (n=1) as a multi-ethnic student. One male participant (n=1) did not reveal his ethnicity. The average age range of the participants was 20-30 (n=26), followed by 31-40 (n=13), and 41-50 (n=1). Sample participants were enrolled full time in their doctoral programs, either in their second year (n=7), third year (n=12), forth year (n=9), fifth year (n=1), or beyond five years (n=1) of their programs. These doctoral students were considered advanced level, having completed their course work.

Six universities from the Northeast, Midwest, and Southwestern regions of the United States were identified (University A, B, C, D, E, F). Universities E and F were used as alternate sample schools in the event additional participants were needed for the study. For example, if I was not able to recruit enough participants in either education or engineering disciplines from the first four universities or needed to diversify the sample gender or ethnicity wise, doctoral students were recruited from the alternate universities. Three female participants were recruited from Universities E and F—two Hispanic/Latina and one African American. Table 5, located in Appendix B, displays a more detailed description of the sample by participating universities.

Table 2

Summary of Demographics of All Sample Participants

Demographics	Education	Engineering
Discipline		
Total	20	20
Gender		
Male	8	15
Female	12	5
Total		40
Ethnicity		
Asian/Pacific Islander*	0	4
Black/African American	3	1
Caucasian/European American	14	10
Hispanic/Latino/a	2	3
International*	0	1
Multi-ethnicity	1	0
Did not identify	1	0
Total		40
Age		
20-30	12	14
31-40	7	6
41-50	1	0
Total		40
Year in Program		
2	4	3
3	7	5
4	6	7
5	3	4
Beyond 5	0	1
Total		40

Note. * Participants identifying in two ethnic/racial categories were only counted once. The first ethnic group listed on pre-screening form was the category used.

I used purposeful sampling methods by selecting doctoral students who were enrolled full time, completed their course work, had research experience, (e.g., experience conducting research, presenting, or writing for publication), and had a faculty mentor. In education, educational leadership, education policy, and English education represented departmental areas of participants, with 50% (n=10) of the education sample participants being enrolled in educational policy departments. In engineering, electrical, environmental, civil, computer science, mechanical, bio-engineering, and programming languages represented departments of participants, with 40% (n=8) of the engineering sample participants being enrolled in mechanical engineering departments. Table 3 lists more detailed demographics of sample participants, identifying department affiliations and participant pseudonyms.

Characteristics of Faculty Mentors

Participants were being mentored by both junior and senior faculty members. Almost half of the participants indicated having mentors who were full professors (n=19), followed by assistant professors (n=15), and associate professors (n=6). Most were in mentoring relationships for one (n=3), two (n=10), three (n=13), four (n=9), and five years or beyond (n=5). All participants indicated participating in specific research activities with their faculty mentors: research projects (n=38), writing (n=36), publishing (n=35), or presenting research at local, regional, national, or international conferences (n=32).

General Observations

Three doctoral students (two from education and one from engineering) declined to participate in the study after being invited to do so. Invitations were subsequently sent to other potential participants meeting the study's criteria until the targeted number of participants (40) was achieved. This meant sampling from the alternate universities (Universities E and F) was necessary. The most common reason stated for declining to participate in the study was availability of time. The other reason given was lack of fit with the study's criteria. One student, for example, expressed a concern that she did not think she had enough research experience with her faculty mentor to participate in the study.

Table 3

Detailed Display of Demographics of Sample Participants

Institution	Name	Department	Gender	Age	Ethnicity	Year
University A						
Education	Jamie	Education Policy	Female	20-30	Caucasian	2
	Adam	Education Policy	Male	20-30	Caucasian	3
	Steven	Education Policy	Male	20-30	Multi-ethnicity	2
	Vickie	Education Policy	Female	31-40	African American	2
	Erica	Education Policy	Female	20-30	Caucasian	4
Engineering	Wanda	Bio-engineering	Female	20-30	Asian/Pacific Islander	4
	Rahim	Mechanical	Male	20-30	Asian/International	2
	David	Computer science	Male	20-30	International	4
	Tom	Computer science	Male	20-30	Caucasian	4
	Bruce	Programming languages	Male	20-30	Caucasian	3
University B						
Education	Isabelle	Education Policy	Female	31-40	Caucasian	3
	Angela	Education Policy	Female	20-30	Caucasian	3
	Josey	Education Policy	Female	31-40	Caucasian	3
	Nolan	Education Policy	Male	20-30	African American	3
	Joy	Education Policy	Female	20-30	Caucasian	4
Engineering	Jacob	Mechanical	Male	20-30	Caucasian	5
	Doug	Mechanical	Male	20-30	Caucasian	5
	Christopher	Mechanical	Male	20-30	Did not identify	5
	Kelsey	Civil	Female	31-40	Caucasian	2
	Melanie	Civil	Female	31-40	Hispanic/Latina	3

(Table continued)

Table 3 (continued)

University C						
Engineering	Terry	Chemical	Male	20-30	Caucasian	2
	Iggy	Environmental	Male	31-40	Caucasian	5
	Huy	Electrical	Male	20-30	Asian/Pacific Islander	3
	Alenjandro	Electrical	Male	20-30	Hispanic/Latino	4
	Coco	Mechanical	Male	31-40	Hispanic/Latino	3
University D						
Education	Anna	English education	Female	41-50	Caucasian	4
	Peter	English education	Male	31-40	Caucasian	5
	Patrick	Educational Leadership	Male	31-40	Caucasian	4
	Lilly	Educational Leadership	Female	31-40	Caucasian	5
	Norman	Educational Leadership	Male	20-30	Caucasian	5
Engineering	Amy	Mechanical	Female	31-40	Black/International	6
	Martin	Chemical	Male	31-40	Caucasian	4
	Jason	Mechanical	Male	20-30	Caucasian	4
	Joyce	Computer science	Female	20-30	Caucasian	3
	Lee	Mechanical	Male	20-30	Asian/Pacific Islander	4
University E*						
Education	Marlene	Educational Leadership	Female	31-40	Hispanic/Latina	4
	Jessica	Educational Leadership	Female	20-30	Hispanic/Latina	3
	Bradley	Educational Leadership	Male	20-30	Caucasian	2
	Alex		Male	20-30	Caucasian	4
University F*						
Education	Elise	Educational Leadership	Female	20-30	African American	3

Note. * Indicates additional institutions used to recruit sample participants or to diversify the sample gender and ethnicity wise. Names are pseudonyms, not the participant's actual name.

In general, I was pleased with how the interviews went. All interviews were conducted by phone at the time and date selected by respondents. Doctoral students were quite responsive to the invitation and eager to participate in the study. All participants spoke openly about their research collaborative experiences and their relationship with their faculty mentor, and in some cases, provided more details to help me understand the doctoral student's experience.

Themes

Data from interviews conducted with education and engineering doctoral students were analyzed separately, however similarities and differences emerged with questions. Major themes and sub-themes will therefore be discussed in cases where similarities existed for participants in both disciplines. Differences that emerged will be discussed where appropriate. Lastly, a summary of findings will be discussed. Tables 6-15 display findings by themes and complete findings, focusing on the steps I took to reach conclusions. These are located in Appendix B.

Five themes emerged from the data regarding the role research collaboration played in socializing doctoral students in education and engineering to faculty careers. First, the research collaborative process with mentors aided in doctoral students improving their research skills and knowledge about conducting research. Specifically, doctoral students learned how to communicate research to different audiences, the realities of research, how to conduct problem solving research, and the competitive nature of the research process. Second, participants identified learning about the complexity of a faculty role, particularly responsibilities that extend beyond teaching and research for faculty members. Third, doctoral students reported learning about the requirements of the tenure process. Fourth, participants described ways that their research collaborative experience positively or negatively contributed to their interest in a faculty role. Positive factors contributing to an interest in faculty careers included enjoyment of research and the perceived autonomy and flexibility of research. Negative factors contributing to an interest in faculty careers included the perceived low priority given to teaching and the demands placed on faculty members. Fifth, participants reported varying levels of commitment to the research collaborative relationship depending on whether they had competing interests.

Research Question One

The research process was enhanced for several participants who were working with faculty mentors. All respondents indicated collaborating with faculty mentors on various

research related activities—designing, conducting, and analyzing research. Participants also engaged in co-authoring papers and presenting research at professional meetings with their mentors. Participants expressed that the mentoring relationship was useful in helping them synthesize research results or fine tune research questions.

Research Process

Through interaction with faculty mentors, doctoral students in education disciplines perceived that their research skills and knowledge to conduct research improved. The research process included the act of designing and conducting research. Participants spoke about the research process in both general and specific terms, mostly identifying how learning how to conceptualize research projects from beginning to end, how to design a research study, and how using various methods to conduct analysis was enhanced through opportunities to collaborate with their faculty mentors. Consider a response from Bradley, a second year doctoral student with more than one research collaborative experience:

> I've learned how to follow through from an idea to a finished manuscript. From, you know, posing the research question to designing the study, to carrying it out, to producing a semi-final product, final product. I think that that is really important especially since I've had the chance to be a collaborator, more than a research assistant, particularly with Mentor #1 and also with Mentor #2. (Bradley, education, University E, Caucasian/European American, male)

The collaboration experience for this student was significant due the experiences with two faculty mentors. Similarly, Joyce, a third year computer science doctoral student with more than one research collaborative experience, describes learning to conceptualize and design research this way:

> I work with two different faculty mentors. I've learned about how to do good research. So, you know, formulating a sound or well-formed research statement with a set of objectives and forming an in-depth examination of related literature, carrying out the research study itself by conducting experiments and performing data analysis and then writing up the works professionally and submitting it to conferences or other publications. That process has become a lot clearer. (Joyce, engineering, University D, Caucasian/European American, female)

From her experience with faculty mentors, Joyce perceived being able to develop conceptually a research project, conduct the research, and then write up results from the study.

Communicating research to different audiences. Communicating research emerged as a sub-theme of the research process with faculty mentors. Communicating research involved writing research findings for publication purposes, presenting research findings at conferences, national meetings, or other venues, and writing research for grant purposes, which require reformatting a writing style, for example. Several participants considered the importance of learning how to write research results or findings that were acceptable by different audiences. Overall, 28 education and engineering participants made comments that suggested communicating research was something they learned how to do during their research collaborative experience. For example, Adam, a third year education student said:

> Learning how to write it [research findings] up is so important, too, and learning the different styles and learning how to I guess different writing for different venues also. I think that Mentor #1 has shown me how to write a book chapter or how to write a peer reviewed article and what the differences are and things like that, but also outside of peer research, how do we use this information that we have to be advocates and to write pieces to advocate for colleges and universities especially in minority serving institutions that oftentimes in the process need advocates because the press is, you know, biased. So, what is our job as researchers in getting information out there to the populous not just to ourselves? (Adam, education, University A, Caucasian/European American, male)

This comment speaks to how the participant learned how to tailor his writing for different audiences and in some instances, cater his writing in such a way that benefited a particular audience. Similarly, Bruce, a doctoral student in programming languages spoke about the importance of writing for audiences. He stated:

> It's important to be able to explain why you're doing what you're doing. Sort of be able to motivate it to a diverse set of audiences from people who are more or less outsiders to computer science all the way to people who are, you know, technical experts in my particular area and know all those little details and so they want to know what makes my particular aspect of the problem interesting. Sort of selling what I'm doing. (Bruce, engineering, University A, 3rd, Caucasian/European American, male)

For this participant, learning how to explain to others what his research means and how it addresses larger issues was important. Bruce continued elaborating on the collaborative nature of his experience. He stated:

> It's definitely collaborative. It's sort of like my advisor and the other individuals in our group all sort of have a vested interest in this project so I feel like there is a really meaningful relationship to working with my advisor. (Bruce, engineering, University A, 3rd, Caucasian/European American, male)

The collaborative mentoring experience seemed to assist in fine tuning the skill of communicating research for this participant. It also showed the participant that his advisor and research team members were equally interested in the research as he was.

Realities of research. A second sub-theme that emerged from the research process for participants was the realities of research. Participants talked about some of the realities of research they experienced during their research collaborations with faculty mentors—research is time consuming, research does not go as planned in most cases, and it is competitive. To that end, several of the participants found themselves having to make compromises to their research design plan. Twenty-three (n=23) education and engineering participants spoke about the realities of research. For example, Joy, an educational policy student in her fourth year states:

> I think part of it is that there's a difference between what you learn in a classroom, even when you get the chance to pilot some information or practice some of those skills in a class, verses going out and doing it for real, you know what I mean? When you're in a classroom learning some of it or figuring it out, there may be 15 or 20 other people in there and so you don't get the same kind of—yes, you get to ask questions and yes, you get to have intellectual kinds of conversations maybe through your papers or assignments or, ask after class, but there's a difference between that and the mentorship that I think happens when we've spent hours upon hours with a faculty member, or other individuals, working on specific projects and thinking about the details and, having to go through the whole thing and needing to go through the IRB process and revising over and over again because it hasn't met, hasn't answered whatever questions that research protection wants you to think about or having to think about, okay, well, you know, now this piece didn't get out in time so now what does that mean for the rest of the timeline? It doesn't work in those ideal perfect kinds of settings you talk about in the classroom. It becomes real

> and problematic in different ways than having to wrestle with those different ideas. I think that's a lot of what I've gained is kind of the reality of it and how interesting and fun it can be, but also how frustrating and how it doesn't always work the way you think it [the research process] is and going through and sometimes it works out better and other times it's frustrating, but there's a lot to be learned that way. (Joy, educational policy, University B, Caucasian/European American, female)

Understanding that research does not always go as planned seemed to become a reality for this participant once she was able to put into practice what she learned in class. This realization was also present for engineering participants. Martin, a fifth year chemical engineering student stated a similar reality:

> Not everything always works out when you plan experimental work. Sometimes you need to change focus. Sometimes you need to take a step back and look at the big picture. I think you have more freedom to do that as a faculty member relative to an industrial career because the company's line sort of drives what you are going to work on so if I find that something isn't working out, I may have pressures from above that say we're going to make it work no matter what, but in a faculty position you have the freedom to say, you know what, this isn't going to work out. I'm going to try another direction. I've learned that, but I've also learned how to overcome and at least try to develop techniques to overcome that adversity. So everything in my research program hasn't gone rosily. It hasn't been designing experiments, get results, write the paper, present, everybody applauds. There has been some cases where the ideas that I've had or the ideas that my mentor has had have not worked out the way we wanted to and so I've learned that—if anything else I've learned that I can overcome that and move on and persevere in this discipline whereas I would not have wanted it to go perfect through my entire experience in graduate school so I didn't know that I can persevere. (Martin, chemical, University D, 5th, Caucasian/European American, male)

This participant also had the experience of research not going as planned, but appreciated the flexibility and autonomy he had with his research to explore other options in the event his research plan did not work as he originally intended for it to. Learning that he could persevere seemed to be the lesson for this student. Along those same lines, participants learned during the

research collaborative process how “time consuming” conducting research can be, especially if it is done correctly. Nolan, a fourth year education student states: I guess I didn’t know how time consuming it [research] was in order to do it well. No matter how much you plan beforehand, there’s always things that don’t go exactly as you planned.” This participant admitted that he was a perfectionist, but considering his work style, the length of research projects now is a reality for him.

