PREDICTIVE RELATIONSHIPS AMONG LEARNER CHARACTERISTICS, ACADEMIC INVOLVEMENT, AND DOCTORAL EDUCATION OUTCOMES

Baaska Anderson, B.S., M.Ed

Dissertation Prepared for the Degree of

DOCTOR OF PHILOSOPHY

UNIVERSITY OF NORTH TEXAS

December 2011

APPROVED:

Marc Cutright, Major Professor
Lin Lin, Minor Professor
Ron Newsom, Committee Member
Robin K. Henson, Committee Member
Janice Holden, Chair, Department of Counseling and Higher Education
James D. Meernik, Acting Dean of the Toulouse Graduate School

Anderson, Baaska. Predictive Relationships among Learner Characteristics, Academic Involvement, and Doctoral Education Outcomes. Doctor of Philosophy (Higher Education), December 2011, 117 pp., 13 tables, 4 figures, reference list, 91 titles.

The literature identifies multiple factors pertinent to learner characteristics and learning experiences that may promote doctoral education outcomes, and yet little quantitative research has examined relationships between those factors deemed important in the effectiveness of doctoral education. This study sought to examine predictive relationships among doctoral students' learner characteristics, their involvement in mentorship and intellectual community, and doctoral education outcomes. Using Astin's theory of involvement and the literature on signature pedagogies in doctoral education as conceptual guides, a survey instrument was constructed for the purpose of measuring variables identified as relevant to the effective formation of scholars. Central to the conceptualization of this study was academic involvement as represented by mentorship and intellectual community. The instrument was validated in a two-stage pilot testing process and administered to doctoral candidates at three public Texas higher education institutions. Of the 217 participants, the majority were female, White (Non-Hispanic), US citizens, and were pursuing education doctorates. Data were analyzed using multivariate statistical analyses. Reliability and validity estimates indicated psychometric integrity of the 20 observed variables measured to represent the constructs of mentorship and intellectual community. Results indicated that doctoral students' learner characteristics were not notably predictive of doctoral students' degree of involvement in mentorship and intellectual community ($p < .05$, $R^2 = .23$). Doctoral students' degree of academic involvement was strongly predictive of outcomes ($p < .001$, $R^2 = .58$), particularly student satisfaction with the doctoral education experience and self-efficacy in conducting various forms of scholarly work. Of this effect, more

tangible outcomes such as scholarly productivity and degree progress were not meaningfully related to academic involvement. Regardless of the frequency of academic involvement, students perceived faculty mentorship and intellectual community as very important. The predictive value and perceived importance of faculty mentorship and intellectual community highlight the critical role faculty and peer support plays in the doctoral learning experience, and imply that such teaching and learning practices should be promoted in doctoral education. Considering that satisfaction and self-efficacy tend to be related to other educational outcomes, those concerned with the overall quality of doctoral education should focus increased attention on building collegial, effective, productive relationships among and within program communities.

ACKNOWLEDGEMENTS

The completion of this dissertation is a function of who I am as an individual, which collectively represents not only my educational experiences, but the full curriculum of life. Therefore, without a doubt, a project of this magnitude represents the inputs and efforts of many individuals, including my faculty and mentors, family and friends, and fellow doctoral students. My explicit appreciation goes to those who were immediately responsible for the completion of this project. To begin, a sincere thanks to my mentor and chair Dr. Marc Cutright, who supported my development as a student and a professional since I began the program, and offered much advice, guidance, and expertise that helped shape this dissertation. I also thank Dr. Ron Newsom, whose thoughtful observation and insight aided my critical and reflective instincts. From Dr. Robin Henson, who served on my committee as a methodologist, I developed an appreciation of the importance of context in quantitative reasoning, an understanding without which my capacity as a scholar would be limited. Dr. Lin Lin has been both a source of motivation and a role model, and has helped me to explore different perspectives. For this, I am very grateful.

Words cannot express my appreciation to my husband Stoerm Anderson, whose endless encouragement and support carried me through many difficulties. He has been a tremendous source of mentorship and intellectual community, and I thank him for being my mentor, colleague, and best friend. For his companionship and love, I am truly blessed. Ultimately, this accomplishment reflects the foundation laid by my parents, Byambaanyam and Tuul, for their provision of seemingly endless opportunities to develop throughout my life.

Finally, I thank my fellow peers who were instrumental in developing and refining my survey instrument. I particularly want to acknowledge David Holland, Tip Robertson, Starr Hoffman, and Annie Downey for their valuable insights and the time they invested in my work.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER 1

INTRODUCTION

Statement of the Problem

Although research on doctoral education has emerged rapidly over the past two decades, a majority of these efforts have been exploratory in nature. Greater accountability and efficiency in higher education has created increased interest in assessing educational effectiveness by measuring desired educational outcomes and in identifying the factors that promote those outcomes. Research, practice, and policy-oriented communities have focused on such doctoral education outcomes as degree completion, time-to-degree, career outcomes, scholarly capacity and productivity (Bowen & Rudenstine, 1992; Council of Graduate Schools, 2009; Gardner, 2008a, 2010; Golde, 1998, 2000, 2005; Lovitts, 2001, 2005; Texas Higher Education Coordinating Board, 2009).

Prior research has identified several factors pertinent to learner characteristics and learning experiences that may promote doctoral education outcomes. Gardner's (2009) study, for example, identified several learner characteristics, such as agency, effort, intellectual ability, and prior experience as important in success in doctoral education. In addition, a large-scale action research project by Walker, Golde, Jones, Bueschel, and Hutchins (2008) suggested two learning experiences, apprenticeship and intellectual community, as crucial types of collaboration in the formation of scholars. However, little research has examined relationships between these factors deemed important in the effectiveness of doctoral education in a comprehensive manner. The problem addressed in this study was the need to explore the relationships between learner characteristics, students' degree of academic involvement, and doctoral education outcomes identified as relevant to the effectiveness of doctoral education.

Purpose of the Study

Given the stated problem, the purpose of the proposed study was to explore the relationships among doctoral students' learner characteristics, academic involvement, and doctoral education outcomes for students pursuing research doctorate at public higher education institutions in the State of Texas. In particular, this study intended to 1) explore the predictive relationship between doctoral students' learner characteristics and academic involvement, as measured by mentorship and intellectual community, and to 2) explore the predictive relationship between doctoral students' academic involvement, as measured by mentorship and intellectual community, and doctoral education outcomes.

Research Questions

The following research questions were addressed in this study:

1. Which, if any, learner characteristics are predictive of doctoral students' academic involvement, as measured by mentorship and intellectual community?
2. Is doctoral students' academic involvement, as measured by mentorship and intellectual community, predictive of doctoral education outcomes?

Significance of the Study

Significance of this study lies in identifying the relative importance of factors that are deemed to be effective in promoting desired educational experiences and outcomes in doctoral education. Although a number of factors have been identified as important in promoting desired doctoral education experiences and outcomes, there is a paucity of quantitative evidence that has tested their relative salience using multivariate statistics. Identifying the relative salience of various learner characteristics on doctoral students' degree of academic involvement, and of doctoral students' academic involvement on different educational outcomes will help refine the literature, informing research, policy, and practice-oriented communities concerned with the

effectiveness of doctoral education in the United States. Most importantly, the findings of this research will inform both doctoral program and individual faculty efforts to improve their educational practices.

Delimitations

Several delimitations have been imposed on this study. The target population this study intends to generalize to is doctoral candidates pursuing research doctorate degrees at three public higher education institutions in north Texas. North Texas was chosen because this region has the highest concentration of public institutions that grant doctoral degrees in the state of Texas.

Another delimitation of the study is the sampling of students pursuing research-oriented doctoral degrees only. Compared to first-professional and/or practice-only oriented doctorate degrees, research-oriented doctorate degrees certify awardees with relatively defined set of competencies as a scholar, centered around knowledge generation, communication, integration, and application. Therefore, the population parameter will be delimited to the following research doctorates as defined by the Survey of Earned Doctorates, including PhD, DA, DBA, DDes, DEng, DFA, DHL, DMA, DME, DML, DNSc, DPH, DSc/ScD, EdD, JCD, and ThD. This study will sample doctoral candidates pursuing above research doctorate degrees offered at the participating institutions.

The third delimitation of the study is the sampling of doctoral candidates, or those who have successfully completed coursework and passed examinations or other milestones that result in advancement to doctoral candidacy. Doctoral candidates will have experienced pre-dissertation or pre-capstone curricula that are intended to equip them with the capacity to function as independent scholars. Therefore, given that they are in the process of demonstrating

their capacity as scholars, doctoral candidates will be able to reflect on their recent past and/or current experiences pertinent to the doctoral education outcomes measured in this study.

Limitations

One limitation of this study was that it examined relationships among learner characteristics, degree of academic involvement, and doctoral education outcomes by asking doctoral students to self-report on these variables and constructs. Self-reporting may be problematic for several reasons. For objective measures such as number of conference presentations and publications produced during doctoral education, doctoral students may have provided inaccurate counts of these outcomes, especially in the case of those who have had a number of such experiences and may be unable to recall the exact number. Furthermore, many of the outcomes were assessed from students' perceptions. It is possible that students' perceptions of their own abilities may be inaccurate, or that temporary states or contexts could influence their overall perceptions of their doctoral education experience. Temporary problems in relationships with faculty mentor at the time of measurement, for example, may result in responses less representative of the doctoral education experience as a whole than would be the case if the measurement was taken at another time.

This study is further limited by the exclusion of faculty and program characteristics from the study. Program structures, such as faculty-student ratio, faculty workload, faculty productivity, nature and degree of funding available for students, and curriculum requirements for degree completion, are conceptualized as a program environment that helps shape student involvement and outcomes. However the variety and complexity of formal degree requirements calls for more qualitative approaches to measurement, and are best addressed by the faculty and administrators of doctoral programs than by doctoral students in those programs.

Definition of Terms

Six terms must be explicitly defined in this study: learner characteristics, academic involvement, mentorship, intellectual community, doctoral education outcomes, and research doctorate. *Learner characteristics* are defined as sets of attributes doctoral students bring with them to doctoral study, and possess during doctoral study, which may influence the doctoral education experience. These characteristics include the following attributes: self-direction, willingness to work hard, prior experience with synthesizing literature and research process, prior content knowledge, family and friend support for doctoral study, home responsibility, financial support assistance, educational debt, and graduate assistantship.

Academic involvement is defined as exchange of intellectual and professional resources among a community of scholars in service of promoting learning and development of doctoral students. Academic involvement can take a number of forms, ranging from program communities working together on a defined work of scholarship to simply exchanging ideas and feedback on each other's scholarship. For the purposes of this study, academic involvement was defined as occurring between faculty and students, and/or between doctoral students and their peers in formal and informal settings. Mentorship and intellectual learning community were the two forms of academic involvement this study addressed.

Mentorship was defined as a teaching and learning experience where a doctoral student enters a formal or informal relationship with one or more faculty who intentionally promote student learning and development as a researcher and scholar by involving them in experiential learning of scholarship, by guiding and offering feedback on students' work, and/or by supporting students navigate through the doctoral program. As such, multiple dimensions represented mentorship as a construct. This definition and representation was derived from

Brown, Collins, and Duguid's (1989) discussion on ways of learning, and later advanced by Walker et al. (2008) in their work on doctoral student development.

The specific indicators of mentorship were operationalized based on Walker and colleagues' discussion of apprenticeship. Although the researchers utilized the concept of *apprenticeship*, pilot test results of this study suggested the need to transform the concept into a broader and more familiar term to doctoral students, *mentorship* or *faculty mentorship*. The following definition of mentorship was provided to students in the survey instrument: "A faculty mentor is defined as a faculty member in your doctoral program who formally and/or informally guides you as a doctoral student, and supports your development as an emerging scholar in your field both inside and outside formal coursework."

Intellectual community was defined as doctoral students' formal and/or informal interaction with doctoral program communities, including both faculty and doctoral student peers, and exchanging ideas and feedback on their scholarly work, and sharing opportunities for professional advancement. This concept, derived from Wenger's (1996) work on learning and learning organization, was later advanced by Walker et al. (2008) in their discussion of doctoral students learning and development. Intellectual community is a construct with multiple dimensions, and its specific indicators were operationalized based on Walker and colleagues' discussion of intellectual community. Although Walker and colleagues utilized the term *intellectual community*, given the relative familiarity to doctoral students, the term learning community was used in the survey instrument. However, the indicators collectively represents source of intellectual community for doctoral students. Therefore the term intellectual community was retained in this study. The following definition was provided to students in the survey instrument: "A learning community is defined as faculty-student, and/or student-student

interactions that promote lively exchange of ideas and feedback inside and/or outside of formal coursework."

Doctoral education outcomes were defined as a set of characteristics, i.e., abilities, achievements, and other characteristics as perceived, assessed, and reported by doctoral students. These characteristics include doctoral students' perceived preparation or self-efficacy to conduct various forms of scholarly work, satisfaction with educational experiences, scholarly productivity, and degree progress. Five dimensions of self-efficacy were measured, including ability to carry out research from inception to interpretation of results, to publish in refereed outlets, to teach disciplinary knowledge to undergraduate students, to apply disciplinary knowledge in practice, and to work collaboratively with other scholars. Scholarly productivity was measured in the form of number of conference presentations and peer-reviewed publications produced during doctoral study, while degree progress was measured as number of semesters took to achieve candidacy status.

A *research doctorate* was defined as a doctoral degree that certifies capacity in the awardee to make original and substantial contributions to their field of study through a completion of a dissertation or equivalent project. This definition was borrowed from the Survey of Earned Doctorate's population parameters as presented in the 2007-2008 academic year report (Fiegener, 2009), and includes the doctor of philosophy (PhD), doctor of arts (DA), doctor of business administration (DBA), doctor of design (DDes), doctor of engineering (DEng), doctor of fine arts (DFA), doctor of Hebrew letters (DHL), doctor of music (DM), doctor of modern languages (DML), doctor of nursing science (DNSc), doctor of public health (DPH), doctor of science (DSc/ScD), doctor of education (EdD), doctor of juridicial science (JSD), and doctor of theology (ThD). Doctoral degrees that are oriented primarily for the practice of the profession,

including medical doctor (MD), doctor of dental surgery (DDS), doctor of veterinary medicine (DVM), juris doctor (JD), doctor of psychology (PsyD), and doctor of ministry (DMin) were not considered research doctorates and were not included in the study.