Conducting problem solving research. A third sub-theme that emerged from the engineering data about the research process was the notion of conducting problem solving research. Participants spoke about approaching research projects with the end goal of solving problems. Sixteen (n=16) participants described the nature of running experiments.

As one participant stated, conducting research sometimes requires “a bit of luck” to solve problems. Kelsey, a second year civil engineering doctoral student with previous work experience in industry describes the difference in her work in industry to her work in academia in approaching research:

> I’m doing hydrological modeling, which I’ve applied the models and used the models before, but now I have to look at it in much more detail and really think about how the model is working and questions that I never asked myself before and that are really difficult questions to answer and to understand so it is much more taxing mentally. It’s very difficult things to understand at least the stuff that I’m doing at the moment. So that’s one place where it definitely helps to have the mentor/advisor because I get into kind of corners where I get frustrated because I can't understand something and then we get together and discuss it and I realize well, maybe it’s just something that in a sense is not understandable or we don’t have the tools yet to understand it so the fact that my advisor can't answer the question either makes me feel better that I’m not – that I maybe shouldn’t even be bothering with my Ph.D. (Kelsey, engineering, University B, Caucasian, female)

The research collaborative experience with a faculty mentor for this student seemed to be important in helping her process the research she was conducting and to help her understand that despite efforts, some questions cannot be answered or may require using different approaches. This student’s efforts and knowledge also seemed to be validated in a way because she learned that her mentor did not always “know the answers” either. Participants, in most cases, are seeing

how the nature of research is different from undergraduate training. At the graduate level, a complex level of thinking is now required to solve engineering problems. Consider Terry's experience:

> Most of this material was done when I got into undergraduate studies—the application of what you learn in the book. Now, we have to consider these different facets of what we're doing. We have to go through and it—like, well, did you take this into consideration? If the answer is no, I've never seen that before. He's [Terry's mentor] really given me multiple ways of looking at the same problem. Before, we came at it strictly from an engineering kind of thing. Now, I'm looking at it from—if it's a question, and nobody can answer it, it was a good question. To me, it shows me that there's so much that's not in a book. (Terry, engineering, University C, 2nd, Caucasian/European American, male)

For this participant, developing questions that have never been asked before are important in his field. What also seems clear is that learning how to solve problems by asking relevant questions is not a skill learned from text books.

Competitive nature of research. Engineering doctoral student participants, more so than education doctoral student participants, spoke about the competitive nature of research in their field as a reality of the research process. This included the competitive process required for applying for grants, conducting research that was driven by what was considered "hot" or new in the field, learning the importance of networking and "being nice to people," and the politics associated with publishing research. In terms of grant writing, most engineers were exposed to the grant writing process or knew somewhat about the grant process because they worked for funded programs through their assistantships, but many felt unprepared to write grants themselves. For example, Doug, a fifth year mechanical engineering student stated:

> I've done I guess a few different things in the lab that made me more familiar with setting stuff up, and I've gone from scratch from having nothing to building up an experiment and running the experiment, but then I guess what it hasn't prepared me is I had no real part in trying to get funding or anything like that. So, not having that familiarity will hurt me to have a faculty position because I haven't had that experience. (Doug, mechanical, University B, 5th Caucasian/European American, male)

Applying for grants to support research in the engineering field for this participant was reality. His lack of preparation and experience writing grants was perceived as negatively preparing him for a faculty role. The same is true for Rahim, also in mechanical engineering from University A:

> One very important thing as a faculty career here in the U.S. is that except for spending time as a faculty member in research and teaching, you also spend a lot of time looking for funding for your research. That part was kind of unknown for me. If I want to go to academia, I should learn that. (Rahim, mechanical, University A, 2nd, Asian/International, male)

When asked if he knew how to write grant proposals Rahim responded, "not at all." Coco, a third year mechanical engineering doctoral student also spoke about how competitive his field is. He stated:

> I consider that in my field, for example, it's a field that has been going for 100 years. It's becoming more and more difficult to publish when compared to other fields. So, it is required that I have really good insight, really good background, and also new techniques. (Coco, engineering, University C, 3rd, Hispanic/Latino, male)

For this participant, new research is required to be successful in the competitive engineering discipline. This requires having innovative ideas and new solutions for problems characteristic to the mechanical engineering discipline.

Through the research collaborative process, doctoral students in both disciplines learned valuable knowledge about the research process—how to carry a project through from start to finish, how to conceptualize and conduct research projects, and how to communicate their research to others. Through this process of learning about research, they also came away from the experience understanding that the research process requires problem solving. Things can happen during the research process that require modifications to be made to the research plan. Engineering doctoral students, in particular, received a glimpse of the competitive element of the research process that included securing external funding for research projects. While many expressed not being prepared in this area, they came away from the experience with the knowledge of how much research is driven by what granting agencies need or are looking for or what is innovative in the field at the moment. These specific activities are gained through putting into action what students have been learning in classes. Also important, is that this is true despite

disciplines. Both education and engineering doctoral students expressed learning these important skills.

Research Question Two

The working life of faculty members involves many duties and responsibilities. Clear themes from this study included how complex a faculty role was and the requirements for the tenure process. Respondents indicated being more aware of these complexities and learning what the tenure process looked like for faculty members working at research universities.

Complexities of Faculty Role

Doctoral students in education and engineering disciplines engaged in collaborative research experiences with their faculty mentors learn about the complex duties and responsibilities of faculty members that reach beyond teaching and research duties. They also learned about the expectations for a faculty role that include the requirements for promotion and tenure. Twenty-nine (n=29) participants spoke about better understanding the many responsibilities their faculty mentors were involved in. In some cases, this knowledge about the complex faculty roles and requirements for promotion and tenure prepared doctoral students for what they should expect as future faculty members. It did not diminish their view of faculty life. In other cases, learning about the complexities of the faculty role and the requirements of promotion and tenure diminished doctoral students' view of faculty life. Christopher, a third year, mechanical engineering doctoral student expressed his surprise at all of the administrative type work his faculty mentor had to do. He stated:

> It seems like it's much more of a managerial type position than getting into the nuts and bolts if you will. You know, I didn't realize to the extent that he goes out and inquires, gets these contracts, research contracts, and then he oversees everything, obviously, but it's much more of a managerial type position than I had perceived in the past. (Christopher, University B, mechanical, 3rd year, Caucasian/European American, male)

In addition to the main responsibilities faculty members have, Christopher now sees that other layers exist for faculty who are involved in securing external funding and managing that funding for research. The complexities of a faculty role are also reflected in the following statement by Vickie, a doctoral student in educational policy:

> So I have first-hand knowledge about their roles outside of the classroom, so on the different committees and what the committees do. There's a variety of things that you can and have to be involved in. For example, traveling to give talks. I think I've always known that people do that, but there'll be weeks at a time where my mentor is out of town and it's not for a conference. It's because there are people in New York and D.C. and Upstate New York that want her to talk and so she goes and how that is not only for her own personal, professional growth, but also as part of our university and putting out what our university is doing, what's on our research agenda. (Vickie, education, University A, 2nd year, African American, female)

A majority of participants viewed the life of a faculty member as one that involved teaching and research, but these responses suggests that a deeper understanding of the intricate details of faculty life are the reality for most faculty members at research universities.

Requirements of Tenure Process

Fifteen (n=15) respondents articulated that the requirements for achieving tenure became clearer through their research collaborative experiences with faculty mentors. Many described seeing this process "up close" because their mentors were coming up for tenure and this influenced their interest in being a faculty member. Understanding the tenure process for these participants meant learning what activities were considered valued in academia or what venues to publish scholarly work in. Consider the following from Jason, a mechanical engineering doctoral student at University D:

> It's not just what you do—you are not simply a mercenary of science. There's more to your job as a faculty member than simply producing and that is on one side very good, but the other end there are so many soft factors that come into play in things like tenure like whether you get, you know, like after five years you come up for review and how many papers have you published and where have you published them and that's—and, you know, what outreach programs you established and worked on. It seems like the junior faculty that I know here at least, I don't know about all universities, but at least here at University D, just seem stretched so thin that it's actually turned me off to the idea of wanting to be a faculty member in an R1 type university because I don't know when they have down time. I'm not saying that I expect to be like lazy, but I don't want to

> work 18 hour days for the next ten years. I want to have a home life, I want to, you know, start a family and have a balance and those are things and in some ways I don't see that being very simple with the faculty members. (Jason, engineering, University D, 5th, Caucasian, male)

After seeing how much work his faculty mentor and other faculty members he knows did to meet tenure requirements, this participant realized that he did not want to commit all of his time to a faculty career in a research university or to be "stretched so thin." An education doctoral student voiced a similar opinion. Consider the statement from Nolan:

> The level of expectations I think for promotion and tenure—I'm talking specifically at research one institutions since that's where I'm going to be working. I mean when I was a master's student I knew my professors were busy, but I guess I didn't really know the extent to why they were busy or how busy they were until I started working with Mentor #1 and saw the pressures of him trying to have his work respected in outlets that weren't necessarily valued by the institution, but then simultaneously having to seek those places out that the institution did value. So, I didn't know I guess the level of expectations that were required upon faculty members to achieve promotion and tenure. That's something I think still to this day is more clear, but it's still one of those things I never think it's going to be fully clear until you actually get into the process. (Nolan, education, University B, African American, male)

Nolan continued elaborating on the importance of getting his research out in top tier journals, venues he has learned are respected in his field. He speaks about struggling with the idea of publishing his work in venues to which only a limited audience will have access. He continues:

> I think the one thing I've learned about research is the importance of getting your research out in those venues that are respected by the field. If it was up to me, I don't even know if I would even publish anything in those so-called top journals of our field because to me, it's a very limited audience who is really not going to use much of my work. It's a privileged audience. You have to be members of certain associations to even subscribe to or get the journals. So, there are not a lot of people who are not in my discipline who would even read those journals. So, to me, it's just a way to reproduce and

> perpetuate exclusion and hierarchy and power, but I know ultimately going into the field, I'm going to have to do that.

Unlike Jason, Nolan's experience, however, did not make him reconsider his commitment level as a future faculty member, but it did help him understand the expectations required for promotion and tenure, particularly at research universities. His comment also seemed to suggest a difference of values in terms of what is respected in his field and where his work should be published in light of these expectations. These findings suggest that doctoral students in education and engineering disciplines are learning much about faculty careers. They are learning the expectations of faculty and the requirements of the tenure process. In accordance with the graduate student socialization model, several participants clarified values as a result of their involvement with faculty mentors and their observations of faculty mentors—decisions to have a personal life verses not having one because of faculty duties or where to publish their research.

Research Question Three

Aspects of the research collaborative experience for participants positively contributed to their interest in pursuing a faculty career, while other aspects of the experience diminished participant's interest in pursuing a faculty career. Passion for research and the perceptions of autonomy of a faculty role seemed to have a positive impact on participants, while heavy expectations placed upon faculty and the lack of emphasis on teaching seemed to have negatively impacted participant's view of faculty life.

Factors Positively Contributing to Interest In Faculty Role

Certain aspects of the research collaborative experiences were perceived as positively contributing to participants' interests in faculty roles. These included participants' enjoyment of research and the perceived autonomy and flexibility that seemed to come with research. These factors were described by respondents' as factors that presented a faculty career as attractive.

Most doctoral students in education disciplines described experiences that positively contributed to their interest in becoming a faculty member because they enjoyed research and have discovered it is something they are capable of doing. Several respondents stated that they had very limited or no research experience prior to entering their doctoral programs or research collaborative experiences with their faculty mentors. Many were rather surprised to learn that they learned so much about the research process and that they "enjoyed" research and writing.

Participants associated their positive research collaborative experiences and enjoyment with the experience with a positive identity as a future faculty member. Consider the following quotations from Marlene and Jessica, educational leadership doctoral students with previous higher education administrative experience:

> Somehow it just snapped, and I was like I'm going to be a faculty member, and I really do think it was because I was so drawn to this particular subject—minority serving institutions, and I thought there was something in me that I really wanted to write about this and so I was so excited about having the opportunity to do that and then I thought, I mean, look at what I was able to do. This is cool, you know. And then it evolved into, you know, doing this collaboration with Mentor #`1 and talking about service learning and let's write about it, you know, and then everything became well, how can we look into this further? How can we research this more? And so it really did come to a point where I really enjoyed doing this. I really like doing research, and I never thought that would be the case. I never thought that that would happen, and now I cannot imagine going back to Student Affairs. …….And, I'm like wow, I am so socialized now, you know? I'm always thinking about potential research opportunities when my student affairs compatriots are like, I just need to finish this end-of-year report, or I'm just trying to get the students to graduate? (Marlene, education, University E, Hispanic/Latina, female)

Similarly, Marlene's colleague also expressed her love for the research process and her desire to continue working on her research projects despite her administrative duties. Jessica stated:

> I found that I was continuing to get involved in more and more research projects and still working full-time, but I was not willing to give up my research projects and really enjoyed that part of the process and actually really enjoyed writing. (Jessica, education, University E, Hispanic/Latina, female)

For these participants, envisioning themselves as future faculty members was a welcomed idea because they enjoyed researching and writing about topics of interest to them and think it is a good fit with their skills and interests. Research was something they valued and looked forward to continuing. Similarly, Jamie, a second year education doctoral student also talked about enjoying the research.

> I thought, I can't do this, and you know, nobody else in my family has gone to college. Nobody teaches you this. But once I actually realized that I liked it, that was a huge shock for me that I would actually like doing something like this. So, I think above anything else what has been my greatest learning experience is that this is actually a good fit for me, and I never ever would have thought that. (Jamie, education, University A, Caucasian/European American, female)

Jamie's research collaborative experience seemed to be a "good fit" and helped build the confidence that she could really be a researcher.

Doctoral students in engineering disciplines engaged in collaborative research experiences with faculty mentors are also positively affected by the prospects of being a faculty member because they are attracted to the flexibility and autonomy faculty members have with their research. Many were able to view their faculty mentors direct their own research in addition to performing other duties. The notion of having "complete control" of their work is reflected in the following statement by Terry (chemical engineering):

> I did not know that a faculty position was so business like. I thought it was more traditional like a teacher in a high school or a middle school. Now, from my understanding, they rent lab space, they are a separate entity all into themselves and they work like a larger company would where they share resources when they need to and when it benefits them, but at the same time they have complete control of their day-to-day activities. (Terry, engineering, University C, 2nd, Caucasian/European American, male)

Amy also reflected a similar interpretation. She viewed this autonomy as a type of "freedom" faculty members had to explore their research interests. Consider her explanation:

> I knew faculty had freedom, but I didn't realize how much freedom they had to do what they wanted. I think that's awesome that you can pretty much expand your horizons once you get established. I think that's kind of neat. (Amy, engineering, University D, 6th, Black/International, female)

Seeing her faculty mentors have what she perceived to be complete control and direction of their research seemed to be an attraction for Amy. Participants seemed to value this notion of having autonomy and the freedom to "expand your horizons" with research. Clearly, flexibility and

autonomy with research was viewed as a benefit of a faculty career for engineering doctoral student participants. This perception of autonomy with research may be the case for engineering doctoral student participants because engineering faculty typically support their research with external funding.

Factors Negatively Contributing to Interest In Faculty Role

Some doctoral students in education and engineering disciplines engaged in research collaborative experiences with their faculty mentors described factors that seemed to negatively contribute to their interest in a faculty role. For example, they are disappointed by the heavy emphasis on research and lower priority given to teaching and saw time demands of faculty members as all-consuming. A majority of participants had an idealized view of faculty life that included teaching as an important component. In fact, many expressed being drawn to the field and wanted to be faculty member themselves because of the faculty they had in their undergraduate programs. They expressed having "good teachers" and learning the most from professors who were good teachers. This idealistic view changed for several participants after seeing how much value was given to research over teaching. Consider the following quote from Angela, an education doctoral student with previous experience working as an adjunct faculty member:

> Before I came to my Ph.D. work, I was an adjunct faculty member out in another state, so I had taught classes, actually several classes. I taught in the math department, and I really enjoyed it and that's why I decided to come back and get my Ph.D. so I could teach full-time at a larger institution, at a research institution. I mean I've always been slightly interested in research, but I didn't think I realized how much of a faculty career is about research. I always kind of assumed and, you know, being naïve that faculty really cared about teaching students. I think there still is some of that and definitely in mentoring and in closer relationships with faculty. I feel like most of the faculty and even in a program that's a great as mine, the faculty don't really want to teach. They want to research and so their priorities are always on their own research and not on teaching, and you know, I've heard faculty make comments like they really don't want to grade papers, they don't want to read papers because they need to get back to their research or, you know, faculty only want to teach as much as they have to. They never take an extra course load, and I definitely see this because my program are all huge names in research so they are all

> really heavy researchers so they don't teach but maybe one class a year even—and if they can get out of that class, they are happy. (Angela, education, University B, Caucasian/European American, female)

This participant saw first hand faculty expressing more of a desire to work on their research than the activities related to teaching. Similar observations were reported by engineering students, Jacob (mechanical) and Tom (computer science):

> I mean it has negatively affected me in terms of the short-term. I came into grad school with the goal of becoming a professor. And, I think it's a combination of just, you know, realizing there's no emphasis on teaching at all and also the fact that I've just been in academia for too long, and I need to do something different. But yeah, I mean overall I would say it's negatively affected my outlook on becoming a faculty member. I've also realized that it's—I didn't realize it was that competitive. It seems to be extremely competitive to get a position. I mean it just seems like if you go in and you have, you know, high marks of being a good teacher, but you spent a lot of time teaching and weren't able to get as many published papers out and bringing in any money then you're not going to get the job, no way. (Jacob, mechanical, University B, 5th year, Caucasian/European American)

The combination of the lower priority given to teaching, needing a change from higher education, and the competitiveness of the field all contributed to Jacob's negative outlook on a faculty career. Similarly, Tom, a fourth year engineering doctoral student also speaks to the lower priority given to teaching. He explained:

> I guess the one negative thing is again we are required to do one year [of teaching].You get to work with the department, and I thought oh, great. I'll be able to keep teaching throughout grad school and really be able to come in and be a really great teacher when I graduate, and that was kind of shot down immediately so I've been discouraged several times from doing anything that would distract me from my research projects, which on the one hand it was great. I mean, you know, I have friends who are in their second or third year of just writing their dissertation but they have to teach such heavy loads. So, it's a great blessing to not be encumbered by teaching, but at the same time, you know, I feel like I don't know if I'm going for a research faculty career—a faculty career at a big

> university or perhaps a small college, and I feel like I could have been better prepared for the teaching aspect by doing a bit more teaching because really in the second year I was more of a TA role. (Tom, engineering, University A, 4th, Caucasian/European American, male)

These participants articulated an obvious interest in teaching, an activity viewed as giving them more interaction with students and preparing them also for the faculty role. Teaching was perceived as a value to these participants, one that they saw as an important role of faculty members. When seeking opportunities to gain teaching experiences, some participants were discouraged from doing so like Tom was. Wanda, a fourth year bio-engineering doctoral student was also discouraged from teaching. She stated:

> I know now that to be in a top research institution it's not about the teaching whatsoever, it's all about the research, and in fact, my program does not require teaching at all, and in fact, my mentor has discouraged me from doing any teaching simply because of the time away from the research that I was doing and since she was paying me, I had no say. Even though I thought, you know, if I'm going to be a professor, I know the best professors that I've ever had were really good teachers, and I didn't care what kind of research they were doing because they were teaching me things in the classroom and that meant more to me than anything else, but I can understand also that institutions can sometimes put that second priority because you need the funding that these researchers bring in, you know, get to be highly ranked and all of that and everything that comes with it. So, that's something that I found out about being faculty. (Wanda, engineering, University A, female, Asian/Pacific Islander, 4th)

These experiences with their faculty mentors negatively contributed to doctoral students in both disciplines from considering faculty careers because of differing values in what they felt should be valued in the academy, with most preferring teaching as important and characterizing what a faculty role should entail even at research universities.

The responsibility and time demands of faculty perceived by participants also negatively contributed to some doctoral students' interest in a faculty career. Both groups of students spoke about the enormous amount of time they saw their faculty mentors giving to their careers. As one engineering student stated, a faculty career "can consume your life." Several participants

commented on faculty expectations and demands negatively affecting them. For example, Martin, a 5th year chemical engineering student elaborated on what he meant by a faculty career consuming your life:

> The biggest thing that I know now is that a faculty career is that it can consume your life if you let it. It really becomes an issue of—how you manage your time, what you value in your life. Ultimately if you allow your job to take over your life, and this is in any discipline, but it seems to be more prevalent in a faculty/academic setting, it will. And I can't deny that I do feel some pressure from my own advisor to work longer hours, to devote more of my time to just research, and I've had to develop my own method of dealing with some of those requests or suggestions that you must not be working hard enough.

Martin continued explaining that he has learned of other career options that he may entertain:

> But also I have found that there are alternatives to a research one based school or research-based school, you know, you can apply your skills at a gamut of locations or potential employers from not opting to do a research career or academic research career so that's one option—to go through a national laboratory and perform research but also within the academic field there are opportunities for teaching at community colleges engineering technical courses, scientific courses and then there are also academic focused research institutions that aren't just focused on the research dollars, but they also look at the educational experience itself. (Martin, engineering, University D, 5th, Caucasian, male)

Martin, consequently found himself developing personal strategies for dealing with demands on his time. His comment suggests that he very well may work in a career that values his work ethic and contributions or continue exploring alternatives. Similarly, education doctoral students also spoke about the amount of time their faculty mentors spent working. For example, Isabelle, an educational policy student in her third year spoke about this:

> As much as I love my advisor, one of the reasons I'm not sure [about pursuing a faculty career] is I see how hard she works. When I first was working with her, she was in her fifth year of tenure, trying to get tenure, and she's since gotten tenure, but I had worked in the university before I was a Ph.D. student and I worked with faculty so I had a pretty

> good picture of what faculty do as far as dividing their time between research and teaching and various forms of service. But I don't think I realized how hard they—well, I shouldn't say everyone—but how hard some of them work. So, my mentor, she's really—she's just driven. She works an insane amount. She did before tenure and now that she is tenured, she hasn't slacked off at all and so I know my own personality and I know what a perfectionist I am and one of the reasons I'm not sure about faculty roles is because I have a feeling if I were faculty I would work as hard as she does, and I'm not sure I want to work those kind of hours. (Isabelle, education, University B, Caucasian/European American, female)

There is an assumption that pre-tenured faculty work extremely hard to achieve tenure and the demands on their time (or productivity levels) are lessened after receiving tenure. This participant, though, did not see that being the case with her mentor. Isabelle, therefore is not certain she is willing to make the sacrifices to her personal life that a faculty career, particularly at research universities, will demand. These participants saw an image of faculty life that positively and negatively contributed to their interest in a faculty role. Those whose ideas (and interests) closely matched these images seemed to be positively interested in a faculty career. Respondents' ability to conduct research and enjoy their craft also seemed to help shape their views of faculty life as well. In other cases, differing values (time demands and less emphasis on teaching) seemed to be negative factors, factors not congruent with the values of some participants, consequently encouraging students to pursue other career options.

Research Question Four

Most participants involved in research collaborative experiences with faculty mentors were highly invested in the relationship. Some doctoral student participants were not so highly invested in the relationship. Participants were asked to quantify their level of investment in the mentoring relationship, with one meaning little to no investment and ten meaning a high level of investment. Thirty-five (n=35) education and engineering doctoral student participants reported an investment level of eight and above, indicating that students were highly invested in the research collaborative relationship. The remainder (n=5) evaluated their investment as seven or below, indicating a lower level of investment in the mentoring experience.

Comparison of lower and more invested participants

Although engineering doctoral student participants did not rate their investment below six, a few did rate their investment a seven, suggesting a lower investment from those who rated eight or above. Interviewees were then asked to explain what that number suggested. The most common reason for this lower number when compared to their peers was because they were interested or involved in other activities. This meant that their time and energies were not devoted solely to the research collaborative relationship. The most common reason for lower investment for education doctoral student participants was lack of interest in research at the time the mentoring relationship began. Participants also spoke about not having a clear research focus. In a sense, participants were still trying to establish their personal research identity. Consider the examples from lower invested engineering and education doctoral student participants. Lee, a mechanical engineering doctoral student in his fourth year stated, "I'm not purely interested in just doing research. I'm involved in other activities whether it's working with student societies or teaching a couple of lectures. So, that's where the missing three are I guess." His peer in the same discipline at University B stated a similar reason:

> There was definitely more room to put more time and effort in so I wouldn't say I've maximized the amount of time and effort and resources that I could have put in, but at the same time I feel like it's a significant amount. I have other interests. I can't drive myself to put 110-percent or whatever into my research. I'm too interested in doing other things outside of research, and I mean it's my fault, but yeah, it's just something, my personality of not being willing to sacrifice all the time I have. (Doug, engineering, University B, 5th, Caucasian/European American, male)

Involvement and interest in other activities seemed to be important to these students, even though their investment in the research collaborative experience was significant. Elise, a third year education doctoral student spoke about not being initially interested in research when an opportunity to collaborate with her faculty mentor became available. She explained:

> I just didn't have the interest. I didn't have the passion and I never thought that at the time I would be interested in research or being a faculty member. It never crossed my mind really. So, I could have invested a lot more. She [Elise's mentor] and I could have collaborated on many more projects, she and I could have presented our research studies

> at many places, all of which I turned down (Elise, education, University F, 3rd, African American, female)

This quote suggests that an interest and perhaps a passion for research are needed to invest fully in a research collaborative relationship.