Assumptions

Conceptualization of this study was based on an assumption that pre-dissertation or pre-capstone learning experiences are intended to prepare doctoral students as scholars capable of making original and substantial contributions to the field (Altbach, 2004; Berelson, 1960; Council of Graduate Schools, 2005; Tinto, 1993; Walker et al., 2008). Pre-dissertation learning experiences such as coursework, independent study, research practica, and internships are devoted to equipping students with the capacity and competence to carry out scholarship, and this competence is assessed through some form of evaluation. Upon gaining competence in the coursework stage of doctoral study, and gaining certification of that competence through examination, students carry out independent scholarship demonstrating their competence as an independent researcher and scholar.

CHAPTER 2

REVIEW OF THE LITERATURE

This section presents the conceptual frameworks and the relevant literature on doctoral education. It begins with frameworks that guided the conceptualization of the study and the variables, followed by a brief overview of doctoral education in the United States, desired educational outcomes, and factors that are related to the desired outcomes in doctoral education.

Conceptual Frameworks

Astin's Input-Environment-Outcome Model and Theory of Involvement

This study was guided by Astin's (1993) input-environment-outcome (I-E-O) model as well as Astin's (1984) theory of involvement as overarching conceptual frameworks. The I-E-O model asserts that student development is contingent primarily upon the characteristics they bring with them and the educational environments and opportunities they experience in college. This model offers conceptual guidance for studying college student development and educational outcomes.

The concept of involvement refers to the investment of "physical and psychological energy that the student devotes to the academic experience" (Astin, 1984, p. 297). He theorized that students learn by becoming involved, and that the amount of learning and development in an educational program is "directly proportional to the quality and quantity of student involvement" (p. 298). This theory offers a useful lens through which to conceptualize and examine student development, the merit of educational programs in yielding student involvement, and the resultant development.

Taken together, Astin (1993) asserted that college student development and outcomes are a result of the nature and extent of the student's academic and social involvement during college. This involvement, however, is shaped by student input characteristics such as prior academic and

social experiences, and family backgrounds the student brings to college, in combination with the educational environments and opportunities the college provides. Although the I-E-O model and the theory of involvement were originally developed, and used, in research on undergraduate student development and outcomes, they offer a useful way of conceptualizing the relationship between personal and programmatic factors, student involvement, and educational outcomes in graduate education. The I-E-O model has been used to frame research in doctoral education, as both personal factors as well as program structures and cultures have a strong influence on students' experience and outcomes (Gardner, 2008a; Golde, 2000, 2005; Haley, 2006; Lovitts, 2001).

Applied to the study of doctoral education, it can be hypothesized that doctoral student development and educational outcomes are influenced directly by the nature and degree of academic and social involvement during doctoral education. Student involvement, in turn, is largely shaped by the complex interaction between personal and programmatic characteristics. For example, salient input or learner characteristics may involve prior knowledge in, and experience with, the subject matter and research process, whereas salient environment or program characteristics may involve program structure, policies, and curricular practices. Taken together, personal and program characteristics may have a profound impact on students' educational experiences, particularly the nature and degree of academic involvement. This conceptualization implies that input and environment (or learner and program) characteristics affect doctoral education outcomes, mediated through the nature and degree of academic involvement.

Academic Involvement: Faculty Mentorship and Intellectual Community

Doctoral students' academic involvement, including faculty mentorship and intellectual community, is conceptualized to represent academic involvement in doctoral education. Academic involvement is one of the most crucial elements that directly and indirectly results in various educational outcomes in undergraduate education (Astin, 1993; Tinto, 1993; Pascarella & Terenzini, 2005). Hence, this study seeks to examine the merit of student involvement in mentorship and intellectual community on doctoral education outcomes, and to identify factors relevant to involvement.

Specific operationalization of mentorship and intellectual community builds on Carnegie Foundation's project on doctoral education, Carnegie Initiative on the Doctorate (CID), as described by Walker et al. (2008). The CID was a national-scale action research project aimed at improving doctoral education practices and outcomes by involving various stakeholders, including faculty and students. Recommendations resulted from this work suggested two teaching and learning practices, apprenticeship and intellectual community, as crucial to the effective formation of scholars (Walker et al., 2008).

Apprenticeship, as the defining pedagogy in doctoral education since its inception, is a form of one-to-one experiential learning where the apprentice student works closely with a faculty mentor on a work of scholarship, taking on responsibility that "builds in size and complexity" (Walker et al., 2008, p. 65), and progressively develops as an independent scholar over the course of doctoral study. Apprenticeship pedagogy in itself builds on Brown, Collins, and Duguid's (1989) discussion of the importance of guided experience and deliberate feedback in learning to think and to carry out intellectually complex skills and practices. They noted that during this guided experience and feedback doctoral students "no longer behave as students, but

as practitioners, and develop their conceptual understanding through social interaction and collaboration in the culture of the domain" (p. 40).

Building on Walker et al.'s discussion, the concept of apprenticeship was re-expressed as mentorship in this study. Apprenticeship is one specific form of mentorship, and furthermore, students are often familiar with mentorship. The concept of mentorship is more common in the literature than apprenticeship, and conceptual analysis that differentiate the two is absent in the literature, and often used interchangeably.

Intellectual community, "a condition, indeed a foundation, for the core of work of doctoral education: building knowledge" (Walker et al., 2008, p. 122), is characterized by a lively exchange of ideas and feedback among program community in both formal and informal environments. The social interaction and exchange ideas and feedback among doctoral program community can occur between faculty and student, as well as between student peers. Intellectual community builds on Wenger's (1996) idea that learning knowledge construction is an inherently social process, highlighting the importance of environments and opportunities for formal and informal social interactions in a learning organization. In advocating for intellectual community, Golde, Bueschell, Jones, and Walker (2009) asserted that the more opportunities there are to interact, the more likely students are "to share ideas, collect input, and learn more" (p. 59).

Mentorship and intellectual community are distinct, but mutually reinforcing educational practices in that they both involve collaboration within program communities revolving around scholarly work in the service of student learning and development. Mentorship is purposeful educative process in which faculty member deliberately promotes student scholarly formation in one-to-one or in a group setting, which may involve providing opportunities for hands-on learning in various forms of scholarly activities, providing feedback on various aspects of student

development as a scholar, and guiding student degree progress and completion. Intellectual community, however, involves formal and informal interactions among department or program community, including faculty and student peers, exchanging ideas and feedback in support of each other's learning and scholarship.

However, these two practices intersect as they both involve exchange of intellectual resources, highlighting the collaborative nature of this interaction. Because they are both also centered on a work of scholarship, shared or not shared, this study synthesizes mentorship and intellectual community as two forms of academic involvement.

Mentorship and intellectual community can take many shapes and forms. This poses a challenge in identifying and measuring student involvement in these educational practices across the disciplines and fields of study. However, Walker et al. (2008) identified a number of defining features regardless of the shape or form they take. It is these defining features, measureable from students' experiences and perspectives, that the proposed study operationalizes as mentorship and intellectual community. Specific indicators of mentorship and intellectual community are presented in Chapter 3.

Overview of Doctoral Education in the USA

Doctoral education in the United States has a long history and tradition. The first doctor of philosophy degree was awarded by Yale University in 1861. The establishment of Johns Hopkins University in 1876 signifies the official birth of graduate education in the United States. Borrowed from the German Humboldtian model of apprentice learning in scientific inquiry, the doctoral degree represents the highest degree of achievement in formal education, with a student emerging as an independent scholar with the capacity and the dedication to make contributions to knowledge (Council of Graduate Schools, 2005).

Since its inception, doctoral education has responded to external pressures, leading to enormous expansion and diversification in students, institutions, and fields of study, as well as in purposes and outcomes. As of 2009, there were 421 higher education institutions (Fiegener, 2009) enrolling about 424,574 students (Bell, 2010) pursuing terminal degrees in life, physical, and social sciences, and humanities, and professional fields. According to the Survey of Earned Doctorate report (Fiegener, 2009), 48,802 doctorate degrees were granted in the 2007-2008 academic year (AY), a 15% increase from 1998. This figure represents an enormous growth and diversity in doctoral education in the United States. Since 1968, the number of doctorate-granting institutions nearly doubled, and the number of doctorates awarded more than doubled.

Across the disciplines, over half of the doctorate awardees had masters degrees. However, possession of masters degrees differs appreciably by disciplines and citizenship status. Only 53% and 63% of those who earned doctorates in life and physical sciences held masters degrees, compared to over 80% of those in education, humanities, and social sciences. Temporary visa holders tend to hold masters degrees more than US citizens and permanent residents across most disciplines. Furthermore, on average across disciplines, 77% of the masters degrees were related to doctorate field of study. Interestingly, while those who pursue education doctorates have the highest number of masters degrees (89%), relevance of their masters degrees to their doctorate was lowest (68%) when compared to all other disciplines. On the other hand, in engineering, 89% of those who pursued a doctorate with a masters degree had a masters degree related to engineering. It raises a question whether having a master degree, and its relative relevance to the doctorate field makes a difference on doctoral education experience and outcomes.

According to the Survey of Earned Doctorate (Fiegener, 2009), research assistantship and traineeship support is most common in engineering, physical and life sciences, and least common in the humanities and education. Teaching assistantships, on the other hand, are more common in the humanities, social and physical sciences, and least common in education and engineering. Overall, doctorate awardees in the field of education held the lowest numbers of research and teaching assistantships during doctoral study. Of those who held research and teaching assistantships, with the exception in life and social sciences, females tend to hold teaching assistantships more than males, while males tend to hold research assistantship and traineeship more often than females.

Doctoral education is a decentralized, localized enterprise where individual departments or programs are the locus of control (Berelson, 1960; Bowen & Rudenstine, 1992; Golde, 2005; Nerad & Miller, 1996; Tinto, 1993), in which graduate faculty set forth much of the curriculum, guidelines, and expectations for the degree requirements (Council of Graduate Schools, 2005). Simultaneously, program structure and culture is shaped by the nature of research and scholarship that are distinct to the discipline (Gardner, 2010; Golde, 2005; Tinto, 1993) as academic departments and programs are local manifestations of the discipline (Clark, 1984). The local and national characteristics that define doctoral education elevate the importance of departments and programs, as well as the distinct disciplinary research and scholarship practices, in studying doctoral education (Golde, 2005; Lovitts, 2005).

A clear distinction is often drawn between life or physical sciences and humanities due to the distinct nature of research and scholarship in these fields (Becher & Trowler, 2001; Biglan, 1973; Clark, 1987). The career of a scholar in life or physical sciences and in engineering is typically defined by collaborative work with others, whereas in the humanities scholarship is

most frequently a more solitary endeavor. Consequently, educational practices in the sciences emphasize conducting research in the lab from the beginning of the doctoral study (Golde, 2005), an arrangement that resembles an apprenticeship model (Tinto, 1993). Students begin by conducting discrete, well-defined, assigned research projects, taking on more responsibility and independence as they progress toward the ill-defined defined research problems that characterize independent scholarship. The lab research is most often conducted with peers under a faculty mentor, taking place in more social settings.

On the other hand, students in the humanities conduct years of reading and independent research, more solitary in nature. Such distinctive disciplinary practices filter through the academic department, shaping the structure and culture of the program, and hence the educational experiences of those who are preparing to enter the profession (Gardner, 2010; Golde, 2005). As Golde (2005) summarized her findings "[h]ow the life of a disciplinary practitioner is portrayed to those who are apprentices [graduate students] is quite different in different departments, with differing impacts on students" (p. 680).

Despite these differences, there are broad elements common to doctoral education across the disciplines. Tinto (1993) characterized them in three distinct stages with respect to persistence. The first two stages, spanning through the completion of coursework, and hence admission to candidacy, students gain working knowledge of their field and research methods deemed necessary for independent research and scholarship through formal and informal means including lectures, seminars, discussions, readings, directed study, and/or hands-on research activities. This is the stage in which student is expected to have proficiency to function as an independent researcher and scholar, certified by an evaluation of the sort.

The final stage spans through successful completion and defense of doctoral dissertation or other capstone projects that certify competency for independent researcher and scholar. Each of these stages are characterized by distinctive socialization processes and challenges within the academic and social contexts of doctoral study, influencing one's decision to persist.

Doctoral Education Outcomes

Doctoral education outcomes are manifold and complex. Expectations of graduates have evolved from focused-research to full-fledged scholarship, reflecting the emergence of diverse responsibilities in a variety of career contexts. First and foremost, doctorate holders are scientific researchers and scholars (American Association of Universities, 1998; Council of Graduate Schools, 2005; Woodrow Wilson National Fellowship Foundation, 2005), who "understand what is known and discover what is yet unknown" (Shulman, 2008, p. ix). The notion of a researcher who has the capacity and commitment to make original, substantial contributions to knowledge in their chosen field is the most recognized and celebrated aspect of doctoral education in the US.

As such, the long-standing tradition in doctoral education has been the preparation of the next generation of "content experts with appropriate research skills that they could apply in their careers, primarily as professors in research institutions" (Wulff & Nerad, 2006, p. 89). However, calls for a broader and more effective application of knowledge and expertise from doctorate degree holders have emerged over the last two decades for careers inside and outside academia, casting implications on doctoral education. LaPidus (1998) noted the emerging conceptualization of doctoral education as one designed to prepare scholars for variety of roles and responsibilities, "all centered on the application of knowledge" (p. 102), and that doctoral program should nurture

multiple professional and career opportunities and competencies to meet society's needs and career contexts for doctorate holders (Nyquist & Woodford, 2000).

Boyer (1990) posited that scholars, as applied to faculty scholars in higher education, should be able to discover, teach, apply, and integrate their disciplinary knowledge. Walker et al. (2008) advanced these scholarly competencies in the preparation of scholars, regardless of career context, that "the work of scholarship is not a function of setting, but of purpose and commitment" (p. 8). Similarly, others called for broader utility of scholarship, including effective teaching and communication, academic citizenship, application of the expertise in addressing problems within and beyond campus walls, integrating knowledge at the disciplinary boundaries, and increased competency in discovering knowledge (Austin, 2002; Austin & McDaniels, 2006; Gale & Golde, 2004; Henson, Hull, & Williams, 2010). While it is debatable as to whether doctoral education should address such diverse learning outcomes and competencies, Lovitt (2005) and Wulff & Nerad (2006) asserted that doctoral education outcomes, at the very least, should involve degree completion within a reasonable amount of time, with a reasonable degree of satisfaction and preparation as an independent scholar.