When comparing lower invested participants with higher invested participants, the most common reason for higher investment for engineering students was because it was their job and they saw themselves as members of a research team. Education doctoral student participants on the other hand gave different reasons for investing highly in the mentoring relationship. Many reported having a desire to learn about research or caring for the research project or mentoring relationship as reasons they invested so highly. Both groups used terms like "extremely invested," "all of my energies," "top priority," or "dedicated" to describe what the number they suggested meant. Jason, a fifth year, mechanical engineering doctoral student talked about his investment level this way:

> I have spent countless hours and potential years of my life in pursuit of not only the answer, but also the question that I'm seeking within my research, and I give a lot of time and effort to ensuring that the experiments that I try to run are sound and appropriate. I try to make sure that the data that I collect are free of disturbances, and I try to develop any hardware and software that I do at a very high level. I expect a lot from myself so that I consequently try to produce papers and presentations at what I feel are a very high level. I think that's why I would give myself a nine. (Jason, engineering, University A, 5th, Caucasian/European American, male)

For this participant, all of his time and energies went to the research collaborative relationship because his work depended on his pursuit of an answer to a problem he had been working on for several years. His efforts were building his research agenda for his career. Another engineering doctoral student reporting a high level of investment speaks about how working hard now will set his future up later. He stated, "I know what I'm going to do in ten years. I work hard now, but compared to him [Huy's mentor], he's a ten because he always works hard." (Huy, engineering, University C, 3rd, Asian/Pacific Islander, male)

Investment for education students seemed to be more for personal reasons. Participants expressed a desire to learn and having passion for their research projects. Interestingly, highly

invested education doctoral student participants also talked about caring for their mentor and the mentoring relationships. To them, participants did not want to let their mentor down by not putting forth all of their efforts in the relationship. Josie, for example spoke to her desire to learn, care for the project, and this notion of not letting her mentor down. Consider her response:

> I'm one of probably a handful of students up in our center who spends the majority of our working time actually in the center working on our project, dedicated to sort of thinking about it, working about it, talking about it, you know, that doesn't necessarily happen with all of our students. It's not because they are not as invested. I think it's because they are not on the types of projects that require that investment. For me I've asked to take on pieces of the project that I know aren't my areas of expertise, but then I've said, you know, look, I will create these SPSS databases, learn how to do that, put the time into it because I want to learn that, I need to learn that, I'm going to take the time even though I know it might be another half an hour of meeting time to say hey, can I ask what this means, you know, so I'm willing to learn, I want to learn. I care too much about the success of the project and my own learning experience and want the outcome of the project to be as good as possible, and I don't want to let down my mentor and faculty members who are part of the project that they have invested their time in me. They expect me to do a good job and so I make sure that I put in the effort to do that. (Josie, education, University B, 4th, Caucasian/European American, female)

Josie feels almost obligated to invest highly to produce good work, learn in the process, and not let her faculty mentor down. Similarly, Lilly, a fifth year education student also talked about caring for the mentoring relationship. She stated:

> This relationship is so incredibly important and so valued that at this point I just couldn't see doing anything to disrupt that or seeing it end. It was the fact she was my advisor in the beginning and for some reason I think still to this day maybe she saw something in me that I didn't see in myself and the desire to cultivate that, but I'm so grateful that she did and she remained committed to me and never, ever lost faith or never seemed to doubt I had skills and talents that maybe I didn't even see in myself. And now it's a true mentoring relationship. (Lilly, education, University D, 5th, Caucasian/European American, female)

Both respondents' investment in the mentoring relationship seemed to be a direct result of their mentor's perceived investment in them personally.

More interesting may be the students' reasoning for entering research collaborative relationships with faculty members and their investment levels. By in large, all participants spoke about having similar research interests as their faculty mentors. This finding was evident despite discipline. Both groups also spoke articulately about how the relationship might benefit them (e.g., professional reasons or personal). Engineering doctoral students, however, spoke about having no other option but to collaborate with faculty mentors, who were also their advisors. These students entered the research collaborative relationships differently because in a majority of cases, the experience was also their job (or assistantship). In a few cases, this applied to education doctoral student participants, but mostly not. Education doctoral student respondents entered into relationships voluntarily, when opportunities where available, for more personal reasons.

Overall, findings revealed that "learning by doing" the research collaborative experience with faculty mentors, education doctoral students discovered if the experience fit their values. For engineering doctoral student participants, conducting "problem solving" research was significant in helping students discover their capabilities to contribute innovative research to a highly competitive field. Engineering doctoral students also gained perseverance due to their experiences. With this highly invested group, in a majority of cases, the research collaborative experience seemed to reinforce an interest in a faculty career because of shared values about research. These experiences helped shape their professional identity as future faculty members. In a minority of cases, the research collaborative experience seemed to discourage a faculty career because of dissimilar values about research and the role of faculty and the less emphasis on teaching, particularly in research universities or a lower investment in the research experience. These experiences consequently encouraged doctoral students to reconsider research intensive faculty careers as viable options. Table 4 displays the overall findings of this study.

Chapter 5 summarizes key findings. The core elements of the graduate student socialization model are discussed, focusing on the implications of findings from this study and recommendations for future research, practice, and theory. How the researcher handled reflexivity is also discussed.

Table 4

Coding Matrix of Findings (to be read from the bottom up)

Code mapping for Knowledge acquisition, involvement, and investment in research collaborative experience with faculty mentor (Research Questions 1, 2, 3, 4) RQ1: Perceived Learning About Research? RQ2: Learning About Faculty Careers? RQ3: Factors Contributing to Interest in Faculty Role? RQ4: Investment in Mentoring Experience?
Fourth Iteration: Overarching theme/conclusion
By "living and doing" the research collaborative experience with faculty mentors, doctoral students in education disciplines discovered if the experience fit their values. With this highly invested group, in a majority of cases, the research collaborative experience seemed to reinforce an interest in a faculty career because they shared similar values about research. These "learn by doing" experiences helped shape their professional identity. In a minority of cases, the research collaborative experience seemed to discourage a faculty career because of dissimilar values about research in a faculty career. These experiences consequently encouraged doctoral students to reconsider research intensive faculty careers as viable options. By conducting "problem solving" research during the research collaborative experience with faculty mentors, engineering doctoral students discovered their capabilities to contribute innovative research to the field that is highly competitive in addition to gaining perseverance during the research process. In a majority of cases, the research collaborative experience confirmed their career aspirations to join the professoriate. In a minority of cases, the research collaborative experience seemed to discourage a faculty career because of dissimilar values about the role of research and teaching in a faculty career and feelings of ill preparedness to be successful in a faculty career. These experiences consequently encouraged doctoral students to explore other career options.

(Table continued)

Table 4 (continued)

Third Iteration: Analytical Propositions
RQ1
1. Through interaction with faculty mentors, doctoral students in education disciplines perceive that their research skills and knowledge to conduct research improved. Interaction with faculty mentors was important in helping guide the student through the research process and in synthesizing/processing research.
2. Through interaction with faculty mentors, doctoral students in engineering disciplines perceived that their research skills and ability to critically approach research improved.
RQ2
3. Doctoral students in education and engineering disciplines engaged in collaborative research experiences with their faculty mentors learn about the complex duties and responsibilities of faculty members that reach beyond teaching and research duties.
4. Doctoral students in education and engineering disciplines engaged in collaborative research experiences with their faculty mentors learn about the expectations for a faculty role that include the requirements for promotion and tenure.
RQ3
5. Certain factors positively contributed to doctoral students' (in education disciplines) interest in a faculty career. Enjoyment of research and the discovery that it is something they are capable of doing positively contributed to doctoral students' interest in pursuing a faculty career.
6. Certain factors negatively contributed to doctoral students (in education disciplines) interest in a faculty career. Disappointment by the heavy emphasis on research and lower priority given to teaching in the academy and the responsibilities and time demands placed on faculty made the prospects of a faculty career unattractive.
7. Certain factors of the research collaborative relationship with faculty mentors positively contributed to doctoral students' (in engineering disciplines) interest in a faculty career. The perceived flexibility and autonomy with research made the prospects of a faculty career attractive.
8. Certain factors of the research collaborative relationship with faculty mentors negatively contributed to doctoral students' (in engineering disciplines) interest in a faculty career. The perceived pressures of a competitive field and the lower priority given to teaching in the profession made the prospects of a faculty career unattractive.
RQ4
9. Levels of investment in the research collaborative experience for education doctoral students vary because of competing interests and activities and lack of interest in research.

(Table continued)

Table 4 (continued)

10. Education doctoral students' level of investment has personal elements. Investment is related to commitment to the mentoring relationship and the mentor's investment in the doctoral student.
11. Levels of investment in the research collaborative experience with faculty mentors for engineering doctoral students are above average, but on occasion vary due to competing interests or activities and lack of interest in research.
12. Engineering doctoral students' level of investment is for professional reasons. The main motivation for being highly invested in the research collaborative experience is for career advancement.

Second Iteration: Pattern Variables

RQ1	RQ2	RQ3	RQ4
Research process	Complexities of faculty role	Positive Affect	High Commitment
Communicating research			
Realities of research		Negative Affect	Moderate Commitment
Conducting problem solving research*	Requirements of Tenure process		
Competitive nature of research*			

First Iteration: Initial Codes/Surface Content Analysis

RQ1		RQ2	RQ3	RQ4
Conducting research	Cutting edge research*	Politics	*Positive*	0-7
Designing research	Complexity	Balancing work and family	Role model; Self actualizing	Fair amount of time and effort
Research methods	Iterative nature	Promotion and tenure	Faculty career is doable; Autonomy with research; Flexibility of faculty role*	Trade off between research and non-research related activities*
Publishing process	Answering unknown*	Daily responsibilities	*Negative*	
Presenting research	Writing research findings	Amount of work involved	Faculty career is not realistic	8-10
Doesn't go as planned	Grants*	Importance of collaboration	Less focus on teaching; Mentoring not valued; Expectations of faculty; Completive field*	Time and effort beyond assistantship hours
Time consuming	Translational work*	Administrative aspect of career*		
Community driven*	Takes bit of luck*	Importance of securing grants*		
DATA		DATA	DATA	DATA

Note: Four iterations of data analysis moving from codes, to categories, to themes, to overarching conceptual explanation. Table to be read from the bottom up.
* Indicates finding relevant to engineering participants only.
Source: Anfara, V. A., Brown, K. M., Mangione, T. L. (2002). Qualitative analysis on stage: Making the research process more public, *Educational Researcher, (2)* 31, 28-38.

CHAPTER FIVE

Discussion, Limitations, and Implications

This study examined the role research collaborative experiences with faculty mentors played in socializing doctoral students to faculty careers. Using the Graduate and Professional Student Socialization Model (Weidman et al., 2001), this study was designed to examine what knowledge, skills, and understandings were acquired during research collaborations some education and engineering doctoral students had with their faculty mentors. This study also examined education and engineering doctoral students' investment and involvement in the research collaborative experience.

This chapter is divided into five sections. In the first section, overall findings, as related to doctoral students' preparation for and commitment to a faculty career are presented, discussing disciplinary differences that existed. A logic model of conclusions is also presented. The second section discusses how findings fit the theoretical framework and what findings add to the theory. The next section discusses the findings as they contribute to the literature. In the fourth section, caveats are presented. The final section discusses implications for future practice, research, and theory.

Summary of Findings

Preparation for and Commitment to a Faculty Career-Encouragers

Findings from this study revealed that certain experiences between doctoral students and faculty members encouraged or discouraged preparation and commitment of doctoral students to a faculty role. Some aspects of the research collaborative neither encouraged or discouraged participants' preparation and commitment to a faculty role.

Certain aspects of the research collaborative experience encouraged participants to commit to a faculty career. Some participants came away from the experience with positive views about the research process and faculty roles. A desire to learn about research, enjoyment of research, the perceived flexibility and autonomy of research, and using research as a problem solving mechanism were attractive to some participants.

For highly invested participants, a desire to learn about research and interest in their projects enhanced their commitment to a faculty role. Participants wanted to be ready for their

future positions and to them that meant learning what they could about research. Having an interest in research was related to how much they invested their time and energies into the research collaborative relationship. Their experiences helped shape their identity as a future faculty member. For doctoral students not invested highly in the mentoring relationship, a lack of interest in research and competing interests and activities took some of their time and energies, not allowing them to fully invest in the research collaborative mentoring relationship. Their experiences offered little in helping to shape their identity as a future faculty member.

Enjoyment of research and an appreciation for the perceived autonomy and flexibility that is associated with a faculty role also added to interest in a faculty career. Participants, after conducting research with their faculty mentors or writing about their projects realized that they enjoyed the research process. These activities confirmed their love of research and aspirations to be future faculty members. This finding was particularly an encouraging factor for education participants. Having autonomy and flexibility with research was also an encouraging factor to commit to a faculty role. Participants appreciated having control over their research projects and flexibility within their work environments. This finding was true for engineering participants.

Some engineering participants enjoyed the idea of using research to solve problems. These doctoral students became a part of the process with their mentors in solving problems and answering the unknown in their field. Participants viewed their efforts as making contributions to their field, a characteristic they had learned was valued in engineering.

Preparation for and Commitment to a Faculty Career — Discouragers

Some aspects of the research collaborative experience for participants discouraged participants' interest in a faculty role. Some came away from the experience with a less positive view of a faculty role than they had originally envisioned. The competitiveness of the field, duties and expectations of a faculty role, lower priority given to teaching, competing priorities of students, and the lack of interest in research in some way served as discouraging factors for participants considering a future in academe.

The perceived competitive nature of the engineering field also discouraged participants' interest in a faculty role. Some engineering participants saw their mentors applying for grants and how the process involved crafting research that had the potential to contribute something new to the field and at the same time address the funding agency's needs. While participants understood the importance of writing grants for their future success, many felt unprepared to do

so. Participants also expressed frustration with entering the job market with not enough or no publications to their names. The publishing process was perceived as being highly competitive in engineering, providing justification for some participants as an explanation for why they did not have enough or any publications. Several participants were disappointed that they did not have opportunities to teach during their graduate training that would have also prepared them for the faculty role. These participants were discouraged by the low value in teaching that seemed to be reflected in their mentor's behaviors. Perhaps an equally important discouraging factor was the lack of interest in research in general. Engineering participants, in particular, worked on projects that typically related to their mentor's research agenda. While this pre-established research plan has a number of advantages, it has the potential to not encourage creativity and self agency on the students' part because the research ideas were conceived by the mentor and a plan for conducting the research was already set. This caused some participants to lose interest in the projects and become discouraged from doing research.