This study assessed doctoral education outcomes as measured by doctoral candidates' experiences and perspectives. These outcomes include: 1) development as an independent scholar, including perceived preparation, or self-efficacy to carry out research projects, to teach, to apply, to work collaboratively with other scholars, and to write for peer-reviewed publication, as well as number of conference presentations and peer-reviewed publications produced during doctoral education, 2) satisfaction with doctoral education experience, and 3) time-to-candidacy. These outcomes are central to doctoral education, and will be further delineated below.

Development as an Independent Scholar

The discussion of the literature in this section pertains to doctoral students' development as a scholar, works of scholarship, and factors that promote these outcomes. The discussion of scholarship as the major developmental area for doctoral students, followed by an examination of the extent to which students feel that they are prepared to function as an independent scholar and actual scholarly productivity during doctoral study will be presented.

Despite diverse career paths, the highest academic degree holders are considered to be scholars with a purpose and commitment to the work of scholarship (Walker et al., 2008). Boyer (1990) defined the work of scholarship to include discovering, teaching, applying, and integrating knowledge. Walker et al., (2008) asserted that the work of scholarship should encompass "a set of knowledge and skills, as well as a set of principles," with functions of "generating and critically evaluating new knowledge, of conserving the most important ideas and findings that are a legacy of past and current work, and of understanding how knowledge is transforming the world in which we live, and engaging in the transformational work of communicating their knowledge responsibly to others" (p. 12) as an integrated whole.

Walker et al. (2008) suggested that the generative function of scholarship speaks to the work of research in a conventional sense, seeking answers to important and interesting questions using proper methodologies, and communicating the results to others. The conservation function of scholarship implies understanding "the history and fundamental ideas of the discipline" and critically judging the merit of ideas, but also understanding "how the field fits into the larger, and changing intellectual landscape" (p. 12). The transformative function of scholarship implies the ability to represent and communicate ideas effectively within their own disciplinary expertise as

well as across disciplines, in a way that "new learners can meaningfully engage with it" (p. 12), as well as the responsible application of knowledge where needed.

Boyer's (1990) broader reconceptualization of scholarship and Walker et al.'s (2008) advancement of scholarship applied in the formation of scholars mirror each other. Discovering or generating knowledge speaks to the scholar's ability to conduct research in a conventional sense. Teaching or transforming knowledge speaks to the scholar's ability to effectively communicate expert knowledge to a broad spectrum of audiences, including such new learners as undergraduate students whom many of the doctorate holders will teach. Integration and conservation implies contextualizing knowledge in a broad array of knowledge within and across disciplinary boundaries, and application speaks to the scholar's ability to use their expertise in addressing problems in disciplinary and professional communities, within and beyond academe.

Doctoral students' scholarly productivity during doctoral education reflects the primary scholarly competencies of doctoral students. Scholarly productivity for doctoral students may include involvement in research projects prior to dissertation and capstone project, and the number of conference presentations and publication produced during doctoral study. Such assumptions are supported by Gardner's (2009) exploration of faculty conceptions of successful outcomes for doctoral students. In her study, doctoral faculty across seven disciplines cited ability to disseminate knowledge in the form of presenting at a conference and publishing in refereed journal as measures of successful educational outcome for doctoral students and graduates. Golde and Dore's (2001) assertion of the importance of publishing in the research process and the need to make publishing a bigger part of doctoral study and outcome measures lends further support to this operationalization of scholarly productivity.

Three national-scale studies (Golde & Dore, 2001; Nerad, Rudd, Morrison, & Picciano, 2007; Nettles & Millett, 2006) offer glimpses of doctoral students' preparation as scholars, particularly at high research activity institutions. The information reveals that about half of doctoral students have opportunities to take progressively responsible roles in research projects, with more opportunities in life and physical sciences and less in humanities. About 65% of respondents to Golde and Dore's (2001) survey indicated their doctoral program had prepared them to conduct research, but less than half reported being prepared to publish their work. Nettles and Millett (2006) found that only about 30% of doctoral students publish in a refereed journal during their doctoral study, and among them women and African Americans tend to publish less than others. Conference presentations appear to be more prevalent experience among students. About 94% of the students reported to have had opportunities to give presentations at professional meetings (Golde & Dore, 2001).

With regard to teaching, only about half of current doctoral students report having an opportunity to serve as a teaching assistant and to learn specifically about teaching in their discipline through workshops and seminars. Students are less confident in their abilities and less satisfied with their programs' preparation to fulfill various roles and responsibilities of the professoriate. Furthermore, less than 20% of students reported being prepared by their program for service or application roles such as applying expertise to the community beyond campus and service to the discipline (Golde & Dore, 2001). These results were largely supported with social science doctorate graduates' evaluation of their program experiences, particularly with regard to program training in research, publishing, and teaching (Nerad, Rudd, Morrison, & Picciano, 2007).

Carrying out scholarship is an indication of the ability to produce scholarly work that stands the test of scholars' scrutiny (i.e., presenting and publishing) and encompasses the ability to generate, critically evaluate, and conserve knowledge, and to engage in the transformational work of communicating their knowledge. Hence, this study inquired students' productivity in the number of conference presentations and publications.

Nettles and Millett (2006) identified several predictors of research productivity in the form of peer-reviewed publication: longer enrollment in doctoral study, apprenticing with a faculty mentor, and engaging in an assistantship–particularly a research assistantship. In lieu of scarce empirical evidence, Walker et al. (2008) proposed several educational practices that may promote scholarly formation, including faculty mentorship and a collegial intellectual atmosphere that is supportive of student learning and development.

Given that student's development as a researcher and scholar is the most essential educational outcome in doctoral education, this study assessed doctoral students' self-efficacy in conducting various forms of scholarship, as well as their research productivity as indicators of student competency in these areas. These competencies were further examined for their relationship with students' academic involvement.

Satisfaction with Doctoral Education Experience

Student satisfaction with the educational experience may well be related to other outcomes of doctoral education such as time-to-degree, degree completion, and scholarly productivity. Increasing competition between doctoral programs in public institutions, as well as competition from private institutions, seems to elevate the attention given to student satisfaction as an outcome of doctoral education. In general, satisfaction appears to be related to degree completion (Girves & Wemmerus, 1988; Lovitts, 2001), and is a function of quality and quantity

of student interaction with faculty (Barnes & Randall, 2011). Given that degree completion is a persistent concern in doctoral education and higher education in general, it is important assess current students' level of satisfaction with their educational experience, and further examine the factors that are purported to be salient in (dis)satisfaction.

Evidence suggests that doctoral students are generally satisfied with doctoral programs (Golde & Dore, 2001; National Association of Graduate and Professional Students, 2001; Nettles & Millett, 2006), however there are considerable differences among students of different backgrounds. When students from different disciplines and broad fields of study are compared, engineering students appear to have the highest level of satisfaction with their doctoral program, while those in social science report lowest level of satisfaction (Nettles & Millett, 2006).

Clearly doctoral education is a complex enterprise and hence multiple dimensions must be taken into consideration when assessing satisfaction. First and foremost, the faculty-student relationship is central to the doctoral experience; with program satisfaction linked to educational experience and quantity and quality of interaction with faculty-student relationship (Lovitts, 2001; Smart, 1987). This was evident in Nettles and Millett's (2006) study, that among students pursuing doctorate degree in social sciences, those who expressed the lowest level of satisfaction with their doctoral program also rated their academic interaction with faculty the lowest compared to their peers in other disciplines and fields of study.

About one third of the respondents to Golde and Dore's (2001) survey expressed dissatisfaction with the relationship with their advisor, with about 37% indicating "yes" or "maybe" to a question asking whether they would select a different advisor were they to start their program over. Similarly, about 49% responded "yes" or "maybe" to a question asking if

they would select a different university were they to start their doctoral program over. These responses give some clue to doctoral students' discontent with their educational experience.

Students who pursued graduate degrees similar to their undergraduate majors adjusted better to graduate education and were more satisfied with educational experience than those who pursued different fields of study in undergraduate and graduate education (Smart, 1987). And yet no meaningful differences in academic performance were found between students who were satisfied and those who were not satisfied with their educational experience (Lovitts, 2001). Given the relationship between satisfaction and other critical educational outcomes, particularly degree completion, this study assessed doctoral students satisfaction with their educational experience, and the degree to which academic involvement relate to satisfaction.

Degree Progress: Time to Candidacy

Degree progress and degree completion are naturally related: As students remain longer in programs, the risk of not completing the degree increases, and many programs therefore have time limits for degree completion. Many of the factors related to degree completion are also salient with regard to time to degree completion. Considering the relatively high cost of doctoral education for taxpayers and students, and high attrition rate and long time-to-degree associated with doctoral education, degree progress is emerging as benchmark for program efficiency and educational effectiveness (Texas Higher Education Coordinating Board, 2009). It is therefore an increasingly important outcome to measure and to better understand the salient factors. This study measured degree progress in terms of number of semesters, Fall, Spring, Summer, took to achieve doctoral candidacy since enrolled in first course in pursuit of the doctoral degree program.

Two major trends regarding time to degree must be noted. First, time to degree has increased as graduate education has expanded and diversified. Second, as with degree completion, there is considerable and consistent variation in time-to-degree across disciplines and fields of study. In particular, students in physical and life sciences, including STEM fields, complete their degree faster than students pursuing social science, education, and humanities doctorate (Abedi & Benkin, 1987; Bowen & Rudenstine, 1992; Council of Graduate Schools, 2009; Nettles & Millett, 2006).

Several factors appear to be salient in degree progress in doctoral programs, including financial concerns, quality and quantity of advising and mentoring from faculty, enrollment type, pattern of employment, involvement in scholarly work with faculty mentor(s), and family background. By far, degree progress along with degree completion is the topic that has received the most attention among research and policy-oriented communities.

The effect of type of financing in doctoral education is well established in that students with lesser financial obligations and/or greater financial support for doctoral study tend to make faster progress toward degree. In particular, students with significant financial support from external sources (including scholarships, fellowships, and assistantships) for their doctoral study tend to make faster progress toward degree than students who self-finance (Abedi & Benkin, 1987; Bowen & Rudenstine, 1992; Berelson, 1960; Girves & Wemmerus, 1988). Survey of Earned Doctorates data suggest that women are more likely to depend on personal sources to finance their doctoral education than men (Fiegener, 2009). This is not surprising given disciplinary differences in financial support for students and the gender representation in different disciplines.

It also appears that the type of financial assistance makes a difference (Berelson, 1960; Bowen & Rudenstine, 1992). When compared to scholarships and fellowship, financial assistance that comes with responsibilities giving students environments and opportunities to interact with faculty and peers, such as teaching and research assistantships, lead to faster degree progress, however sole reliance on teaching or research assistantship as income may slow degree progress (Berelson, 1960; Nettles & Millett, 2006). According to Nettles and Millett (2006), debt incurred during doctoral education appears to be related to degree progress for students pursuing social science doctorates, and employment that is time-consuming and/or full-time equivalent during doctoral study has been linked to slower degree progress (Girves & Wemmerus; 1988 Maher, Ford, & Thompson, 2004).

Students' educational experiences in their programs also account for variation in degree progress. Students who continuously enroll in doctoral study full-time and frequently interact with faculty and peers, particularly through involvement in scholarship with faculty, tend to progress toward degree faster (Baird, 1990; Girves & Wemmerus, 1988; Maher, Ford, & Thompson, 2004; Nettles & Millett, 2006).

Again, these findings highlight the centrality of faculty in doctoral education experiences and outcomes. Early exposure to research, providing students with authentic research experience, was considered an important aspect of doctoral education that increased competence and confidence to carry out independent research (Anderson & Anderson, 2011). Such practice was identified as an exemplary practice in Boyle and Boice's (1998) study across disciplines as well as in Levine's (2007) study of doctoral programs in the field of educational research.

The context of time, environment, and opportunities afforded to full-time enrollment and various assistantship duties is associated with increased access to faculty mentor, thus increasing

the quantity and quality of interaction with faculty (Anderson & Anderson, 2011; Lovitts, 2001). The same contexts could also be related to productive research experience prior to and during doctoral education, which helps explain differences between early and late finishing female doctoral students (Maher, Ford, & Thompson, 2004). Peer support offering advice and sympathy was considered particularly important at the dissertation stage (Lenz, 1997).

Furthermore, family background, number of dependents, and level of family support is also related to degree progress. In particular, students with larger numbers of dependents, particularly children under the age of 18, tend to make slower progress (Abedi & Benkin, 1987; Nettles & Millett, 2006). Mental and emotional family support was identified as an important factor in timely progress toward degree completion for female doctoral students (Lenz, 1997; Maher, Ford, & Thompson, 2004). As such, women tend to take longer to complete doctorate than men (Abedi & Benkin, 1987).

Salient Factors in Doctoral Education Outcomes: Learner Characteristics

Few studies identified a number of learner characteristics, aside from demographic characteristics, as essential to success in doctoral education, as conceptualized by doctoral faculty and doctoral students. Doctoral faculty across seven disciplines at one institution cited the following characteristics as necessary for student success in doctoral education: Initiative, independence, self-direction, self-discipline, organization, communication (with mentor), ambition, intelligence, preparation and background related to research, motivation, a willingness to work hard, and high Graduate Record Examination (GRE) scores (Gardner, 2009). Additionally, having a vision of future career goals and knowing how to achieve those goals when the student entered the program was perceived as essential.

Doctoral students in the field of education cited internal locus of control and self-direction as essential to make the most of doctoral education (Anderson & Anderson, 2011). Furthermore, students perceived the pursuit of doctoral education with few external obligations and the benefit of assistantships (particularly research assistantships) as important to a productive educational experience. As discussed earlier, both of these characteristics are linked to increased interaction with faculty.

Leading scholars on the topic of doctoral education have also emphasized the roles and responsibilities that students approach doctoral education with as an enabling or impeding factor for student success. Golde, Bueschel, Jones, and Walker (2009) suggested that students should be self-directed and assertive in their learning, to actively define "near-term and career goals, and seek out experiences that will help them learn" (p. 58). Similarly, Austin (2002) identified students' locus of control, sense of self-efficacy, and "the ability to make connections with people and opportunities" (p. 103) as factors affecting graduate student development.

Finally, program admission criteria also provide a glimpse of the beliefs doctoral faculty hold about characteristics that promote desired outcomes. The Council of Graduate Schools (2005) summarized common graduate admission criteria, indicating appropriate and adequate academic credentials combined with academic abilities, motivation, and dedication to learning as the usual criteria for admission to graduate study. These are often used with direct and/or indirect measures such as the GRE scores, completion of a masters degree or equivalent in a relevant field, samples of student work, and employment records, to screen prospective students.

Although these sources point to a myriad of learner characteristics as potentially relevant, no studies have explored their relationships with learning experiences such as degree of academic involvement. Again, these characteristics are primarily exploratory and/or untested

assertions by experts, faculty, and doctoral students. Much of the research has examined learner characteristics in relation to degree progress and completion. Given that degree progress and completion are primary results of educational experiences (Gardner, 2008a, 2010; Golde, 2005; Lovitts, 2001), an examination of the relationship between learner characteristics and students' educational experiences are in order.

The findings of these studies, presented in the discussion of doctoral education outcomes, offer such learner characteristics as financial support, family support, enrollment and employment type (full/part-time), assistantship, to be relevant. However, again, no evidence points to these variables' relationships with doctoral students' academic involvement.

In summary, based on the literature reviewed, several types of learner characteristics can be hypothesized to be relevant to the doctoral education experience and need to be examined as such. These characteristics include doctoral students' agency or self-direction, prior relevant preparation and experience with content knowledge and research process, type of enrollment and employment, degree of financial and family support, and family responsibility.

Salient Factors in Doctoral Education Outcomes: Academic Involvement

This section presents educational experiences identified in the literature as salient in doctoral education. The majority of the studies that identified and/or recommended certain learning experiences as good practices are exploratory in nature (Anderson & Anderson, 2011; Gardner, 2008b; Golde, 2005; Haworth & Bair, 2000; Nyquist et al., 1999). Some are simply expert assertions (Council of Graduate Schools, 2009; Tinto, 1993; Walker et al., 2008). Finally, a few studies have identified links between certain learning experiences and outcomes (Cook & Swanson, 1978; Nettles & Millett, 2006; Roaden & Worthen, 1976).

The good practices reported in the literature point to learning experiences that integrate students into scholarly practice and program and/or disciplinary communities early on and throughout students' program of study. The Council of Graduate Schools (2005), for example, posited that the development of scholars is "most effectively accomplished in close association with those experienced in research and teaching" (p. 7), in settings where faculty and students interact on regular basis. Empirical evidence appear to support Council of Graduate Schools' position, that there is a link between quantity of faculty student interaction and students' involvement in research projects (Roaden & Worthen, 1976; Weidman & Stein, 2003), productivity during doctoral study (Nettles & Millett, 2006), and higher rates of degree completion (Cook & Swanson, 1978). Given the link between research assistantships and research productivity during doctoral education, Nettles and Millett (2006) recommended research assistantships in doctoral education experience.

Walker et al.'s (2008) recommendation that programs strive to include apprenticeship and intellectual communities echoes the importance of involvement in scholarly practices in supportive and collegial program environments as crucial in doctoral students' development as scholars. In particular, learning experiences that grow in size and complexity, are progressively developmental, and that start early and continue throughout the program of study are suggested to be ideal. Walker et al. advised doctoral programs to structure their curricula and their mentoring practices accordingly.

Gardner (2008a), Golde (2000), and Lovitt's (2001) studies on doctoral attrition and Austin's (2002) study on socialization of doctoral students identified support from program communities, particularly from faculty, as essential to the doctoral experience, and recommended improved advising and mentoring on the part of faculty. Doctoral students and graduates from

four professional doctorate programs, including clinical psychology, education, engineering, and nursing cited a learning environment that promoted collegial and reciprocal relationships between faculty and students as most developmental (Haworth & Bair, 2000). In particular, students identified problem-based learning, individualized mentoring, and engagement in authentic, research-based discovery activities as meaningful learning experiences in their doctoral education.

Given the challenges some doctoral students face with making the transition from coursework to independent scholarship, Gardner (2008b) recommended learning experiences that resemble independent scholarship and require original thought and intellectual independence. Gardner suggested that including such experiences during the coursework stages may socialize students to the needed independence and ease this transition. Education doctoral students also noted involvement in pre-dissertation scholarship as essential for increasing their competence and confidence to carry out dissertation research (Anderson & Anderson, 2011).

CHAPTER 3

METHODOLOGY

This chapter presents the methods employed in the study. The discussion includes a reiteration of the research purpose and questions, a description of the research design, the population, methods of sampling, the instrumentation, the procedures for collecting and analyzing data, and the assessment of reliability and validity of the measurement scores.

The purpose of the study was to examine the predictive relationships among doctoral students' learner characteristics, academic involvement, and doctoral education outcomes for students pursuing research doctorate degrees at three universities in the North Texas area. As such, this study sought to answer the following research questions:

1. Which, if any, learner characteristics are predictive of doctoral students' academic involvement, as measured by mentorship and intellectual community?
2. Is academic involvement, as measured by mentorship and intellectual community, predictive of doctoral education outcomes?

Research Design

This research employed a cross-sectional, non-experimental quantitative research design. Specifically, non-experimental correlational research design was used to answer the research questions. Non-experimental correlational design allows examination of the nature and degree of association between two variables or variable sets. Therefore, this design is appropriate for examining the nature and degree of the predictive relationship between two sets of continuous variables, i.e., between learner characteristics and academic involvement, and between academic involvement and doctoral education outcomes.

Description of the Population

The population this study intended to generalize its findings to was doctoral candidates pursuing research doctorate degrees across disciplines and fields of study at three public higher education institutions in the North Texas area. Doctoral candidates pursuing a research doctorate degree are current doctoral students who have completed coursework, passed any applicable examination(s), and therefore advanced to doctoral candidacy.

Three institutions this study sampled doctoral candidates from represent diverse institutional contexts with regard to institutional characteristics. Of the three, one institution is classified as research university with high research activity (RU-HRA), while the other two institutions are doctoral/research university (D/RU), according to Carnegie Foundation for the Advancement of Teaching (2010) classification. Furthermore, RU-HRA is named as the one of the seven emerging-research universities in Texas by the Texas legislature, while the D/RUs are doctoral granting institutions that rank lower in research capacity and productivity. Historically, all three were teacher education institutions, and currently have large enrollment in undergraduate and masters degree programs.

Sampling

Of the defined population, this study collected data from a convenience sample of those who responded to the survey. Therefore, of the doctoral candidates pursuing research doctoral degrees across the disciplines at three institutions, those who responded to the survey were sampled in this study. Specifically, doctoral students who have completed coursework and passed any applicable examination(s) at three institutions in North Texas area and completed the survey constituted this study's sample.

To obtain the sample, senior administrators in the graduate schools at the three institutions were contacted, requesting their cooperation in distributing the survey to their doctoral candidates. In doing so, description of the study and the survey instrument were provided. Additionally, the senior administrators were assured that data will be reported in aggregate, and that their institutional results to be shared with them upon request. All three graduate deans agreed to distribute the instrument to their students.

Instrumentation

Based on the literature on doctoral education, a new instrument has been developed to measure doctoral candidates' learner characteristics, academic involvement, and doctoral education outcomes. The survey consists of 55 items, with 15 items measuring learner characteristics, 20 items measuring students' academic involvement, 9 items measuring doctoral education outcomes, and 11 items measuring demographic and contextual information of the respondents. Survey items were measured in both nominal and continuous scales. The continuous scales were measured at 1-7 interval scale statements, to allow for optimal variation and discrimination in the responses, 1 indicating lowest level such as *never*, *not at all important*, and *strongly disagree*, and 7 indicating *very often, very important,* and *strongly agree*. All survey questions and statements, except for the open-ended comments, had forced responses where respondents are unable to proceed without providing answer to each question. This option was chosen to record only responses with complete data, thus eliminating missing data.

The survey was developed and administered using a web-based survey software program entitled Qualtrics. The instrument is divided into five sections, logically organized by topic and/or methods of scaling (Alreck & Settle, 2004). The first page of the survey serves as an

informed consent; respondents are asked to read, and to acknowledge that their progression to the survey will signify their consent to participate in the study.

The first section consisted of ten items concerning various dimensions of faculty mentorship as follows: 1) works collaboratively with the student on a research prior to beginning dissertation/capstone project; 2) creates hands-on learning opportunities that increased in complexity over time; 3) creates hands-on learning opportunities that in which the student learned to connect theory with practice; 4) provides personalized guidance and/or feedback on student learning needs; 5) provides guidance and/or feedback on student development on regular basis; 6) gives feedback on student paper/project in a timely manner; 7) provides constructive feedback on student paper/project; 8) promotes student development as a researcher, 9) promotes student development as a teacher; and 10) multiple faculty mentors.

The second section consisted of ten questions concerning various dimensions of intellectual learning community as follows: 1) stimulates lively exchange of ideas and feedback; 2) shares intellectual resources; 3) shares opportunities for professional advancement; 4) helps develop professional relationships with others in the field; 5) values intellectual contributions form a variety of perspectives; 6) values intellectual contributions form graduate students; 7) nurtures intellectual community; 8) respects one another regardless of differing opinions; 9) take time to provide feedback to one another; 10) promotes student development as an emerging scholar.

These 20 questions in the first two sections were asked twice, eliciting respondents' perceptions toward frequency with which they experienced various dimensions of faculty mentorship and intellectual community during their doctoral study, as well as perceived importance they attributed to each of the dimensions. These items drew on Walker et al.'s (2008)

suggestion of the importance of such learning experiences in doctoral education as well as on doctoral education literature.

The third section of the instrument composed of 12 statements related doctoral students' learner characteristics and educational outcomes in which the participants were asked to indicate their level of agreement on 1-7 scale. The responses elicited in this section include students' experience with literature review and research project; clarity of professional goals, and the degree with which taking active roles in identifying learning needs and seeking learning opportunities; supportiveness of the family and friends toward doctoral study; perceived preparation to carry out research projects and to publish, to teach and to apply disciplinary knowledge, and to work collaboratively with other scholars; and satisfaction with doctoral education experience.

The fourth section was composed of six questions also related to learner characteristics and educational outcomes with different scaling from the third section in a way that respondents were asked to choose numbers. This section elicited responses regarding number of scholarly outputs; average credit hours enrolled; average number of hours spent on academic work; average number of hours worked during coursework and dissertation stages; amount of financial support granted; and number of dependents under 18 the student had while pursuing doctorate.

The last (fifth) section inquired learner characteristics and participants' background information to contextualize the responses. These items were concerned with master's degree major, doctoral degree major, doctoral degree type, semester began doctoral coursework, semester completed qualifying examination, graduate assistantship, career plan regarding primary work and work setting, sex, ethnicity, citizenship status, and birth year.

While the content of the instrument relied on research literature, construction of individual items was consulted with current and former doctoral students, and faculty members from a variety of disciplines and backgrounds, and has undergone several drafts prior to the formal first draft. Upon finalizing the first formal draft, the instrument was pilot tested in two stages at one of the three institutions, i.e., RU-HRA. The purpose of the pilot tests was to further refine the instrument, and to examine measurement reliability and validity of the two constructs.

Pilot Test 1

The first pilot test elicited feedback from 8 to 10 doctoral candidates at RU-HRA. Respondents were asked to complete the survey and provide feedback on any aspect of the instrument design and development that needed revision, particularly on clarity of items and exhaustiveness of responses. Network sampling method was used to recruit participants. A total of 15 doctoral students and recent graduates completed the survey and offered feedback during the week of January 13 and January 20 of 2011. Each participant was contacted again for qualitative feedback. Of the 15 respondents, 9 offered feedback on the survey design and development. No statistical analyses were performed on data collected for the first pilot test.

Substantial revisions were made to the instrument based on this feedback. The primary changes were made to Sections 1 and 2 to simplify and clarify the statements, as several feedback indicated the complexity in each item. For example, Item 1.2. was stated as "at least one faculty mentor who created hands-on learning opportunities that increased in complexity prior to beginning my dissertation/capstone project." This item was revised as "A faculty mentor who creates hands-on learning opportunities that increased in complexity over time," removing the timing qualifier "prior to beginning my dissertation/capstone project" as "hands-on learning opportunity that increased over time" was the primary interest.

Another major revision was the naming of the scaling for Section 1 and 2. Some respondents expressed difficulty with responding to these sections they required respondents to keep two statements in mind as they responded. Specifically, while each statement remained the same, the beginning … "My doctoral education experience included:" and "As a doctoral student, I feel it is important for me to have:" and the response choices "1=*strongly disagree* and 7=*strongly agree*" were revised as question format "How often have you experienced this as a doctoral student? With response choices "1=*never*, and 7 =*very often*" and "1=*not at all important* and 7=*very important*." This revision allowed respondents to read the response choices once, and to easily proceed to each statement and indicate their level of frequency and importance.

Additionally, Item 3.6. "During my doctoral education, my family members showed a great deal of understanding and/or support for the demands of doctoral study" was revised as "I have had family/friends who were understanding and supportive of the demands of doctoral education." Similarly, Item 4.8 "While pursuing your doctoral education, how many children under the age of 18 lived/living with you?" was revised as "I have had significant home/family responsibilities while pursuing my doctoral education," as the purpose of this item was to assess students' perceived level of responsibility with family/home and to examine its relationship with educational experience and outcome.

The latter half of the respondents who completed the survey reported a number of technical glitches. These glitches were fixed by changing the survey template. However, one technical problem persisted, that is, improper display of the response for questions in Section 4. Hence, these items were replaced by text-box in which the respondents were asked to enter

numbers. Lastly, several minor grammatical and linguistic revisions were made. Upon making these revisions to the instrument, the second pilot test began.