Difficulty in publishing research, grant funding process, lower priority given to teaching, and lack of interest in research all played a role in discouraging some participants from committing to a faculty role. For these participants, exploring other career opportunities (e.g., industry, teaching universities, etc.) were viable options.

Preparation for and Commitment to a Faculty Career — Factors, But Neither Encouragers or Discouragers

During the research collaborative process with mentors, both education and engineering participants learned the realities of research. The findings that research is time consuming and does not go as planned were significant experiences learned during the research collaborative process, but did not serve as encouragers or discouragers to participants' commitment to a faculty role. For example, participants had to revise research designs, start experiments over from scratch, or extend the research process for months at a time depending on their results or additional revisions needed by the institutional review boards. These factors were a reality of the process that participants now understand and are able to plan for in future research projects.

Disciplinary Differences

Overall, education and engineering participants were more alike than different in their research collaborative experiences. For example, participants in both disciplines learned about

the research process by actually conducting research with their mentors. Participants gained valuable knowledge and improved skills in conceptualizing, designing, and using multiple methods to conduct research. Participants also came away from the experience with improved skills in communicating their research to different audiences and the realities that exist with conducting any research. Participants in both disciplines also learned about the complexities of a faculty role. Participants seemed to be discouraged by the heavy faculty duties, the requirements for promotion and tenure and the time demands placed on faculty. Value differences in teaching and research was also a consistent finding in both disciplines, with some participants preferring teaching as an equally important faculty role as research.

In terms of how the research collaborative relationships formed, it is important to note differences that existed between the disciplines. The biggest difference was in how the relationships were formed. Relationships between doctoral students and faculty mentors were established more informally for education participants and formally for engineering participants. Mentoring relationships for education participants were formed after students were enrolled in their programs. These participants identified faculty members based on similar research interests, similar personal values, or because the mentor was perceived as being approachable, characteristics discovered after interacting with faculty members. The mentoring relationships for engineering doctoral students were formed at the recruiting process as both doctoral students and faculty members were interviewing each other before the student was enrolled in their program.

Research Process

Engineering participants were engaged in research that involved running experiments with the end result of solving problems. This process often involved running experiments over and over and developing new ways to run experiments. For these participants, examining questions and possibilities they had never explored before were skills developed during the research collaborative process. Mentoring in these instances was important to help participants "process" their research.

Grant Preparation

Learning about the grant process was a more significant finding for engineering participants as well. All worked as research assistants for funded projects with their mentors, and

were exposed to the grant proposal writing process. Unfortunately, a majority of the participants articulated not being prepared for this important faculty expectation after leaving their programs and becoming faculty members. Several mentioned this lack of preparation as a missing element on their resumes and a liability in terms of being prepared to secure funding in the future. Being less prepared for grant writing made participants feel less competitive in a field that participants had been socialized to learn was very competitive.

Logic Model

Elements of the socialization process for education and engineering doctoral students promote preparation for and commitment to a faculty role. Based on findings from this study, improved research knowledge and skills and awareness of the complexities of a faculty role constituted "knowledge acquisition" for doctoral students. Specific activities, such as conceptualizing, designing, conducting, and presenting research, to name a few, illustrated doctoral students' "involvement" in the research collaborative mentoring experience. Certain experiences doctoral students engaged in encouraged or discouraged their level of "investment" in the mentoring experience and commitment to a faculty career. The logic model for understanding doctoral student preparation for and commitment to a faculty career is displayed in Figure 3. It summarizes core elements (or outcomes) of the socialization experience.

Elements of the socialization process to a faculty career promote preparation for and commitment to a faculty role for doctoral students in education and engineering. At the left side of Figure 3 are two of the core elements of the socialization process—knowledge acquisition and involvement. Doctoral students in both disciplines acquired the knowledge and skills necessary to implement research projects from start to finish. That is, doctoral students improved their knowledge and skills in their ability to conceptualize research, design research studies, conduct research using multiple methods, and analyze results of their studies. Their knowledge and skills also improved in their abilities to communicate research to various audiences (e.g., academic groups, policy groups, general public). Engineering doctoral students, in particular, became aware that the knowledge and skills they acquired aided in their ability to solve problems or answer the unknown in their fields. Through the mentoring experience, doctoral students learned about the realities that exist in the research process (e.g., research doesn't go as planned, is time consuming, is competitive).

During the research collaborative process, doctoral students in both disciplines also acquired knowledge about faculty roles. They learned the expectations of a faculty role and the requirements of promotion and tenure. This is part of the "knowledge acquisition and involvement" section of the model as it also serves as important aspects of the mentoring process doctoral students in education and engineering were able to learn by becoming engaged with their faculty mentors.

These activities also constitute explicit involvement in the research collaborative experience for doctoral students. In conceptualizing, designing, conducting, analyzing, and communicating research, doctoral students are actively involved in the socialization process of their academic programs and professional identity development. Experiences related to "knowledge acquisition and involvement" are illustrated in connected boxes to capture both core elements.

The right side of Figure 3 illustrates the investment of doctoral students to the mentoring experience and commitment to a faculty career. A desire to learn about research, enjoyment of research, the perceived autonomy and flexibility with research, and conducting problem solving research contributed to doctoral students' higher levels of investment in the mentoring experience and future commitment to a faculty career. The perceived competitive nature of the field, heavy emphasis on research and lower priority given to teaching, the perceived time demands on faculty, lack of interest in research, and competing priorities contribute to doctoral students' lower levels of investment in the mentoring experience and future commitment to a faculty career. Figure 3 displays a complete description of these findings.

Theoretical Framework

The ultimate outcome of the socialization process is the individual's identification with and commitment to the professional role (Austin & McDaniels, 2006; Weidman et al., 2001). Socialization to a faculty career begins at the graduate level as students interact with faculty and peers, learn the norms and expectations of the program and field, and adopt values of the profession (Tierney & Rhoads, 1994; Weidman, et al.; Wulff & Austin, 2004). This study focused on core elements of the Graduate and Professional Socialization Model—knowledge acquisition, investment, and involvement (Weidman et al.). Findings in this study have been informed by the core elements of the model and provide new insight on the socialization of graduate students to faculty careers.

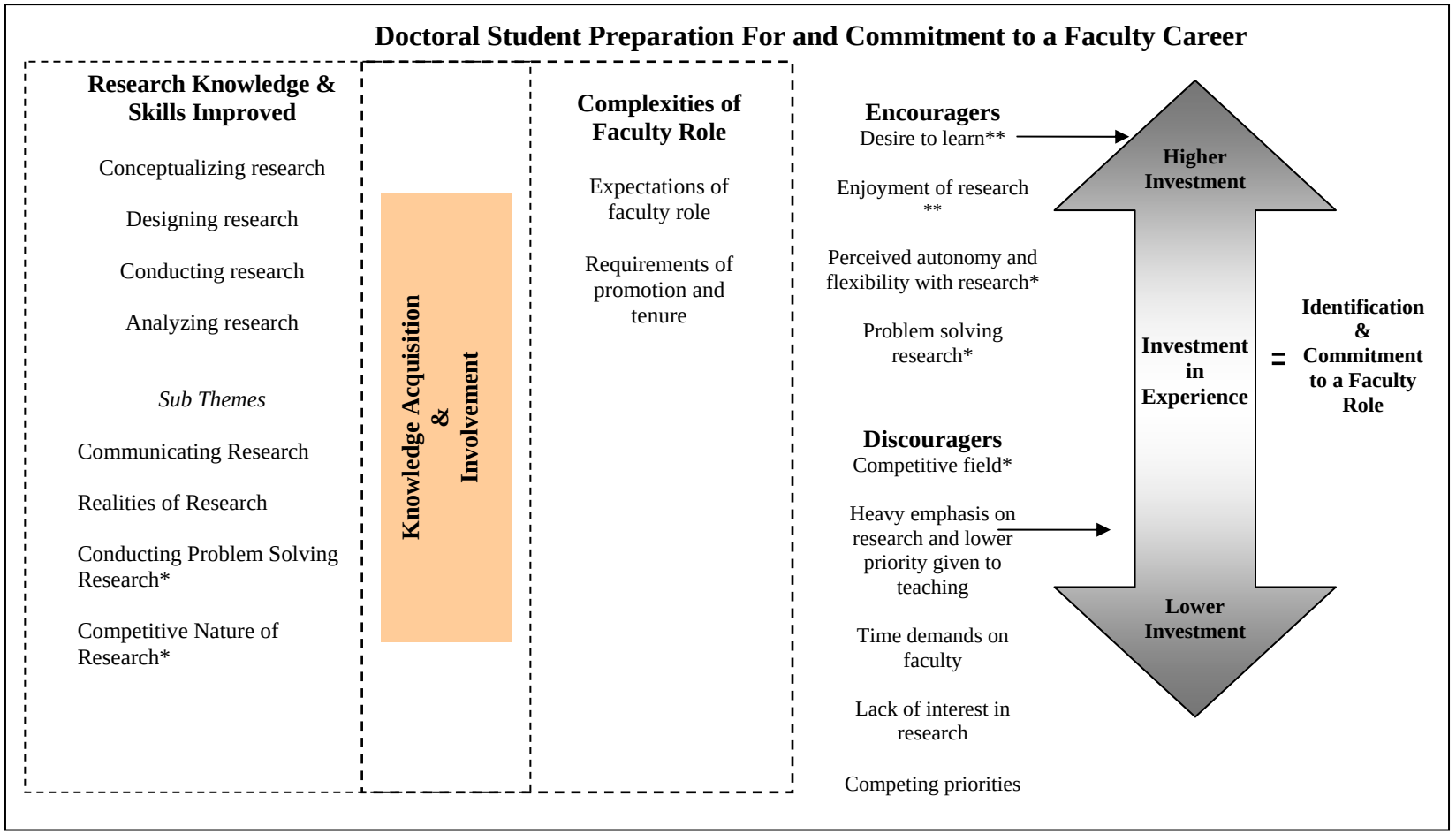

Figure 3. Proposed conceptual framework – An explanatory figure that illustrates key findings and overarching theme.

Note. Proposed framework for understanding doctoral student socialization to research and preparation and commitment to faculty careers illustrates core elements of the socialization experience (knowledge acquisition, involvement, and investment). Research knowledge and skills improved and complexities of a faculty role constitute knowledge acquisition and involvement in the research collaborative experience. These are illustrated in dotted lined boxes that connect two core elements. Certain experiences either encouraged or discouraged varying levels of investment. * indicate findings for engineering doctoral students. ** indicate findings for education doctoral students.

Knowledge acquisition in the graduate school setting involves the "students' ability to understand and acclimate to the academic culture, to meet faculty standards, and to perform expectations after being provided basic and advanced information" (Weidman et al., 2001, p.55). Information can be gained formally and informally by faculty members who serve as primary socializing agents (Tierney & Rhoads, 1994). Consistent with the literature, participants in this study learned what was considered "normative expectations" of the academy through their research collaborative experiences (Austin & McDaniels, 2006; Tierney & Bensimon, 1996; Weidman et al.). Participants learned what is valued in research universities, particularly in their respective fields—research is essential for success and is valued over teaching. Considering these values of the profession, participants chose faculty mentors who would be able to provide opportunities for them to improve their research knowledge and skills. Participants perceived that their knowledge and skills about the research process (conceptualizing, designing, conducting, analyzing, writing, and presenting research) improved. This may enable them to be competent researchers.

During the process of collaborating on research projects, participants were able to evaluate their performance in their roles (Weidman et al., 2001). Several found that they were successful in conceptualizing, designing, conducting, and analyzing research. They concluded that research was an activity they enjoyed. This realization that they could do something that they had not considered doing before was an example of participants' assessing their own skills and abilities, an aspect of knowledge acquisition (Weidman et al.).

Investment, the second core element of the Graduate and Professional Socialization model (Weidman et al., 2001) involves the individual investing time, self-esteem, or something personal to the organization or field in preparation for a professional role (Austin & McDaniels, 2006). Findings from this study revealed that most participants were highly invested in their experiences. Congruent with earlier studies, students who are supported (or sponsored) by a faculty member to guide them through their graduate training or include them on research projects, are more obligated to their mentors and the project itself (Sherlock & Morris; Weidman et al.). Participants in this study had frequent interactions with a faculty member. This frequent involvement could be a possible explanation for participant's describing higher levels of investment in their mentoring experiences. For participants describing lower levels of investment, competing priorities, lack of interest in the research topic, or their inability to make

research a number one priority could be possible explanations for their lower levels of investment in the mentoring relationship.

Investment in the research collaborative relationships and later a commitment to a faculty career increases as some students identify with values of the academy that are consistent with theirs (Tierney & Bensimon, 2002; Weidman et al., 2001). For example, participants who were able to internalize the high value placed on research were able to see themselves committing to the idea of establishing a research agenda as a future faculty member. Others, who valued teaching as equally important as research to a faculty career were not able to fully commit to this value placed on research or "expected norm." For some, exposure to the research process and to faculty members' day-to-day lives, diminished their interest in the research process and pursuing a faculty career.

Various factors motivated individual's investment in the mentoring experience. For education participants, intrinsic motivators, such as "caring" for the research, project, and/or mentoring relationship were all important factors explaining why students invested in the relationships. This notion of "obligation" to the mentor (Weidman et al., 2001) was important in this study. Investment in the mentoring relationship for engineering participants was for career advancement.