Pilot Test 2

The second pilot test sought 20 to 40 responses. Network and convenience sampling methods were used to recruit participants in conjunction with an on-campus event for graduate students on the university campus. The same procedure and feedback was employed as in the first pilot test. A total of 36 doctoral candidates completed the revised version of the survey instrument during February 12 and February 28, 2011. During this period, each participant was contacted again for input on the survey design and development. Out of 36 respondents, 22 responded to the request and offered feedback. In addition to this feedback, quantitative data from 36 participants were analyzed to assess reliability and validity of the two constructs, mentorship and intellectual community.

Qualitative feedback revealed need for minimum revisions on the survey design, in that wording of the items are clear, and response choices are exhaustive. Few grammatical and technical changes were suggested, and subsequently addressed in the survey. One respondent clarified time frame for Item 4.7. "How much financial support did you receive from any external sources in support of your doctoral study?" As a result, the question was clarified with "in support of your *entire* doctoral study." In Section 5, eight respondents commented "half teaching and half research" in response to Item 5.7. "What is your primary professional interest?" Therefore, a response option *teaching and research* was added.

Quantitative data was analyzed using SPSS version 19. The primary concern of the quantitative analysis was the psychometric integrity of the two constructs, i.e., doctoral candidates' perceived frequency of involvement in faculty mentorship and learning community,

as represented by 20 items in the survey. Again, no data were missing as all items, except for the open-ended comments, had forced-response.

As an initial step, the 20 observed variables were screened to examine normality, and to identify miscoded data and outliers. To this end, frequency, mean, median, mode, standard deviation, skewness and kurtosis, and range were obtained. Results of this analysis are presented in Table 1. Standard deviation values ranged from 1.46 to 2.21, indicating a rather wide spreadout distribution. Skewness and kurtosis values ranged from -1.31 to .57, where the majority of the values range within -1.00 and 1.00, indicating a fairly normal distribution. These results suggest that sample statistics closely approximates population parameter, and therefore results of the subsequent analysis can be fairly generalizable to future samples, despite small sample size.

Second, reliability and validity of the constructs, mentorship and intellectual community, were assessed. Internal consistency of scores, as assessed using Cronbach's α coefficients, were over .90 for both constructs. Exploratory factor analysis (EFA) was invoked using principal component analysis as the factor extraction, and Promax ($k = 4$) as the factor rotation method. Factor retention decision was consulted with eigenvalues (EV), scree test, minimum average partial (MAP) analysis, and parallel analysis (PA) results. Initial analysis resulted in four factors with EVs greater than 1.00. However, scree test resulted in two, whereas MAP suggested three factors. However, PA resulted in two randomly generated factors with EVs lower than the first two EVs in the empirically generated factors. Given Kaiser's (1960) EV>1 rule tends to over extract factors (Zwick & Velicer, 1986), and given the last two components' low EVs (1.33 and 1.12), EFA was performed again with two factors, to test the results yielded by scree test and PA.

The two-factor solution resulted in a fairly strong and clear factor structure, as presented in Table 2. All intellectual community items had strong pattern and structure coefficients with low cross-loadings on mentorship. The same was true with mentorship items, with the exception of two items with similarly strong pattern and structure coefficients on learning community as on mentorship. These items were M4 "A faculty mentor who provides personalized guidance and/or feedback on my development as a scholar," and M10 "Multiple faculty mentor whom I consider mentors."

Although both items contributed more toward mentorship construct, similarly strong cross-loadings on learning community may speak to the social nature of intellectual development attributed to the construct. Given the preliminary nature of the instrument, those items were retained in the instrument to test with larger sample. However, in doing so, the Item M4 was moved to precede M10 in an effort to minimize its potential influence on responses to other mentorship items by being placed as the fourth item. Overall, with the exception of M4 and M10, the items appear to measure their respective constructs fairly consistently and accurately.

A major problem was identified with the scaling of items in Section 4. Rather than entering a definite number into the textbox, some participants responded in a way that made their responses unquantifiable, e.g., "all," "none," "20-30," and "40-50." Therefore, items in this section were revised to choose from a range of numbers. For example, for Item 4.5, "On average, for how many hours per week were you employed during the coursework stage of your doctoral program (not counting graduate assistantship)?" 14 response choices with 5-hour intervals (*1-5, 6-10, 11-15*) beginning at *0* and ending with *60+*, were provided.

Data Collection

Upon completing two pilot tests and having revised the instrument accordingly, Institutional Review Board approval was modified accordingly and data collection was initiated at all three institutions. Initial data collection began in April 5, 2011, followed by two reminders in two-week intervals. A minimum of 200 responses was sought. A minimally sufficient item to response ratio is a debated topic in educational and psychological research, and this ratio varies depending on the type of analysis. Per EFA, for example, the literature offers guidance ranging from five to 20 responses per item (Kieffer, 1999; Stevens, 1996). Clearly, the larger the sample size, the more likely the results will be stable.

However, a minimum item to response ratio of 1:10, a total of 200 responses was sought, as this ratio would be minimally sufficient for EFA and canonical correlation analysis (CCA). This estimate was arrived by calculating survey items to be used per each analysis. Per EFA, for example, 20 items hypothesized to measure two constructs will require a minimum of 200 responses. Assuming that the 20 observed variables to two latent variables as result of EFA, response rate of 200 is also minimally sufficient for each CCA addressing the two research questions.

Data Treatment

Several variables were recoded, including number of hours spent on academic work outside coursework per week, number of hours employed per week during coursework, amount of financial assistance received for doctoral study, and amount of educational debt incurred. Although these variables were measured in intervals beginning at 0, e.g., 0, 1-5 hours, 6-10 hours, and $0, $1-$5000, $5001-$10000, the survey software recorded them beginning at 1 in

which the response 0 was recorded as 1. To reflect the true zero nature of these variables, these variables were recoded beginning at 0.

Several new variables were derived from the observed/measured variables. The variable time to candidacy was derived out of variables semester began coursework and semester taken qualifying exam by deducting number of Fall, Spring, and Summer semesters elapsed between them, inclusive of the two semesters in which the student began coursework and taken the examination. For example, if a student began doctoral coursework in Spring 2005, and completed their qualifying exam in Fall 2010, this student's time to doctoral candidacy was calculated as 18 semesters. The variable age was derived by deducting the variable birth year from the current year 2011. Also, the graduate assistantship variable was derived to examine the difference between graduate assistantship holders (=1) and non-holders (=2).

Another variable master-doctorate was derived from the measured variables Masters and Doctoral Degree Specializations. In doing so, both masters and doctoral degree specializations were categorized based on Survey of Earned Doctorate categories presented on the 2011 questionnaire. For example, raw data Chemistry was categorized as Life Science, Counseling as Psychology, Educational Administration as Education, History as Humanities, Marketing as Business, and Material Science as Engineering. These variables were further coded numerically as 1=Business Administration and Management, 2=Communication, 3=Computer Science, 4=Education, 5=Engineering, 6=Humanities, 7=Life Science, 8=Math, 9=Physical Science, 10=Psychology, 11=Social Science. Then new master-doctorate variable was created based on the similarity between respondents' masters and doctoral degree majors, assigning 1 if the masters and doctoral degrees were within the same broad disciplinary categories, and 2 if different.

Data Analysis

Data Screening, Descriptive Analysis, and Variable Correlations

Prior to conducting statistical analyses on the data, data was screened in an effort to optimize accuracy and efficiency of the statistical estimates (Odom & Henson, 2002; Wilkinson & APA Task Force on Statistical Inference, 1999). Specifically, raw data on all variables were screened to identify miscoded and missing data, outliers, as well as multivariate normality, and bivariate linearity and homoscedasticity of score distributions. Although selection of data screening techniques is unique to the type of statistical analysis, these techniques are appropriate for correlational methods in the general linear model (Odom & Henson, 2002). Data were treated as appropriate.

Frequency distribution, measures of central tendency, and standard deviation values were obtained. Univariate normality was assessed using skewness and kurtosis values of the observed scores, as well as *P-P* plot of the error/residual scores. Outlying cases were detected using *z*-score distribution. Bivariate normality and linearity was assessed through bivariate scatterplot of standardized residual scores against observed score of each predictor variable. Multivariate normality was assessed using Thompson's (1990) MULTINOR procedure Henson (1999) illustrated. Pearson correlation coefficients between each variable were obtained to assess the relationships within and between learner characteristics, academic involvement, and outcome variable sets.

Psychometric Properties of the Measurement Scores

Reliability of measurement scores was invoked, as it is the first and foremost necessity in measurement precision. In doing so, internal consistency estimate was sought as a measure of how well the survey items measure the same construct (Henson, 2001) as an indirect estimate of score reliability (Gall, Gall, & Borg, 2007). Therefore, internal consistency of the observed

scores measuring the two constructs, mentorship and intellectual community, was assessed using Cronbach's α coefficients. Cronbach's α coefficient of .80 or greater is considered ideal for scores to be considered reliable in basic research (Loo, 2001), with .70 considered a minimally acceptable exploratory standard for instrument development (Nunnally, 1978). For this study, .70 was used as a benchmark for the obtained reliability estimates for each construct. Additionally, inter-item correlations, i.e., Pearson *r* coefficients, was examined to aid understanding the reliability estimates.

Upon obtaining estimates of internal consistency of the scores, establishing reliability of the observed variables measuring the constructs, the second consideration for measurement precision was validity of the measurement. Specifically, construct validity was invoked to assess the degree to which observed variables represent the hypothesized constructs. As Thompson (2004) noted, factor analysis techniques are used to inform the degree to which the survey items produce scores that measure a construct. Therefore, the contribution of each item in measuring the constructs was assessed using exploratory factor analysis (EFA) technique.

Given that the two constructs are hypothesized to have a moderate to high positive correlation, the construct validity of the two constructs was assessed as part of a single EFA. As such, in principal component analysis (PCA) was employed along with a correlation matrix of association. PCA was chosen over principal axis factoring (PAF) as the measured variables have high score reliability, and there are 20 measured variables, hence the difference between the two factor extraction method is negligible in terms of interpretation of results (Thompson, 1992).

Furthermore, factors were rotated obliquely, as oblique rotation techniques allow the extracted factors to be correlated. Specifically, Promax, with κ value of 4, was employed, as it is a good oblique rotation choice (Thompson, 2004). Several factor retention test results were

consulted, including eigenvalue greater than 1.0 (Kaiser, 1960), scree test (Cattell, 1966), parallel analysis (PA), and Velicer's minimum average partial (MAP) test (Velicer, 1976).

Given that the extracted factors were allowed to correlate, the factor pattern and factor structure matrices were not identical (Henson & Roberts, 2006). Therefore, both matrices were interpreted in assessing each item's relative representation of a factor. In doing so, an item-factor correlation of .60 or above on a single factor was referenced as sufficient (Stevens, 1996), as it indicates 36% shared variance between the item and the factor.

Upon obtaining a clear factor structure measured with reasonable reliability and validity, standardized factor scores were calculated per participant for each construct. Standardized factor scores were calculated as observed variables vary in representing the construct. The purpose of calculating factor score(s) per participant was to reduce the number of variables to be used in the subsequent analyses. As Thompson (2004) noted, use of parsimonious variables in substantive analyses "tends to conserve degrees of freedom and improve power against Type II error" (p. 5).

At this point in data analysis, reliability and validity of the 20 observed variables hypothesized to measure two constructs were assessed, and were reduced to smaller number of latent variables. The following discussion pertains to data analyses as they relate to the substantive research questions.

Given multiple outcome variables used in this research, canonical correlation analysis (CCA) was employed to answer the research questions. CCA is a multivariate statistical analysis that simultaneously examines the degree that two continuous variable sets are related to each other, and then determines how the specific variables in each variable set performs in the model. In doing so, CCA creates two unobserved, synthetic variables from the observed variables in each variable set by maximizing variance both within and between the sets (Thompson, 1984),

and then performs a bivariate correlation between the two synthetic variables. As a multivariate analytic technique, CCA reduces the risk of experimentwise Type I error (Sherry & Henson, 2005; Thompson, 1991).

Canonical Correlation Analysis - Research Question 1

The Research Question 1 examined the multivariate predictive relationship between learner characteristics and doctoral students' academic involvement, as measured by mentorship and intellectual community. To answer this question, CCA was performed using the learner characteristics variables as predictors of frequency of involvement in mentorship and intellectual community. In particular, 15 observed variables in the predictor set learner characteristics and two latent variables in the outcome set, mentorship and intellectual community, were entered into the analysis.

Again, CCA first creates one synthetic variable out of the variables in each set by maximizing the relationship among the observed or measured variables (predictor and outcome) and then correlate the two synthetic variables. Given that CCA assumes continuous scaling of the variables, variables were scaled on a 7-point scale, while two dichotomous nominal variables, i.e., graduate assistantship, and similarity between masters and doctoral degree majors, were entered into this model.

CCA results were interpreted using Thompson's (1997) a two-stage hierarchical decision strategy. In the first step, the sufficiency with which the full CCA model captures the relationship between the predictor and outcome sets was examined. In doing so, the inverse of Wilk's λ and the p value were assessed as they estimate practical and statistical significance of the full model across all canonical functions. Given that the full model effect across all canonical

functions was sufficiently large and statistically significant, then each canonical function was assessed through the squared canonical correlations.

Upon establishing the sufficiency of the full model across all canonical functions as well as each function, each observed variable in the predictor and outcome set was assessed for their relative contribution to the overall effect. In doing so, standardized canonical function coefficients, structure coefficients, squared structure coefficients, and communality coefficients of each observed variable were consulted in the interpretation of the results for all meaningful canonical functions.

Canonical Correlation Analysis - Research Question 2

The Research Question 2 examined the predictive relationship between doctoral students' academic involvement, as measured by mentorship and intellectual community, and doctoral education outcomes. To answer this question, CCA was performed using frequency of involvement in mentorship and intellectual community as predictors of doctoral education outcomes. In particular, two latent variables in the predictor set mentorship and intellectual community, and nine observed variables in the outcome set were entered into this model. All variables in this model were continuously scaled on 7-point. The same interpretation procedures described to answer Research Question 1 was employed.

Two CCA models were interpreted in the context of the general linear model assumptions, including sample size, multivariate normality, and linearity. Multivariate normality "requires all linear combinations of variables and all linear combinations are normally distributed" (Sherry & Henson, 2005, p. 40). Therefore, graphical method (Thompson, 1990) was chosen to assess multivariate normality.

CHAPTER 4

RESULTS

This chapter reports the results of the study. This chapter is organized into the following discrete sections: descriptive analysis; general linear model assumptions (GLM) including multivariate normality, linearity and homoscedasticity; psychometric properties of the constructs; variable correlations; and Research Questions 1 and 2.

Descriptive Analysis

A total of 245 responses with complete data were recorded. Each variable's minimum and maximum range were examined. No miscoded variable or data was identified. Although the survey employed forced-response option to minimize missing data, 17 responses to the open-ended forced-response questions were unusable. For example, one participant responded "I'd rather not answer" in response to the doctoral degree major. These cases were removed from the sample.

Additionally, responses to the variable "semester completed qualifying exam" were screened and subsequently 11 non-doctoral candidates were removed from the sample. Participants who have completed coursework and are scheduled to complete qualifying exam in Summer 2011 were retained in the sample. The variable number of hours worked during dissertation stage of doctoral study was excluded from analysis as the majority of the respondents had just achieved doctoral-candidate status, and commented that they do not yet know the response to this question. The final useable sample size was 217.

The following sections describe results of descriptive statistical analysis, conducted as part of data screening. Frequency distribution, measures of central tendency, and standard deviation were calculated for each variable. Table 3 presents the descriptive statistics for categorical variables pertaining to respondents' background contexts, while Table 4 and 5

present the descriptive statistics for continuous variables pertaining to learner characteristics, involvement, and educational outcomes.

From the background and contextual variables presented in Table 3, of the 217 respondents, about half were from a research university with high research activity (RU-HRA) (53.5%, *n* = 116), while the two doctoral/research universities (D/RU) were equally represented in the remaining half. The sample was comprised of about two thirds female (73.7%, *n* = 160), two thirds non-Hispanic Caucasian (65.4%, *n* = 142), and overwhelming majority U.S. citizens (85.3%, *n* = 185).

Although the survey respondents represent a variety of disciplines, fields of study, and professions, approximately half were doctoral candidates pursuing an education doctorate (53.0%, *n* = 115). Of these, over half were enrolled in education doctorate or EdD (*n* = 67) degree programs. About two third of the respondents were pursuing doctoral degrees in the same discipline or field of study as their masters degree (69%, *n* = 140). Furthermore, over half of participants held some form of graduate assistantship during their doctoral study (59%, *n* = 128). Finally, a similar proportion of respondents plan to work in teaching and/or in research capacities (58.08%, *n* = 176), and the vast majority plan to work in an educational setting (79.3%, *n* = 172).

Turning to the academic involvement variables presented in Table 4, and given the 7 point scale with a midpoint of 4.0, mean scores for frequency involvement in mentorship and intellectual community indicate a generally moderate frequency with mean scores ranging from 3.73 to 4.99. On the other hand, mean scores for the perceived importance of involvement in mentorship and intellectual community were generally high, with mean scores ranging from 5.88 to 6.66. Overall, there is greater variation in responses to frequency of involvement (*SD*=1.71 to 2.10) than to importance of involvement (*SD*=.65 to 1.48).

Score distributions of all 20 variables deviate from normality to varying degrees. Frequency of involvement in both mentorship and intellectual community scores were mildly negatively skewed (-.06 to -.59) for the most part, while all were mildly platykurtic (-.34 to -1.31) relative to a normal distribution. Such distribution, particularly platykurtosis, confirms greater variation in the degree of academic involvement. These distributions differ markedly from the importance of academic involvement scores. Score distribution for all ten observed variables deviated from normality substantially with moderate negative skew (-1.05 to -2.42), and severe leptokurtic distributions for the majority of the variables (1.78 to 7.00). This is an indication that most participants perceive the various dimensions of mentorship and intellectual community to be important, thus the relatively few responses on the not important end of the scale are skewing the score distributions. In fact, the response choice 7 or "very important" comprised 43% to 74% of all responses across the 20 dimensions.

No effort was made to transform score distributions to approximate normality given the relatively normal distribution of the frequency of involvement variables aside from moderate platykurtosis. Mild to moderate platykurtic distributions were not considered problematic because the large number of scores under the tails of the distribution increases the likelihood of obtaining statistical significance (Henson, 1999) and tends to "foster power against type II error" (Stevens, 1996, p. 243). Similarly, severe deviations of importance of involvement score distributions were not transformed as they will not be part of any inferential statistics in this study.

Of the ten dimensions of faculty mentorship, providing constructive as well as timely feedback on paper/project, and providing feedback on degree progress (variables M4, M5, and M6) were experienced most frequently and received highest ratings in importance relative to

other variables. Promoting development as a teacher and involving in pre-dissertation research experience (M1 and M8) were experienced least frequently, and also received the lowest ratings of importance. Of the ten dimensions of intellectual community, however, there was less consistency between frequency and importance of involvement. For example, participants experienced exchanges of ideas and feedback, sharing intellectual resources, and respect of one another (IC1, IC2, and IC8) most frequently, however, they were not the highest rated in terms of importance. Figures 1 and 2 present graphic representation of mean scores of variables measuring frequency and importance of mentorship and intellectual community.

Descriptive statistics for continuously scaled learner characteristics and outcome variables are presented in Table 5. On learner characteristic variables LC3 to LC7, measured on 1-7 point interval scale, respondents generally agreed with mean scores ranging from 5.13 to 5.99. These results indicate that students generally agreed with statements suggesting they had clear professional goals, identified their own learning needs, sought learning opportunities outside formal courses, had supportive family and friends, and had significant family/home responsibilities.

Five learner characteristic variables LC8 to LC12 were continuously scaled at the ratio level. Results suggest that, on average, students were enrolled in 8.70 credit hours per semester during the coursework stage of their doctoral program, and spent approximately 16-25 hours per week engaged in academic work outside of classes during the coursework stage, such as reading, writing, meeting with faculty/peers, etc. On average, students were employed 26-30 hours per week during the coursework stage of doctoral study, not counting graduate assistantship, and received $15,000-$25,000 in support for their doctoral study from external sources, while they accumulated $25,000-$35,000 in educational debt.

Turning to outcome variables O1 to O6, measured on 7-point interval scale, participants generally agreed with statements, i.e., participants tended to perceive that their doctoral education experience had prepared them to engage in various forms of scholarly activities, and were generally satisfied with their educational experience (*M*=4.85 to 5.49). Three outcome variables were measured continuously at the ratio level, i.e., O7, O8, and O9. On average, students presented or were scheduled to present 4.36 papers, and published or were in the process of publishing 2.18 peer-reviewed manuscripts on a topic related to their discipline or field of study during their doctoral programs. Lastly, on average, students took about 11 semesters (including fall, spring and summer semesters) to achieve doctoral candidacy.

Frequency distributions revealed two bimodal distributions for learner characteristic variables (LC1 and LC2) at the two ends of the scale. Specifically, 55%-64% of participants tended to either strongly disagree or strongly agree with the statements "Prior to pursuing my doctoral education, I carried out (or contributed to as a partner) research projects," and "Prior to pursuing my doctoral education, I wrote at least one literature review," while only 9.2% (20 participants) and 4.6% (10 participants) selected mid-point response option.

Owing to this bimodality and the strong possibility that the 7-point scale was inappropriate for measuring these experiences, the two variables were recoded into categorical variables in which the first three response options, 1 (=*strongly disagree*), 2, and 3, were recoded as *disagree* (=1), and the last three response options, 5, 6, and 7 (*strongly agree*), were recoded as *agree* (=2), while the mid-point response option 4 was labeled as missing. This recoding into dichotomous categories allowed these variables to be used in the CCA model.

Score distributions of each continuous variable were examined through skewness and kurtosis values. Skewness and kurtosis statistics revealed several variables that deviate

moderately from normal distribution with values below -1 and above 1, including LC4, LC5, LC6, LC7, LC9, LC10, LC11, O3, O5, and O9. Specifically, moderate negative skewed distributions were observed for variables LC4, LC5, LC6, LC7, O3, and O5 with skewness values ranging from -1.49 to -1.08, while moderate positive skewed distributions were observed for variables LC9, LC11, and O9 with skewness values ranging from 1.06 to 1.79. One platykurtic, or wider and flatter distribution was observed for variable LC10 with kurtosis value -1.07, while leptokurtic, or thinner and taller distributions were observed for variables LC4, LC5, LC11, and O9 with kurtosis values ranging from 1.32 to 3.74. Overall, distribution of all continuously scaled variables approximated normality, with the exception of O9.

Each observed variable was then screened for outlier influence through *z*-scores. Only one variable, O9 time to candidacy, had three cases with *z*-scores beyond three standard deviations outside the mean, which may be a reflection the severe leptokurtosis that characterizes the score distribution of this variable. Examination of these three outlying values revealed those who achieved candidacy in 29 to 33 semesters, which represents about 9 to 10 years. These may be students who may have taken time off and/or changed degree program during the process. Nonetheless, these cases were kept in the data because univariate outliers may not be relevant in multivariate analysis. Influence of these extreme values will be examined in the analysis of the substantive research questions.

Assumptions

Multivariate Normality and Outliers

Multivariate normal distribution was assessed because it is the most relevant assumption in multivariate analysis, with normality at univariate and bivariate levels a necessary, but insufficient, condition for multivariate normality (Henson, 1999). Multivariate normality was assessed using Thompson's (1990) MULTINOR graphic method. To this end, two tests were

performed, each involving the variables paralleling the two substantive research questions. One test involved 16 variables, including 14 learner characteristics and two involvement variables for the first research question, and another involved 11 variables, including two involvement and nine outcome variables for the second research question. As presented in Figures 3 and 4, resultant bivariate relational graphic between chi square and Mahalanobis distance formed a relatively straight diagonal line. This result is an indication that multivariate normality is tenable.

Multivariate outliers were examined using *z*-scores of Mahalanobis distances used in each multivariate normality analysis. Distribution of *z*-scores revealed one Mahalanobis distance score that is outside three standard deviations from the sample mean (3.55). Influence of this case's data was examined in the analysis of the substantive research questions by comparing the results with and without this case.

Linearity and Homoscedasticity.

Bivariate linearity and homoscedasticity were assessed as general linear model analyses, including canonical correlation analysis, assume such distribution in the data (Odom & Henson, 2002). Linearity was assessed using two sets of graphics: one set involved observed scores of predictor and outcome variables while the second set involved predicted and error/residual scores. Turning to scatterplots involving observed scores between predictor and outcome variables, each variable score in the learner characteristics, involvement, and outcome variable sets were first converted into *z*-score form. Then the relationship between each variable in the learner characteristics and involvement variable sets, as well as between involvement and outcome variable sets, were graphed using simple scatterplots.

Turning to scatterplots involving predicted and error scores, multiple linear regression analyses were conducted between predictor and outcome variable. Specifically, given that the

first research question pertains to a predictive relationship between learner characteristics and degree of academic involvement, i.e., mentorship and intellectual community, each observed outcome variable pertaining to mentorship and intellectual community was regressed on each of the 14 observed predictor variables pertaining to learner characteristics. The same analytical procedures were applied for graphing predictor and error scores of doctoral education outcomes as predicted by 20 observed variables pertaining to mentorship and intellectual community.

Overall, the bivariate scatterplots suggest linearity in the data. Although several bivariate combinations formed broadly scattered plots, an indication of non-systematic pattern or weak relationship, none indicated a non-linear relationship. Specifically, no clear bulges or dips were observed. Given these results, the sample data is bivariate linear, and the assumption of linearity was considered tenable.

The assumption of homoscedasticity was assessed using a scatterplot of standardized predicted and standardized error scores for each outcome variable. Specifically, standardized predicted and error scores of latent variable mentorship as predicted by all 14 learner characteristics variables was assessed. The same process was used for the latent variable intellectual community. Similarly, each of the nine outcome variables as predicted by the two latent variables were assessed. Overall, the resultant graphs indicate fairly uniform variance in error scores across predicted scores for all pairs of variables. Given these results, the sample data is homoscedastic, and therefore, the assumption of homoscedasticity was considered tenable. However this process identified eight bivariate outliers lying beyond three standard deviations from the mean. The influence of these cases' data was assessed in the analysis of the substantive research questions by comparing the results with and without these cases.

Psychometric Properties of the Constructs

Internal consistency and construct validity estimates of the 20 observed variables measuring students' frequency of involvement in mentorship and intellectual community were obtained using Cronbach's α coefficients and exploratory factor analysis. Two reliability analyses resulted in α coefficients of .94 for mentorship, and .95 for intellectual community. These estimates are considered ideal (Loo, 2001), an indication that the survey item are measuring their respective construct well (Henson, 2001). With each construct, the coefficients could not be increased by deleting items.

Given that reliability is a necessary, but insufficient, condition for measurement precision, exploratory factor analysis (EFA) was invoked to examine the degree to which individual items represent the constructs, using the EFA methods utilized in Pilot Test 2 data and in the methods section. Factor retention decision was consulted with eigenvalues (EV), scree test, minimum average partial (MAP) analysis, and parallel analysis (PA) results. Sample size to variable ratio for EFA was sufficient at approximately 11:1 (Stevens, 1996).

Given the two constructs are hypothesized to have moderate to strong positive correlation, one EFA was performed using oblique rotation. As presented in Table 6, EFA resulted in two factors with eigenvalues > 1, indicating existence of two factors according to Kaiser's (1960) EV>1.00 rule. This result was confirmed with scree test, MAP, and PA results. Two factors explained about 68% of the total variance in the data. Each factor explained approximately 35% and 32% variance prior to rotation, respectively.

Turning to the properties of individual observed variables, communality coefficients ranged from .51 to .82, an indication that each variable is explained by the entire model, or across both factors, fairly well. Furthermore, factor pattern and factor structure coefficients

indicate that this model resulted in a clear factor structure where each observed variable represent the latent variables dominantly. Specifically, factor pattern and factor structure coefficients of the observed variables pertaining to intellectual community ranged from .73 to .92, and .77 to .90, respectively, on the first factor, and ranged from -.15 to .14, and .39 to .63, respectively, on the second factor. While factor pattern and factor structure coefficients of the observed variables pertaining to mentorship ranged from -.11 to .19, and .37 to .59, respectively, on the first factor, and from .64 to .87, and .71 to .88, respectively, on the second factor.