Possible explanations for this finding might be due to the cultures of engineering and education disciplines. In engineering, doctoral students are, in a sense, set up early in mentoring relationships through their assistantships. This structure promotes research collaboration from the beginning of doctoral students' graduate training. Doctoral students, as was the case in this study, view their assistantships are jobs, one in which they report to daily from 9 am to 5 pm. The expectation for them is to produce the research. This arrangement may not allow for personal elements to evolve between the doctoral student and the faculty member because the relationship is viewed more professional or "business like." This type of arrangement (set assistantships from beginning of doctoral training) was not present for education participants, suggesting that the culture of their programs was not as formal as was the case in engineering disciplines. Education participants with research assistantships did not describe research as a job.

Involvement, leading to role identification and commitment to the role includes interactions with faculty members and engagement in professional activities (Austin & McDaniels, 2006; Weidman et al., 2001). This is the third "core element" of the Graduate and

Professional Socialization model (Weidman et al.). Consistent with the graduate and professional student socialization conceptual framework, organizational and program structures in graduate programs serve as frames of reference for doctoral students in socializing them to the academic culture and to a professional role (Weidman et al.). Participants in this study interacted frequently with faculty members. All had faculty mentors, a privilege every doctoral student does not have. These close interactions helped build their knowledge about research.

Previous literature on the benefits of faculty-student engagement highlights that interactions with faculty members are important (Brown-Wright, Dubick, & Newman, 1997; Campbell & Campbell, 1997; Kelly & Schweitzer, 2005; Tierney & Rhoads, 1994). These studies, however, do not identify what activities enhance the graduate experience. Still other studies fail to mention what activities help prepare graduate students for particular professional roles (Weidman et al., 2001). What this study provides that is new to the literature is the "what" doctoral students involved in research collaborative experiences actually learn and how this knowledge and skills will prepare them for faculty roles, particularly to the research aspect of faculty roles. The literature states how essential interaction with faculty mentors is (Weidman et al.), but what has become clearer is that students interacting with mentors seem to increase their research knowledge and skills. They are learning how to take the knowledge learned in classrooms or from textbooks and apply it to "real life" settings. Participants gained skills in conceiving research from start to finish, from an idea, to designing research studies, and conducting research using various methods. Participants also learned how to present their research to various audiences and in written form for publication purposes. Participants gained valuable experience attending and presenting at professional meetings. These activities are evidence of involvement for participants, helping them gain better understandings of key features of their profession and academic community. These experiences also helped participants either internalize positively or negatively their professional identity and commitment to their professional role (Weidman et al.).

Another unanticipated finding from this study was that almost half of the participants were being mentored by junior faculty members. Previous literature suggests that pre-tenure faculty members are discouraged from participating in mentoring because mentoring students or other colleagues takes them away from their main duties (teaching and research). The literature situates mentoring as an act that is performed by senior colleagues for junior colleagues

(Johnson, 2007; Luna & Cullen, 1995). In higher education, senior faculty are sought to be mentors because of their experience, expertise, and national prominence in their respective fields. Pre-tenure faculty, on the other hand, are less sought after to be mentors because of the perceived pressures of preparing for promotion and tenure (Tierney & Rhoads, 1994). My findings suggest that junior faculty members are indeed mentoring doctoral students.

Possible explanations for this finding could be that junior faculty members might have had work loads that required assistance from doctoral students. Perhaps, the junior faculty mentors of these participants had the financial resources to support additional assistance from graduate students. This could very well be the case, especially for participants at University A, a private research university. The resources available to faculty members and students could have been more abundant than resources at state funded (or state supported) research universities included in this study (Universities B, C, D, E, F). Another possible explanation for the finding that junior faculty members were mentoring doctoral students could be that these faculty members were still early in their career where they had the time to invest in mentoring. Still another possible explanation could be that faculty mentors of these participants were mentored themselves as graduate students. Perhaps they understood the importance of connecting with faculty members during the graduate experience for the academic and professional experience mentoring could bring later because they were provided with these opportunities. Mentoring their graduate students could have been a way they were "giving back" to the profession, in terms of preparing the future professoriate. Still another possible explanation could be that junior faculty members who were mentors to participants in this study may have been assigned graduate students during the hiring process. Formal graduate or research assistantships may have become mentoring relationships.

Caveats About the Nature of Sample

The advanced level of participants should be considered when interpreting findings from this study. Doctoral students participating in this study were purposely sampled for their previous research experiences and level of graduate training. Participants were considered advanced because they had completed their coursework. Many were entering the dissertation phase of their graduate training, in the middle of the dissertation process, or nearing the end of their dissertation studies. This meant that several participants were engaged in research collaborations that were in addition to their dissertation work or in line with their dissertation work. Doctoral

students participating in this study were highly motivated individuals. For example, all were enrolled in doctoral education, were in mentoring relationships with faculty members in their departments, and had several research collaborative experiences. Participants had experience conducting research, presenting research, and writing about research, experiences every graduate student does not have.

Most of the participants were also very clear about their career goals. Almost all expressed a desire to be a faculty member after completing their graduate studies. This was evident from their responses on the pre-screening survey administered before the interview process. Some participants' career goals changed during the course of their research collaborative experiences, as expressed during the interviewing process. The researcher could have achieved more variability if the sample plan included doctoral students who were not interested in a faculty career.

Implications

Findings from this study have implications for future practice, research, and theory. In terms of practice, several constituencies might benefit from the results of this study, including graduate faculty and deans in graduate schools. Doctoral students enrolled in graduate programs and considering enrolling in graduate programs might also find results of this study useful.

Findings from this research are most directly related to faculty members who supervise research. Graduate faculty serve as primary socializing agents for doctoral students. For those aspiring to a faculty career, graduate faculty can provide explicit opportunities for doctoral students to engage in research collaborative activities. For example, as found in this study, faculty mentors aided in the process of synthesizing research with students and providing time to discuss research with students. In other words, being "present" in the experience with students before, during, and after the research process as opposed to giving students a research assignment and leaving them with little guidance was an instrumental element of the research collaborative relationship.

In terms of the actual research process itself, faculty can be engaged in the process of conducting research together with their students. For example, talking about the process together, analyzing data together, and discussing results of a study are beneficial for doctoral students during this learning process. This also helps doctoral students learn how the process of research

works outside of the classroom setting and textbooks. These were explicit examples participants of this study shared as activities they engaged in with a faculty mentor.

In terms of communicating research to various audiences, it is beneficial for faculty to actually engage in the writing and presenting phase with their students. Most participants in this study articulated having the experience of co-authoring papers with their faculty mentors. This process involved each member writing sections of a paper and then presenting their work at professional meetings, for example. Again, this process proves to be beneficial for doctoral students in improving their presentation and writing skills and overall confidence in their ability to conduct, write about, and present what is considered quality research, as well as creating an awareness of the audiences for their work.

One clear finding from this study was that participants wanted experiences teaching in addition to research because these duties combined were viewed to prepare them for a faculty role. Considering this, graduate faculty can provide opportunities for graduate students to gain experiences leading both undergraduate courses or graduate level seminars under the direction of faculty. An experience of this nature will give graduate students opportunities to design a course syllabi and conduct activities related to preparing the course that faculty engage in on a regular basis.

Lack of preparation for grant writing also seemed to be a concern for some participants. Graduate faculty involved with writing grants can make opportunities available for doctoral students to be a part of this process. For example, graduate faculty may provide doctoral students with opportunities to develop a proposal plan from their own research as if they were applying for a grant. This would give doctoral students the opportunity to write a draft plan of a proposed research idea that they may be able to use in the future as a faculty member. Graduate faculty may also expose their students to grant writing workshops offered by their institutions or outside agencies or companies that doctoral students may attend to learn more about the grant writing process and in some cases, gain certification for attending such training.

Consistent with previous literature, findings from this study document that doctoral students have concerns about their abilities to live a balanced academic life as a future faculty member (Austin, 2002; Golde & Dore, 2001). Faculty members then are in a key position to openly discuss the realities of their working lives and present alternate opportunities for their

students who may desire alternate careers, careers other than faculty positions at research one institutions.

Graduate students and potential graduate students considering faculty careers are a second group that might benefit from findings from this study. This study provides data and insight on the working lives of faculty members. As revealed in this study, participants who once may have held unrealistic views of faculty life, now have a clearer picture of the duties and responsibilities of faculty. Identification and discussion of the faculty duties as perceived by some participants could encourage graduate students and potential graduate students to take a more active role in their career preparation by exploring the complexity of faculty roles in more detail. This will prepare a more informed next generation of faculty.

Graduate programs might find findings from this study beneficial as they explore opportunities to expose doctoral students to all aspects of a faculty career. For example, Preparing Future Faculty programs (PFF) can be instrumental is assisting already busy faculty members who might not be able to provide information about the full scope of faculty roles and duties to their students. PFF programs can complement efforts of graduate programs by providing teaching opportunities, research opportunities, and seminars on faculty roles and responsibilities across disciplines, as well as career options for faculty based on interests, expertise, and institution type.

Findings from this study also have policy implications. Graduate faculty and chairpersons directly involved with creating internal faculty polices might benefit from findings from this study. This study showed that pre-tenured faculty members were engaged in mentoring doctoral students. Faculty, typically are not rewarded for mentoring students during promotion and tenure reviews. Those involved in the promotion and tenure policy process could consider this and implement changes in promotion and tenure policies so that faculty members are rewarded for this important teaching (research mentoring) role. This role can be viewed more of a teaching role than the typical service role it is presently being viewed as. Perhaps if faculty were giving more credit for this service, or mentoring was valued in the promotion and tenure process, more faculty members would serve as mentors to students, thus improving retention and graduation rates of graduate students and ultimately successful socialization of doctoral students in their graduate programs and future professional roles.

In addition to practice and policy implications, this study has implications for future research. The present study considered the investment levels of doctoral students in the mentoring relationship. Investment of faculty mentors was not focused on, although some participants were able to hypothesize why they thought their mentors invested in the relationship. Future research might consider what motivates faculty members to invest in the research collaborative experience with students. Zey's (1991) Mutual Benefits Model of social exchange could be explored to examine in more detail the benefits of the mentoring relationship that occur in higher education for both the doctoral student and faculty mentor. His (Zey) model is appropriate for applying social exchange theory to mentoring in higher education. Additional data are needed from faculty members who are mentors to confirm their levels of investment and reasons for investing in mentoring relationships with their students. It is possible that themes from this study might be enhanced if elements of a social exchange model are added to better understand the holistic and two-way process of mentoring of doctoral students.

In terms of ethnicity and gender, the sample for this study was very diverse. Research questions, however, did not address differences in the experiences of participants by race or gender. Future studies should explore the socialization experiences of male and female doctoral students and doctoral students from various ethnic groups to learn if their socialization to research experiences with faculty mentors are similar or different in any way. In addition, future research examining same-sex and same-ethnicity mentoring, an issue that did not emerge in this study, might be useful in understanding the socialization experiences of students in these types of mentoring relationships.

This study found that both similar and different experiences existed for education and engineering doctoral students engaged in research collaborative relationships with faculty mentors. Previous research examining graduate education focused on the experiences of doctoral students in neuroscience, chemistry, English, and education (Golde & Walker, 2006). This study provides new insight on the socialization of doctoral students to faculty careers in engineering, a discipline not examined in other studies to date (Golde & Walker). While important in providing new insight on socialization to faculty roles for educational researchers and scholars in engineering education, future research might replicate this study to increase the sampling size of engineering doctoral student participants and other program areas of engineering not explored in this study. Future studies may also include an examination of doctoral students in other

disciplines, including the life sciences, humanities, and medical or law disciplines to explore how these students are prepared for the research aspect of faculty roles.

Conclusions

This study identified factors that contributed to the socialization of doctoral students to faculty careers—improved research knowledge and skills, how to communicate research, the realities of research, and the complexities of a faculty role. These factors either contributed positively or negatively to their interest in a faculty role. Doctoral students who were able to invest fully to the research collaborative relationship and identify as a future faculty member were able to express commitment to a faculty career. Those who were not able to invest fully in the research collaborative relationships or identification as a future faculty member were not able to commit to a faculty career.

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APPENDIX A

RESEARCH TOOLS

I. Doctoral Student Socialization Pre-Screening Instrument

Pre-Screening Questionnaire

Doctoral Student Sample

Please answer the following questions by indicating or circling the answer that best describes you. Your responses will be kept strictly confidential.

The following questions will ask you about your graduate program.

1. Indicate your current field of study

_____

a. Specific program

_____

2. Have you completed all course work in your field?

Yes No

3. Have you completed and passed the preliminary exam in your field?

Yes No

4. What month and year did you first enroll in your current program?

_____

5. What month and year do you expect to complete your current program?

_____

The following questions will ask you about your career aspirations.

6. Do you have aspirations of being a faculty member after completion of your degree?

Yes No

7. If you aspire a career in academia as a faculty member, in what field/discipline?

_____

The following questions will ask you about your faculty mentor.

For purposes of this study, a "faculty mentor" is defined as the person who collaborates with the doctoral student on a research project and who the doctoral student and faculty member identify as the person having the most significant role in helping to prepare the student for a faculty role.

8. Do you have a faculty mentor in your field of study?

Yes No

9. What is your mentor's professional status?

a. Full Professor
b. Associate Professor
c. Assistant Professor
d. Adjunct Professor
e. Research Faculty
f. Other (specify)

_____

10. What ethnicity best describes your mentor?

a. African American
b. Asian/Pacific Islander
c. Caucasian/European American
d. Hispanic/Latino(a)
e. Native American
f. Multi-ethnicity
g. Other (specify) _____

11. How long has this person been your mentor?

Years_____ Months_____

12. Indicate the research activities you work with your faculty mentor on. Check all that apply.

a. Research project
b. Writing
c. Publishing
d. Presenting research at local, regional, national, or international conferences

The following questions will ask you about yourself.