Although all variables distinctly and strongly represented their respective constructs, some contributed more or less variance than others. Of the intellectual community, such characteristics as "values intellectual contribution from a variety of perspectives," "nurtures its intellectual curiosity," and "promotes development as an emerging scholar" contributed the most variance, while such characteristics as "respects one another regardless of differing opinions," "shares opportunities for professional advancement," and "helps develop professional relationships with others in the field" contributed the least variance in the representation of this construct.

Similarly, of mentorship, such characteristics as "promotes my development as a researcher," "provides personalized guidance and/or feedback on my development as a scholar," and "provides constructive feedback on paper/project" contributed the most variance, while "works collaboratively with me on a research project prior to beginning my dissertation/capstone project," "gives feedback on my project/paper in a timely manner," and "multiple faculty whom I consider mentors" contributed the least amount of variance in the representation of this construct.

As assumed, two factors had moderate positive correlation ($r = .627$, $p < .01$), sharing approximately 39% of variance, thus supporting the use of oblique solution as the factor rotation

method. This result is not surprising given that the mentorship was theorized to be a source of intellectual community for students, while intellectual community was theorized to be a source of mentorship to students. Also, intellectual community was operationalized to include faculty as well as peers. The amount of variance these two factors shared is indicative of the presence of higher- or second-order factor in the data, thus making it possible to generalize across these two primary factors to some degree (Gorsuch, 1983).

In summary, the measurement scores yielded a clear internal structure that can be represented by two constructs, confirming the a priori expectation of the relationships among the observed variables as well as between the latent variables. The internal consistency and construct validity estimates indicate good psychometric integrity of the measurement scores of the two constructs.

Given these results, factor scores were calculated for each participant in an effort to use more a parsimonious number of variables in the subsequent analyses, thereby helping "improve power against Type II error" (Thompson, 2004, p. 5). In doing so, Thompson's method (Thompson, 1993) was used to calculate factor scores, hence reducing 20 observed variables to two latent variables. Thompson's method was chosen as it weighs each measured variables' relative contribution to their respective factor in creating factor scores, thus standardizing the factor scores, yet allowing for comparison of factor scores, such as their means and standard deviations.

Descriptive statistics of the two latent variables, as presented in Table 8, suggests that participants were generally involved in learning community (M=3.79) slightly more frequently than in faculty mentorship (M=3.43). Although, given the 7-point scale used, both means were slightly lower than midpoint. Average spreadoutness of each person's score from the mean is

slightly higher for mentorship (*SD*=1.56) than for learning community (*SD*=1.25). While the scores are slightly negatively skewed, and are flatter and wider relative to normal distribution, these distributional estimates are ≤-1.05. Therefore, the distribution of these two variables was considered relatively normal.

Variable Correlations

Bivariate relationships were examined between variables within and across learner characteristics, involvement, and outcome variable sets using Pearson *r* correlation coefficients. Overall, learner characteristics variables had the weakest correlations with other variables in the study, while academic involvement and outcome variables sets had moderate positive correlations within and across each variable set.

Specifically, within the learner characteristic variable set, only four relationships were worth examining further, with coefficients ranging from $r = .41$ to $r = -.52$, sharing about 17% to 27% variance. As presented in the previous section, the two latent variables mentorship and intellectual community had moderate positive correlation ($r = .627$). Within the outcome variable set, moderate positive relationships were observed among variables that measured student perceptions, including self-efficacy to conduct various forms of scholarly activities, and satisfaction with doctoral education experience, with coefficients ranging from $r = .44$ to .75. However, these variables' relationship with tangible educational outcomes such as scholarly productivity and time to candidacy were negligible. Finally, the two scholarly productivity variables, conference presentations and publications shared 23% variance ($r = .482$).

Given the centrality of academic involvement in both research questions, Table 9 presents their relationships with learner characteristics and outcome variable sets. Despite a few statistically significant results, the latent variables mentorship and intellectual community were not related to any of the variables pertaining to learner characteristics meaningfully. As presented

in Table 9, the magnitude of these relationships was less than 10% for all pairs. However, more meaningful relationships, both in statistical and practical terms, were observed between involvement and outcome variables, particularly with students' perceptions concerning preparation and satisfaction, with effect sizes ranging from 13% to 47%. Overall, of the two involvement variables, mentorship had a stronger correlation with the outcome variables than did intellectual community.

Both mentorship and intellectual community variables had the strongest correlation with O6, i.e., students' satisfaction with doctoral education experiences, with effect sizes 47.47% and 36.24%, respectively. However, outcome variables such as number of conference presentations and publications, and time to doctoral candidacy, did not have noteworthy relationships with neither mentorship nor intellectual community.

In summary, the direction and degree of correlations indicate that the more frequently a student is involved in faculty mentorship and intellectual community, the more likely that student is to be satisfied with their doctoral education experience. However despite students' involvement in faculty mentorship and intellectual community and their relationship with their perceived preparation and self-efficacy to engage in various forms of scholarly activities, more tangible educational outcomes such as the research productivity and the number is semesters it takes to achieve candidacy were not meaningfully related to involvement in mentorship and intellectual community. None of the learner characteristics were related to degree with which students interacted with program community.

Canonical Correlation Analysis - Research Question 1

The first research question examined the predictive relationship between doctoral students' learner characteristics and their degree of academic involvement. To answer this

question, CCA was conducted using 14 observed variables concerning students' characteristics as predictors of two latent variables, degree of involvement in mentorship and intellectual community, to evaluate the multivariate shared relationship between the two variable sets (learner characteristics and academic involvement). Sample size for this analysis was 176, as 30 cases were labeled as missing from variables LC1 and LC2 as result of recoding the variables. Interpretation of the results was based on Thompson's (1997) two-stage hierarchical decision strategy.

The analysis yielded two functions with squared canonical correlations (R_c^2) of .167, and .08 for each function. Collectively, the full model across two functions was statistically significant using the Wilk's $\lambda = .766$ criterion, $F(28, 320) = 1.63$, $p = .026$. Given that Wilk's λ represents the variance unexplained by the model, 1-λ yields the full model effect size in an r^2 metric. Thus, for the entire model, r^2 effect size was .234 (23.4%), indicating a small shared variance between the two variable sets. This result indicates that learner characteristics have a limited predictive relationship with doctoral students' involvement in mentorship and intellectual community, as measured in this study. The CCA was repeated upon deleting univariate, bivariate, and multivariate outliers, respectively, and did not result in appreciably different results, an indication that the "results are not produced by anomalies in the data" (Wilkinson & Task Force on Statistical Inference, 1999, p. 599).

Given the exploratory nature of this study and observed effect, the source of the overall model effect was assessed for the first function. As presented in Table 10, some variables contributed more variance to the creation of the synthetic predictor variable, learner characteristics, than did others. For example, structure coefficients for Function 1 suggest that variables LC1, LC7, and LC10 share little to no variance with the canonical variable.

Given the result, the irrelevant learner characteristic variables were deleted based on the strength of communality coefficients in the first function. In doing so, one variable with the lowest communality coefficient was deleted at a time, and CCA was performed again with the remaining variables. Resultant changes in R_c^2 for the entire model and for the first function, as well as communality coefficients were consulted, and variables with the lowest coefficients were deleted in the next round. This process was repeated until significant amounts of reduction were observed in the R_c^2 for the entire model and for the first function, as well as in the communality coefficients.

As a result, a total of eight variables were deleted, including LC1, LC7, LC10, GA, LC9, LC2, LC11, LC8, in this order. This final model (N = 203) with six variables resulted in Wilk's λ =.827, F (12, 390) = 3.22, p < .001. This result is 6% drop in canonical effect, down from 23.4% to 17.3%. During the deletion process, the biggest drop in canonical effect, 3.8%, was observed with deletion of the variable LC10. Interestingly, R_c^2 remained the same 16% for the first function (p<.001), while it dropped for the second function (R_c^2 = .01), upon deleting of all eight variables. Variable deletion was terminated as the deletion of the next variable with the lowest coefficient resulted in a significant drop in canonical effect for the entire model as well as for the first function, 13%, and 12%, respectively. This final model resulted in a parsimonious solution.

Coefficients for the remaining six variables are presented in Table 11. Of the six variables, LC4 (r_c^2 = .646) contributed the largest amount of variance, followed by LC3 (r_c^2 = .227), LC6 (r_c^2 = .174), while LC14 (r_c^2 = .114) contributed the least amount of variance to the creation of synthetic predictor, learner characteristics. This conclusion was supported by squared structure coefficients which also represent communality coefficients when only one function is reported. Variable LC5 had a very low standardized canonical function coefficient (β = .02) and

high structure coefficient (r_c^2 = .358). This result was due to multicollinearity that this variable had with LC3 and LC4 (Pearson *r* = .203** and .405**). Furthermore, all but one variable (LC12) had positive structure coefficients, and indication that these predictors were all positively related. Overall, compared to the initial 14 variable model, all six variables' coefficients had increased in this final model.

Regarding the outcome variable set, the coefficients indicate that both mentorship (r_c^2 = .994) and intellectual community (r_c^2 = .325) were relevant in the creation of the synthetic outcome variable, academic involvement, although mentorship undoubtedly was the primary contributor. Compared to the initial model, coefficients for the outcome variable intellectual community dropped appreciably to .57, down from .74, while mentorship was not affected by variable deletion.

These results suggest that the most relevant learner characteristics related to students' degree of involvement in mentorship and intellectual community were identifying learning needs to meet professional goals, having clear professional goals upon pursuing doctoral degree, seeking learning opportunities outside of formal courses to meet professional goals, having family and friends who are understanding and supportive of the demands of doctoral study, accumulating less educational debt, and pursuing same or similar discipline or field of study in doctoral study as in masters degree. The finding in this final model demonstrates theoretically consistent relationships among all the variables that contributed to this canonical effect.

However, this canonical result presented evidence of multicollinearity. First, the sum of squared structure coefficients are >1 in each variable set. Second, low function and high structure coefficients associated with LC5 indicate that this variable contributed little unique variance to the effect, or that its variance is also explained by other variables. This context necessitated

further clarification of the model. Specifically, given the multicollinearity exist in the data, each variable needed to be further examined for their unique and shared contribution to the observed effect. To this end, canonical commonality analysis (CA) was conducted as it partitions variance unique to a variable and common to groups of variables (Nimon, Henson, & Gates, 2010).

The last three columns of Table 11 present partitioning of the unique, common, and total effects of each variable. It appears the synthetic predictor variable was explained primarily by variance unique to LC4 (.056), LC14 (.039), I12 (.022), and common to both I3 and I4 (.017). These commonality coefficients represent 83.44% of the canonical effect, each representing about 35%, 24%, 14%, and 11% variance.

Turning to the outcome variable set, it appears the synthetic outcome variable was explained primarily by variance unique to mentorship (.182) and common to both mentorship and intellectual community (.303). These commonality coefficients represent 92.28% of the canonical effect. The unique contribution of intellectual community was negligible (.041), only representing 7.72% of the canonical effect. The common contribution attributed to both variables is not surprising given the moderate relationships between these two latent variables.

In summary, the majority of the learner characteristics were not as relevant in predicting students' degree of academic involvement, as expected. Hence, overall, this result contradicts empirical evidence in the literature on student-related factors that ought to be related to their educational experience. Despite low practical significance, only six learner characteristic variables in the final model emerged as more relevant than when they are combined with eight other variables as predictors. However, these six variables predicted student involvement in mentorship much better than involvement in intellectual community. The final six predictor

model offers a more parsimonious canonical solution without substantial reduction in canonical effect, hence more likely to be true and replicable in future samples (Thorndike, 1978).

Canonical Correlation Analysis - Research Question 2

The second research question sought to examine the predictive relationship between doctoral students' academic involvement and doctoral education outcomes. To answer this question, CCA was conducted using two latent variables, mentorship and intellectual community, as predictors of the nine observed variables concerning doctoral education outcomes to evaluate the multivariate shared relationship between the two variable sets (academic involvement and doctoral education outcomes). Sample size for this analysis was 227.

The analysis yielded two functions with squared canonical correlations (R_c^2) of .552, .053 for each function. Collectively, the full model across two functions was statistically significant using the Wilk's $\lambda = .422$ criterion, F (18, 386) = 10.09, $p < .001$. The effect size for the entire model, or 1- λ, was .578 (57.8%), indicating a substantial amount of shared variance between these two variable sets.

The dimension reduction analysis allowed testing of the hierarchical arrangement of functions for statistical significance. As noted, the full model (Functions 1 to 2) was statistically significant. However, only the first function was statistically significant F (18, 386) = 11.58, $p <$ .001, while the second function did not explain a statistically significant amount of shared variance between the variable sets F (8, 194) = 1.35, $p = .217$. Given the practical (55.2% and 5.3%) and statistical ($p < .001$ and $p = .217$) significance of each function, only the first function was considered worthy of further interpretation.

Table 12 presents standardized canonical function coefficients, structure coefficients, and squared structure coefficients for Function 1. Communality coefficients were not reported as

they equal the squared structure coefficients when only one function is reported. The results indicate that the two predictor variables, mentorship and intellectual community, both made meaningful contributions to the creation of the synthetic predictor variable in this model, although mentorship contributed more than learning community. This conclusion was supported by both the function coefficients $\beta = -.689$ and $\beta = -.410$, and the structure coefficients $r_s = -.948$ and $r_s = -.846$.

Regarding the outcome variable set, the variable O6, or the satisfaction with doctoral education experience, was the dominant contributor in creating the synthetic outcome variable, followed by O1 to O5, which measure students' perceived preparation or self-efficacy to conduct various forms of scholarly activities. However, tangible educational outcomes such as scholarly productivity (O7 and O8) and time-to-candidacy (O9) made little to no contribution. Given the moderate correlations among the outcome variables presented in the previous section, and hence the presence of strong multicollinearity, structure coefficients were consulted arriving at this conclusion.