13. Please indicate your gender:

a. Female
b. Male

14. Please indicate your age range:

a. 20-30
b. 31-40
c. 41-50
d. 51-60
e. 61 or older

15. Please indicate your ethnicity. Check all that apply.

a. African American
b. Asian/Pacific Islander
c. Caucasian/European American
d. Hispanic/Latino(a)
e. Native American
f. Multi-ethnicity
g. Other (specify)

Return to: saddlert@vt.edu

Thank you!

II. Doctoral Student Socialization Interview Protocol

Interview Protocol
Doctoral Students

Main RQ: What contribution does research collaboration with a faculty mentor play in the socialization of doctoral students in education and engineering committed to a career as a faculty member?

RQ1-What do doctoral students perceive they learn through the process of collaboration with faculty mentors on research projects and how do these vary in engineering and education fields?

Interview Question 1-What kinds of experiences have you had collaborating (in terms of research) as a doctoral student?

Interview Question 2-Describe what you think/feel you have learned by collaborating/working with your faculty mentor on research projects.

Interview Question 3-What do you know now about research that you did not know before?

Interview Question 4-[Probing] Is there anything else you would like to share with me related to your research collaboration experience?

RQ2-What do doctoral students learn about faculty careers through their engagement in research projects with faculty mentors?

Interview Question 5- Describe for me your relationship (with regard to research collaboration) with your faculty mentor.

Interview Question 6-How did you meet/select your faculty mentor and who established the relationship?

Interview Question 7-What qualities about your mentor attracted you to her/him? (about your doctoral student)

Interview Question 8-What would you say motivated you to collaborate on a research project with your faculty mentor?

RQ3- In what positive and negative ways has the mentoring relationship as defined as collaborative research experiences affected doctoral students' interest in faculty roles?

Interview Question 9-What do you know now about a faculty career that you did not know before?

Interview Question 10-What have you learned so far about research that, in your opinion, has prepared you for a faculty role (or not)?

RQ4-How do doctoral students describe their own investment in their mentoring experience?

Interview Question 11- What do you think motivates your mentor to invest in this type of relationship?

Interview Question 12-On a scale of 1 to 10, indicate how much time and effort have you invested in this relationship, with 1 meaning little to no investment and 10 meaning high level of investment? Now, describe what the number you have suggested means.

Is there anything else on these issues that you would like to add, that I did not cover in this interview?

May I follow up with you if I have additional questions?

III. Sample E-mail Invitation to Doctoral Student Sample

Dear [Insert name of Doctoral Student],

My name is Tonya N. Saddler and I am a doctoral candidate in the Educational Leadership and Policy Studies department at Virginia Tech. I am currently conducting a study exploring the socialization experiences of doctoral students to faculty careers. Specifically, I am interested in learning about the research collaboration experiences doctoral students have with their faculty mentors that prepare them for the faculty research role. This study is being conducted under the supervision of Dr. Elizabeth G. Creamer for my dissertation.

You have been identified by your department as a doctoral student aspiring to be a faculty member upon completion of your program. I am inviting you to participate in this study, If you choose to participate in this study, you will be asked to participate in a telephone interview with me. The telephone interview will take approximately 50 to 60 minutes to complete. Prior to the interview, I will administer a pre-screening questionnaire via e-mail to determine your eligibility to participate in this study.

Participation in this study is completely voluntary. As an incentive for participating, each participant will receive a $10 gift card from a local retail store after the data collection process has been completed.

If you have any questions about this research project, please contact me at saddlert@vt.edu or 540.231.7862. Thank you in advance for participating in this study.

Sincerely,
Tonya N. Saddler
Doctoral Candidate
Virginia Polytechnic Institute and State University

IV. IRB Approval Letter

VirginiaTech

Office of Research Compliance
Institutional Review Board
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, Virginia 24061
540/231-4991 Fax 540/231-0959
e-mail moored@vt.edu
www.irb.vt.edu

FWA00000572(expires 1/20/2010)
IRB # is IRB00000667

DATE: October 1, 2007

MEMORANDUM

TO: Elizabeth G. Creamer
Tonya Saddler

Approval date: 10/1/2007
Continuing Review Due Date:9/16/2008
Expiration Date: 9/30/2008

FROM: David M. Moore

SUBJECT: **IRB Expedited Approval:** "Socialization to Research: A Qualitative Exploration of the Role of Collaborative Research Experiences in Preparing Doctoral Students for Faculty Careers in Education and Engineering" , IRB # 07-476

This memo is regarding the above-mentioned protocol. The proposed research is eligible for expedited review according to the specifications authorized by 45 CFR 46.110 and 21 CFR 56.110. As Chair of the Virginia Tech Institutional Review Board, I have granted approval to the study for a period of 12 months, effective October 1, 2007.

As an investigator of human subjects, your responsibilities include the following:

1. Report promptly proposed changes in previously approved human subject research activities to the IRB, including changes to your study forms, procedures and investigators, regardless of how minor. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.
2. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.
3. Report promptly to the IRB of the study's closing (i.e., data collecting and data analysis complete at Virginia Tech). If the study is to continue past the expiration date (listed above), investigators must submit a request for continuing review prior to the continuing review due date (listed above). It is the researcher's responsibility to obtained re-approval from the IRB before the study's expiration date.
4. If re-approval is not obtained (unless the study has been reported to the IRB as closed) prior to the expiration date, all activities involving human subjects and data analysis must cease immediately, except where necessary to eliminate apparent immediate hazards to the subjects.

Important:
If you are conducting **federally funded non-exempt research**, this approval letter must state that the IRB has compared the OSP grant application and IRB application and found the documents to be consistent. Otherwise, this approval letter is invalid for OSP to release funds. Visit our website at http://www.irb.vt.edu/pages/newstudy.htm#OSP for further information.

cc: File

V. Informed Consent Form

Virginia Polytechnic Institute and State University

INFORMED CONSENT FORM FOR PARTICIPANTS

Title of Project: Socialization to Research: A Qualitative Exploration of the Role of Collaborative Research Experiences in Preparing Doctoral Students for Faculty Careers in Education and Engineering

Investigators: Dr. Elizabeth G. Creamer, PI and Tonya N. Saddler, Co-PI and doctoral candidate

I. Purpose of Project
The purpose of this qualitative study is to explore the research collaboration experiences doctoral students have with their faculty mentors to better understand how such collaborations contribute to the socialization of doctoral students to the faculty research role. Doctoral student socialization refers to the process by which individuals acquire knowledge and skills necessary to become members of the academic community. Doctoral students are defined as graduate students at a research university who were enrolled full time in a doctoral program and who had completed their course work. Research collaboration refers to the engagement of research related activities (research project, writing, presenting, etc.). Faculty mentors are defined as the faculty member who collaborated with the doctoral student on a research project and who the doctoral student and the faculty member identified as the person having the most significant role in helping prepare the student for a faculty career.

II. Procedures
Participants will complete a telephone interview for approximately 45 minutes to one hour with the co-investigator. The interview will be voice taped and transcribed verbatim.

The interviews will follow a semi-structured protocol. Questions are designed to assess various aspects of the doctoral student socialization process that involve research collaboration with faculty mentors and aspects of the mentoring relationships.

III. Risks & Benefits
There are no more than minimal risks involved in participating in this project. The interview may cause anxiety as participants think about some of the issues being raised. Participants may reflect on positive aspects of their doctoral training. This may evoke deeper reflections of personal experiences. There is the possibility of participants to reflect on negative experiences in their programs as well.

IV. Anonymity & Confidentiality
Results will be kept confidential. Neither your name nor any other personal identifier will be associated with the information you supply. The researchers listed above are trained in procedures for ensuring confidentiality. Personal identifiers, such as proper names, will be removed from interview transcripts. Transcripts will then be identified and stored by a pseudonym/number code. Tapes and transcripts from the interviews will be kept in a secure place. Only the researchers will have direct access to interview transcripts. Tapes and transcripts will be destroyed at the end of the project.

V. Compensation
You will receive a $10 gift card to a retail store after the interview has been completed for participating in this study.

VI. Freedom to Withdraw
You are free to withdraw at any time without penalty. You may ask that the tape recorder be turned off at any time during the interview.

VII. Informed Consent
Participants will receive a copy of the consent form [generally electronically] prior to the interview and asked to indicate their agreement with the stated conditions.

This research project has been approved by the Institutional Review Board for Research Involving Human Subjects at Virginia Tech.

VIII. Participants Responsibilities
I voluntarily agree to participate in this study.

IX. Participant's Permission

I have read and understand the Informed Consent Form for Participants and the conditions of this project. I have had all of my questions answered. I hereby acknowledge the above and give my voluntary consent to participate in this project.

_____

Participant signature Date

Should you have pertinent questions about this research project or its conduct, contact the investigators, Dr. Elizabeth G. Creamer at creamere@vt.edu, or Tonya N. Saddler at saddlert@vt.edu.

Dr. Elizabeth G. Creamer & Tonya N. Saddler — 540.231.8441/540.231.7682
Investigators

Dr. Elizabeth G. Creamer — 540.231.8441
Faculty Advisor

David M. Moore — 540.231.4991 moored@vt.edu
Chair, Virginia Tech Institutional Review Board — Telephone/e-mail
For the Protection of Human Subjects
Office of Research Compliance
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, VA 24060

APPENDIX B

TABLES

Table 5

Summary of Demographics of Sample Participants by Institution

Demographics	University A	University B	University C	University D	University E*	University F*
Discipline						
Education	5	5	0	5	4	1
Engineering	5	5	5	5	0	0
Gender						
Male	6	4	5	6	2	0
Female	4	6	0	4	2	1
Ethnicity						
Asian/Pacific Islander	2	0	1	1	0	0
Black/African American	1	1	0	1	0	1
Caucasian/European American	5	7	2	6	2	0
Hispanic/Latino/a	0	1	2	2	2	0
International	2	0	0	0	0	0
Multi-ethnicity	0	0	0	0	0	0
Did not identify	0	1	0	0	0	0
Age						
20-30	9	6	3	4	3	1
31-40	1	4	2	5	1	0
41-50	0	0	0	1	0	0
Year in Program						
2	4	1	1	0	1	0
3	2	5	2	1	1	1
4	4	1	1	5	2	0
5	0	3	1	3	0	0
Beyond 5	0	0	0	1	0	0

Note. Indicates additional institutions used to recruit sample participants or to diversify the sample gender and ethnicity wise.

Table 6

Matrix of Education Findings for Research Question One and Sources (n=20)

Themes	Marlene	Jamie	Jessica	Adam	Alex	Steven	Bradley	Erica	Isabelle	Vickie
1. Research process	X	X	X	X	X	X	X	X	X	X
2. Communicating research	X	X	X	X		X	X	X	X	
3. Realities of research		X		X	X				X	
Themes	**Nolan**	**Josie**	**Angela**	**Norman**	**Peter**	**Anna**	**Patrick**	**Joy**	**Elise**	**Lilly**
1. Research process		X	X	X	X	X	X	X	X	X
2. Communicating research	X	X	X	X		X	X	X	X	
3. Realities of research	X		X		X	X		X		X

Note. X indicates participant offering comment related to theme

Table 7

Matrix of Engineering Findings for Research Question One and Sources (n=20)

Themes	Jacob	Wanda	Chris	Doug	Martin	Melanie	Kelsey	Rahim	Jason	Joyce
1. Conducting problem solving research	X	X	X			X	X	X	X	X
2. Communicating research		X					X	X		X
3. Realities of research - Competitive nature of research	X	X	X	X		X	X		X	

Themes	David	Amy	Tom	Bruce	Iggy	Lee	Alejandro	Coco	Terry	Huy
1. Conducting problem solving research		X	X	X	X	X	X		X	X
2. Communicating research	X		X	X	X	X	X	X		X
3. Realities of research- Competitive nature of research			X	X	X	X	X	X		

Note. X indicates participant offering comment related to theme

Table 8

Matrix of Education Findings for Research Question Two and Sources (n=20)

Themes	Marlene	Jamie	Jessica	Adam	Alex	Steven	Bradley	Erica	Isabelle	Vickie
1. Complexities of faculty role	X	X		X	X	X	X	X	X	X
2. Requirements of tenure process		X	X	X	X	X				X
Themes	**Nolan**	**Josie**	**Angela**	**Norman**	**Peter**	**Anna**	**Patrick**	**Joy**	**Elise**	**Lilly**
1. Complexities of faculty role	X				X		X	X		X
2. Requirements of tenure process	X	X	X	X	X					X

Note. X indicates participant offering comment related to theme

Table 9

Matrix of Engineering Findings for Research Question Two and Sources (n=20)

Themes	Jacob	Wanda	Chris	Doug	Martin	Melanie	Kelsey	Rahim	Jason	Joyce
1. Complexities of faculty role		X		X	X		X		X	X
2. Requirements of tenure process							X		X	

Themes	David	Amy	Tom	Bruce	Iggy	Lee	Alejandro	Coco	Terry	Huy
1. Complexities of faculty role		X		X	X	X	X			
2. Requirements of tenure process					X					

Note. X indicates participant offering comment related to theme

Table 10

Matrix of Education Findings for Research Question Three and Sources (n=20)

Themes	Marlene	Jamie	Jessica	Adam	Alex	Steven	Bradley	Erica	Isabelle	Vickie
1. Positive Affect	X	X	X	X	X	X	X	X		
2. Negative Affect									X	X

Themes	Nolan	Josie	Angela	Norman	Peter	Anna	Patrick	Joy	Elise	Lilly
1. Positive Affect	X	X		X	X	X	X	X		
2. Negative Affect			X		X				X	X

Note. X indicates participant offering comment related to theme

Table 11

Matrix of Engineering Findings for Research Question Three and Sources (n=20)

Themes	Jacob	Wanda	Chris	Doug	Martin	Melanie	Kelsey	Rahim	Jason	Joyce
1. Positive Affect	X						X	X		X
2. Negative Affect	X	X	X	X	X	X			X	

Themes	David	Amy	Tom	Bruce	Iggy	Lee	Alejandro	Coco	Terry	Huy
1. Positive Affect	X	X		X	X	X	X	X	X	X
2. Negative Affect		X	X							

Note. X indicates participant offering comment related to theme

Table 12

Matrix of Education Findings for Research Question Four and Sources (n=20)

Themes	Marlene	Jamie	Jessica	Adam	Alex	Steven	Bradley	Erica	Isabelle	Vickie
Level of investment	8	10	8	10	10	9	9	8	9	5
Themes	Nolan	Josie	Angela	Norman	Peter	Anna	Patrick	Joy	Elise	Lilly
Level of investment	10	10	10	7.5	8	10	9	8	4	9.5

Note. X indicates participant offering comment related to theme
Degree of investment=1 means little to no investment, 10 means a high level of investment

Table 13

Matrix of Engineering Findings for Research Question Four and Sources (n=20)

Themes	Jacob	Wanda	Chris	Doug	Martin	Melanie	Kelsey	Rahim	Jason	Joyce
Level of investment	8	9	9	7	8	10	9	8	9	8
Themes	David	Amy	Tom	Bruce	Iggy	Lee	Alejandro	Coco	Terry	Huy
Level of investment	9	8	8	9	9	7	8	9	8	8

Note. X indicates participant offering comment related to theme
Degree of investment=1 means little to no investment, 10 means a high level of investment

Table 14

Coding Matrix of findings from Education Data (to be read from the bottom up)

Code mapping for Knowledge acquisition, involvement, and investment in research collaborative experience with faculty mentor (Research Questions 1, 2, 3, 4)

RQ1: Perceived Learning About Research?
RQ2: Learning About Faculty Careers?
RQ3: Factors Contributing to Interest in Faculty Role?
RQ4: Investment in Mentoring Experience?

Fourth Iteration: Overarching theme/conclusion

By "living and doing" the research collaborative experience with faculty mentors, doctoral students in education disciplines discovered if the experience fit their values. With this highly invested group, in a majority of cases, the research collaborative experience seemed to reinforce an interest in a faculty career because they shared similar values about research. These "learn by doing" experiences helped shape their professional identity.

In a minority of cases, the research collaborative experience seemed to discourage a faculty career because of dissimilar values about research in a faculty career. These experiences consequently encouraged doctoral students to reconsider research intensive faculty careers as a viable option.

Third Iteration: Analytical Propositions

RQ1

1. Through interaction with faculty mentors, doctoral students in education disciplines perceive that their research skills and knowledge to conduct research improved. Interaction with faculty mentors was important in helping guide the student through the research process and in synthesizing/processing research.

RQ2

2. Doctoral students in education disciplines engaged in collaborative research experiences with their faculty mentors learn about the complex duties and responsibilities of faculty members that reach beyond teaching and research duties.
3. Doctoral students in education disciplines engaged in collaborative research experiences with their faculty mentors learn about the expectations for a faculty role that include the requirements for promotion and tenure.

(Table continued)

Table 14 (continued)

RQ3

4. Certain factors positively contributed to doctoral students' in education disciplines interest in a faculty career. Enjoyment of research and the discovery that it is something they are capable of doing positively contributed to doctoral students' interest in pursuing a faculty career.
5. Certain factors negatively contributed to doctoral students in education disciplines interest in a faculty career. Disappointment by the heavy emphasis on research and lower priority given to teaching in the academy and the responsibilities and time demands placed on faculty made the prospects of a faculty career unattractive.

RQ4

6. Levels of investment in the research collaborative experience for education doctoral students vary because of competing interests and activities and lack of interest in research.
7. Education doctoral student's level of investment has personal elements. Investment is related to commitment to the mentoring relationshipand the mentor's investment in the doctoral student.

Second Iteration: Pattern Variables

RQ1	RQ2	RQ3	RQ4
Research process	Complexities of faculty role	Positive Affect	High Commitment
Communicating research	Requirements of Tenure process	Negative Affect	Moderate Commitment
Realities of research			

First Iteration: Initial Codes/Surface Content Analysis

RQ1		RQ2	RQ3	RQ4
Conducting research		Politics	*Positive*	0-7
Designing research	Complexity	Balancing work and family	Role model; Self actualizing	Fair amount of time and effort
Research methods	Iterative nature	Promotion and tenure	Faculty career is doable;	
Publishing process		Daily responsibilities	Autonomy with research	8-10
Presenting research	Writing research findings	Amount of work involved	*Negative*	Time and effort beyond
Doesn't go as planned		Importance of collaboration	Faculty career is not realistic	assistantship hours
Time consuming			Less focus on teaching;	
			Mentoring not valued;	
			Expectations of faculty	

DATA	DATA	DATA	DATA

Note: Four iterations of data analysis moving from codes, to categories, to themes, to overarching conceptual explanation. Table to be read from the bottom up.

Source: Anfara, V. A., Brown, K. M., Mangione, T. L. (2002). Qualitative analysis on stage: Making the research process more public, *Educational Researcher, (2)* 31, 28-38.

Table 15

Coding matrix of Findings from Engineering Data (to be read from the bottom up)

Code mapping for Knowledge acquisition, involvement, and investment in research collaborative experience with faculty mentor (Research Questions 1, 2, 3, 4)

RQ1: Perceived Learning About Research?
RQ2: Learning About Faculty Careers?
RQ3: Factors Contributing to Interest in Faculty Role?
RQ4: Investment in Mentoring Experience?

Fourth Iteration: Overarching theme/conclusion
By conducting "problem solving" research during the research collaborative experience with faculty mentors, engineering doctoral students discovered their capabilities to contribute innovative research to the field that is highly competitive in addition to gaining perseverance during the research process. In a majority of cases, the research collaborative experience confirmed their career aspirations to join the professoriate. In a minority of cases, the research collaborative experience seemed to discourage a faculty career because of dissimilar values about the role of research and teaching in a faculty career and feelings of ill preparedness to be successful in a faculty career. These experiences consequently encouraged doctoral students to explore other career options.
Third Iteration: Analytical Propositions
RQ1
1. Through interaction with faculty mentors, doctoral students in engineering disciplines perceived that their research skills and ability to critically approach research improved.
RQ2
5. Doctoral students in engineering disciplines engaged in collaborative research experiences with their faculty mentors learn about the complex duties and responsibilities of faculty members that reach beyond teaching and research duties. 6. Doctoral students in engineering disciplines engaged in collaborative research experiences with their faculty mentors learn about the expectations for a faculty role that include promotion and tenure.
RQ3
7. Certain factors of the research collaborative relationship with faculty mentors positively contributed to doctoral students' (in engineering disciplines) interest in a faculty career The perceived flexibility and autonomy with research. 8. Certain factors of the research collaborative relationship with faculty mentors negatively contributed to doctoral students' (in

engineering disciplines) interest in a faculty career. The perceived pressures of a competitive field and the lower priority given to teaching in the profession made the prospects of a faculty career unattractive.

RQ4

9. Levels of investment in the research collaborative experience with faculty mentors for engineering doctoral students are above average, but on occasion vary due to competing interests or activities and lack of interest in research.
10. Engineering doctoral students' level of investment is for professional reasons. The main motivation for being highly invested in the research collaborative experience is for career advancement.

Second Iteration: Pattern Variables

RQ1	RQ2	RQ3	RQ4
Research process Communicating research Realities of research Conducting problem solving research Competitive nature of research	Complexities of faculty role Requirements of Tenure process	Positive Affect Negative Affect	High commitment

First Iteration: Initial Codes/Surface Content Analysis

RQ1		RQ2	RQ3	RQ4
Conducting research			*Positive*	
Complexity	Grants	Politics of faculty career	Flexibility of faculty role	7-10
Publishing process	Translational work	Promotion and tenure	Autonomy with research	Time and effort beyond assistantship hours
Answering unknown		Daily responsibilities of faculty		
Cutting edge research		Administrative aspect of career	*Negative*	Trade off between research and non-research activities
Takes a bit of luck		Amount of work involved	Competitive field	
Community driven		Importance of securing grants	Expectations of faculty	

DATA	DATA	DATA	DATA

Note: Four iterations of data analysis moving from codes, to categories, to themes, to overarching conceptual explanation. Table to be read from the bottom up.
Source: Anfara, V. A., Brown, K. M., Mangione, T. L. (2002). Qualitative analysis on stage: Making the research process more public, *Educational Researcher, (2)* 31, 28-38.

Table 16

Coding Dictionary—Complete list of codes, categories, and definitions

Code Name	Code Description
Conducting research	The act of analyzing data, interviewing participants, conducting literature searches, running experiments participants engaged in
Designing research	Conceptualizing a research study from beginning to end
Research methods	Involves the process of designing a research project and the process of conducting research
Publishing process	Involves the process of writing scholarly/research work for publication purposes in journals or reports
Presenting research	Involves the process of presenting orally scholarly/research findings to various audiences (professional associations, granting agencies, secondary or post secondary communities)
Doesn't go as planned	Occurrences in the research process that were not planned and/or led the research process in a different or unexpected direction
Time consuming	The length of the research process that required additional time on the part of the researcher to put into the project
Complexity of research	Involves the ability to manage the work load and tasks involved with research, the challenging nature of research, how time consuming research can be, and the unexpected nature of research
Iterative nature	Involves the continuous nature of the research process (e.g., various stages of the research process)
Writing research findings	The process of writing findings from research projects in manuscript form
Answering unknown	The process of conducting research that involves solving a problem that is unknown in a particular field
Research takes luck	The nature of the research process that appears to happen by chance
Community driven research	Research that is driven by issues important to a local community
Grant process	Involves the process of learning about grant funding, writing proposals to secure external funding to support research

Translational work	Involves research that is conducted that has the potential to apply to (or translate to) a different setting (work setting, secondary education, postsecondary education, etc.)
Politics	Term used by participants to describe interactions among faculty, perceived bureaucracy in the academy, or a culture of a department/program that appeared less harmonious, cliquish
Balancing work & family	Involves the individuals' ability to balance responsibilities of work and personal life
Promotion and tenure	Involves the promotion process of faculty members that leads to the granting of tenure after several years of service, scholarly activity, and teaching
Daily responsibilities	Involves the routine, daily activities faculty members are engaged in
Amount of work	Involves the amount of work (i.e., quantity) faculty members are involved in
Collaboration	Involves the activity of working with another faculty member on research related projects
Flexibility of faculty role	The perceived freedom and ability to control the work schedule and environment of a faculty member
Autonomy with research	The perceived amount of agency faculty members have with their research
Competitive field	Includes research that is cutting edge or the pressure/importance of publishing research or securing grant funding
Expectations of faculty	Includes all duties faculty members are expected to perform (e.g., teaching, research, service, advising, consulting, administrative duties, etc.) or that come with a faculty role
Role model	Term participants used to describe their faculty members as individuals they wanted to be like as a future faculty member
Self actualizing	Doctoral student's realization that they could perform a research task or that they could envision themselves in a faculty role
Faculty career-doable	Doctoral student's realization that they could see themselves being faculty members and that a faculty role was manageable

Faculty career-not realistic	Doctoral student's realization that they could not see themselves being faculty members and that a faculty role did not seem manageable
Less focus on teaching	Perceived value doctoral students saw (faculty members valuing research over teaching) during their research collaborative experiences
Mentoring not valued	Perceived value doctoral students saw during their research collaborative experience
Investment-Fair amount of time and effort	A significant amount of time and effort given to the research collaborative experience
Investment-Time and effort beyond assistantship	A maximum amount of time and effort given to the research collaborative experience that was above the time and effort given to assistanships
Investment-Trade off between research and non-research activities	The amount of time and effort proportioned equally to the research collaborative experience and other non-research related activities the doctoral student was involved in

Notes. Coding dictionary includes definitions for initial codes and categories developed during analysis

APPENDIX C

REPUBLICATION PERMISSION FORM

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A01_First_Name: Tonya
A02_Last_Name: Saddler
A03_Company_Name: Virginia Tech
A04_Address: 900 Houndschase Lane, NW Unit A
A05_City: Blacksburg
A06_State: Virginia
A07_Zip: 24060
A08_Country: USA
A09_Contact_Phone_Number: 540-552-2837
A10_Fax: 540-231-1991
A11_Emails: saddlert@vt.edu
A12_Reference:
A13_Book_Title: Socialization of graduate and professional students in higher education: A perilous passage?
A40_Book_or_Journal: Book
A14_Book_Author: John C. Weidman, Darla J. Twale, Elizabeth L. Stein
A15_Book_ISBN: 0-7879-5836-0
A16_Journal_Month: N/A
A17_Journal_Year: N/A
A18_Journal_Volume: N/A
A19_Journal_Issue_Number: N/A
A20_Copy_Pages: 37
A21_Maximum_Copies: 1
A22_Your_Publisher: VT (dissertation research)
A23_Your_Title: Socialization to Research: A Qualitative Exploration of the Role of Collaborative Research Experiences in Preparing Doctoral Students for Faculty Careers in Education and Engineering
A24_Publication_Date: 2008
A25_Format: print
A31_Print_Run_Size:
A41_Ebook_Reader_Type:
A26_If_WWW_URL:
A27_If_WWW_From_Adopted_Book:
A28_If_WWW_Password_Access: No
A45_WWW_Users:
A29_If_WWW_Material_Posted_From:
A30_If_WWW_Material_Posted_To:
A42_If_Intranet_URL:
A32_If_Intranet_From_Adopted_Book:
A33_If_Intranet_Password_Access: No
A48_Intranet_Users:
A34_If_Intranet_Material_Posted_From:
A35_If_Intranet_Material_Posted_To:
A36_If_Software_Print_Run:
A37_Comments_For_Request:

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