Given the near zero variance accounted for by variables O7, O8, and O9, canonical correlation analysis was performed again without these variables in an effort to obtain a parsimonious model without significant reduction in the canonical effect. In doing so, the same variable deletion method was used in addressing the first research question. Variables O9, O7, and O8 were deleted, in that order. The final six outcome variable model resulted in minor reductions in canonical effect for full model (Wilk's $\lambda = .444$) as well as for the first function ($R_c^2 = .539$), 1.6% and 1.3% reductions, respectively, from the initial model. Table 13 presents the results of the final model with six variables. Similarly, individual coefficients indicate

negligible change in source of effect. This process resulted in a more parsimonious model that is more likely to be replicable.

Although strength of the function coefficients was fairly consistent with structure coefficient for variable O6, they were less consistent for variables from O1 to O4, with negligible function coefficients (.001 to -.078), and fairly strong structure coefficients (-.602 to -.671). These results confirm the presence of multicollinearity, in that the creation of the synthetic outcome variable did not incorporate variance these four outcome variables could contribute as the variance they could have contributed had already been accounted for by O5 and O6. This result is not surprising given the moderate positive relationships among these variables discussed in the previous section. All six outcome variables' structure coefficients had the same sign, an indication that they were all positively related, thus confirming correlation analyses results.

Although function and structure coefficients provided insight into the composition of the synthetic variables, they fail to clearly articulate whether and how much each observed variables' contributions to the effect were unique to them or shared with other variables. As with the first CCA, results present evidence of multicollinearity. First, the sum of squared structure coefficients are >1 in each variable set. Second, low function and high structure coefficients indicate many of the observed variables contributed little unique variance to the effect, or that their variance is also explained by other variables. Lastly, as presented earlier, correlation coefficients indicate there is about 20%-56% shared variance between the predictor variables mentorship and intellectual community, as well as between the outcome variables O1-O6.

Given this context, commonality analysis was performed to further clarify each variable's unique and shared contribution to the canonical effect. The last three columns of Table 10 present partitioning of the unique, common, and total effects of each variable. The predictor

variable set commonality analysis results were consistent with the first research question, in that the variance unique to mentorship (.182) and common to both mentorship and intellectual community (.303) explained about 92% of the variance in the synthetic predictor variable. The unique contribution of intellectual community is negligible (.041). With its common effect with mentorship, intellectual community contributed 65% variance.

Mentorship was inarguably the dominant variable in this set. Although the variance accounted for by intellectual community is not insignificant, most of its variance, 57% out of 65%, was also accounted for by mentorship. This large common effect is not surprising given that learning community is theorized to include faculty members as well as student peers, and hence they share 40% variance (Pearson r = .627). This common variance suggests that the role intellectual learning community play (i.e., helping germinate and develop ideas, and sharing intellectual and professional resources) is also fulfilled by faculty mentors, while intellectual community has the benefit mentorship brings about as well. This finding supports theoretical expectations of these two constructs.

Turning to the outcome variable set, it appears that the synthetic outcome variable was explained primarily by variance unique to variable O6 (.178) and common to variables O1 through O6. The unique variance of O6 accounted for 33.1% of the effect, while the variables O1 through O6 commonly accounted 19% of the variance to the effect. The lack of noteworthy unique effects attributable to self-efficacy suggest the variance self-efficacy contributes is also accounted for by satisfaction. Given the large number of variables in the outcome set, commonality coefficients and percent variance accounted by all combination of variables was not presented in tabular format.

The common effect is indicative of those who were more satisfied with their educational experience also tended to have greater sense of self-efficacy to conduct various forms of scholarly activities, particularly being able to conduct research projects from conception to interpretation of results, to write manuscripts for peer-reviewed publication, to teach, to solve practical problems, and to work collaboratively with other scholars. Again, this was evident from the variable correlations, and makes intuitive sense for these variables to be correlated. If these outcomes are the primary educational goals of doctoral education, then meeting them, even in terms of student perception, should lead to a satisfying educational experience, especially if interaction with program community was useful in achieving those goals.

In this study, however, increased self-efficacy in research and publishing did not translate into significantly more research productivity or vice versa, given the statistically significant ($p \leq .004$), but weak relationships ($r^2 \leq .114$). Clearly the link between self-efficacy and actual productivity is questionable among this sample and in this timeframe.

In summary, canonical correlation and commonality analyses concerning the relationship between involvement and educational outcome results suggest that students' frequent academic involvement, particularly faculty mentorship, are predictive of educational outcomes such as satisfaction with doctoral education and self-efficacy to conduct various forms of scholarly work as result of doctoral education. However tangible educational outcomes such as number of conference presentations and publications, and time-to-candidacy were not related to their involvement in mentorship and intellectual community.

Summary of the Findings

Results suggest that doctoral students' educational experiences, expressed in terms of the quality and quantity of interactions and relationships with faculty and peers, are clearly related to

levels of satisfaction and self-efficacy. Given the operationalization and measurement of the variables, the findings of this study lend partial support to the theoretical expectations of the relationship between doctoral students' learner characteristics, their academic involvement, and educational outcomes as conceptualized by Astin's input-environment-outcome model and academic involvement, operationalized based on Walker et al.'s (2008) proposed pedagogical practices in doctoral education. In particular, given the low practical significance, student involvement in mentorship and intellectual community, conceptualized to represent students' psychological and physical energy spent on academic work, was not meaningfully related to their learner characteristics as expected.

However results yielded theoretically expected relationship between students' educational experience, i.e., their degree of involvement in mentorship and intellectual community, and educational outcomes, at least in terms of student perceptions. This result supports Astin's theory that educational outcomes are proportional to the amount of psychological and physical energy spent on academic work that was represented by academic or intellectual interaction with faculty mentors and peers. Given the contextual background of the study participants, the findings of this study are more representative of white (non-Hispanic), U.S. citizens pursuing doctoral education at public higher education institutions in North Texas area.

CHAPTER 5

DISCUSSION

This final chapter begins with a brief description of the study followed by a summary of the findings. The findings of the study are then discussed in the context of relevant literature. Practical and theoretical implications of the findings as well as the recommendations for higher education practice and policy are discussed. Finally, recommendations for further research conclude this chapter.

Description of the Study

This study examined predictive relationships between variables pertaining to doctoral students' learner characteristics, their degree of academic involvement, and educational outcomes identified as relevant in the effectiveness of doctoral education. Specifically, multivariate predictive relationships were explored between doctoral students' learner characteristics and academic involvement, and between doctoral students' academic involvement and doctoral education outcomes as doctoral students perceived and experienced in their program of study.

Variables were operationalized based on the literature relevant to doctoral education. Specifically, variables including self-direction, willingness to work hard, prior experience with synthesizing literature and with research process, prior content knowledge background, family support and responsibility, financial support and debt, and graduate assistantship, were measured to represent learner characteristics. Two broad constructs, faculty mentorship and intellectual community (Walker et al., 2008), each measured with ten observed variables, were used to represent academic involvement (Astin, 1993) in relation to faculty mentors and student peers. Finally, variables such as satisfaction with educational experience, self-efficacy in conducting various forms of scholarly work, scholarly productivity including number of conference

presentations and publications, and degree progress were measured to represent doctoral education outcomes.

A survey instrument was developed and underwent a two-stage pilot test with doctoral students and doctoral faculty at one public university in the state of Texas. Both qualitative and quantitative feedback were used in revising the instrument for final data collection in answering substantive research questions. Upon completion of pilot testing, a sample was drawn from doctoral candidates pursuing research doctorates across disciplines and fields of study at three public universities in the state of Texas, i.e., one research university with high research activity, and two doctoral/research university.

Data (N=217) were analyzed to describe characteristics of the sample, assess internal consistency and construct validity of the two constructs using Cronbach's α and exploratory factor analysis, and to examine multivariate predictive relationships among the variables addressed in the substantive research questions using canonical correlation and canonical commonality analyses. Finally, doctoral' students perceptions regarding the importance of faculty mentorship and intellectual community were examined using descriptive statistics.

Summary of the Findings

The sample data were more representative Caucasian, female, and US citizen students pursuing doctorate. Although broad disciplines and fields of study were represented in the sample, half were pursuing doctoral degrees in education. The scores on the observed variables measured to represent faculty mentorship and intellectual community were reliable and valid in measuring their respective constructs. Regarding Research Question 1, doctoral students' learner characteristics as operationalized and measured in this study were statistically significantly ($p <$ .05) predictive of doctoral students' degree of academic involvement, yet lacked compelling

practical significance ($R_c^2 = .23$). Of the 14 observed variables representing learner characteristics, self-direction, family support, educational debt, and background in content knowledge were relevant in predicting academic involvement, particularly with faculty mentors. Specifically, as students pursued doctorates with clear professional goals, identified their learning needs, and sought learning opportunities outside of class, they tended to be more academically involved. Likewise, certain circumstances, such as greater support from family and friends, having accumulated less debt, and greater content knowledge in their field accounted for more variation in the degree of academic involvement.

Regarding Research Question 2, degree of academic involvement was strongly predictive of doctoral education outcomes ($p < .001$, $R_c^2 = .58$), particularly intangible outcomes such as satisfaction with doctoral education experience and self-efficacy in conducting various forms of scholarly works, but was not predictive of more quantifiable educational outcomes such as scholarly productivity and degree progress. Specifically, students' frequent interaction with one or more faculty mentors who promote student development as researchers and scholars, who provide students constructive feedback on learning and development, and involve students in hand-on learning were particularly relevant in student satisfaction with their educational experience as well as self-efficacy in conducting various forms of scholarly work, especially research and the publishing processes.

Finally, participants perceived involvement in various dimensions of faculty mentorship and intellectual community as important to them as doctoral students. These perceptions were fairly uniform among the participants. Taken together, not only did students believe that various dimensions of academic involvement concerning faculty mentors and intellectual community as measured in this study were important, but the more academically involved they were the more

they likely they were to feel satisfied with their educational experience and feel that they can do research, publish, teach, apply, and integrate knowledge in their chosen field.

Discussion of the Findings

Learner Characteristics and Academic Involvement

Despite statistically significant relationships between various characteristics and their degree of academic involvement, the lack of practical significance of this relationship largely contradicts doctoral education literature. Qualitative studies on doctoral education suggest a link between student attributes and educational experiences and outcomes including self-direction, willingness to work hard, content knowledge background, and prior experience with the research process (Anderson & Anderson, 2011, Austin, 2002; Gardner, 2009; Golde, 2005; Walker et al., 2008). Quantitative studies also link certain learner characteristics such as graduate assistantships and content knowledge background with educational experiences such as interaction with program community and involvement in academic activities (Girves & Wemmerus, 1988; Malaney, 1988; Nettles & Millett, 2006), and satisfaction (Barnes & Randall, 2011; Smart, 1987).

Taken together, the lack of a practically significant relationship between learner characteristics and degree of involvement in mentorship and intellectual community found in this study is puzzling. It logically follows that doctoral students with appropriate preparation, motivation, and opportunities are more likely to be involved in academic work with faculty mentors and peers. Several reasons may explain the lack of noteworthy relationship between learner characteristics and academic involvement.

First, because most research on doctoral education has been conducted at so-called “Tier One” institutions, the variables pertaining to learner characteristics may be less relevant in these

different institutional contexts sampled in this study – that is, in high research activity and doctoral research universities. For example, Gardner's (2009) study that identified successful student characteristics from faculty perspectives was sampled from doctoral programs with national reputations at a research university with very high research activity. Therefore, the success factors identified in the literature may be less generalizable in the different institutional contexts.

Educational focus and practice, and therefore the culture of doctoral programs may differ based on institutional type. Programs in one type of institution may be more selective in their admission and have more resources to support faculty scholarship and student program of study than programs in different type of institutions (Levine, 2007), leading to differences in faculty workload, faculty productivity, and the type of students enrolled at different types of institutions. Some programs may also have different foci, and attract students with different professional goals. These contexts may in turn affect the dominant teaching and learning practices. Given this perspective, factors relevant in one institutional context may not be relevant in others.

Second, even if the variables were relevant in different institutional contexts, it is possible that operationalization and/or measurement of learner characteristic variables in this study may not have accurately captured underlying concepts. For example, prior experience with literature review and research process was used as proxy for relevant academic preparation or ability, and was measured on 7-point agree-disagree continuum. Responses to these statements were bimodal at the tail ends, in that students either agreed or disagreed with these statements. Dichotomous recoding of the responses may have failed to capture variance among those who brought experience with literature review and research processes. Therefore, measuring the

number of literature reviews and research studies the students had experience with in differing contexts may have been more useful.

Similarly, operationalization of self-direction and willingness to work hard in this study may have failed to capture these traits. How much having clear professional goals, identifying learning opportunities, and seeking learning opportunities are reflective of learners' self-directedness, and do they cover the scope of self-directedness? Likewise, aside from hours spent on doctoral study, what other indicators of willingness to work diligently for doctoral students may have been used? Clarification and refinement of these behavioral phenomena is in order.

Third, exclusion of other important variables related to student experience and outcomes may also be contributing to inconclusive findings. The Graduate Record Examination (GRE), for example, is the conventional measure by which prospective doctoral students' academic preparation and intellectual ability are evaluated. Therefore, without capturing the variance accounted by such variables as GRE, any model that attempts to explain the relationship between learner characteristics and learning experience may prove less fruitful.

Fourth, faculty- or program-level variables may account for much variance in explaining students' degree of involvement. Indeed, regardless of the level of preparation, motivation, and circumstances the students bring with them, without adequate support, faculty may not be able to attend to students' developmental needs to the fullest extent. For example, faculty-student ratio, faculty workload, faculty productivity, and other faculty and/or program specific contexts may well affect the quality and quantity of student involvement more than anything else. Again, as with GRE scores, it was beyond the scope of this study to collect faculty- or program-level data.

Finally, disciplinary characteristics have a profound impact on doctoral student experiences (Gardner, 2010; Golde, 2005) and outcomes (Barnes & Randall, 2011). The method

with which research and scholarship is learned and conducted differs markedly across the disciplines in that students in basic and applied life and physical sciences begin to experience research much earlier than students in social science and humanities. Life and physical science students' learning experiences can be characterized as more social than other fields. Therefore, analysis of the entire sample without examining discipline-based subsamples may have attenuated the observed effect. Unfortunately, in this study the small discipline-based cell sizes precluded such analysis.

Regardless of inconclusive results, it is worth noting that some of the attributes faculty and programs perceive as important in doctoral student success may yet be of merit. For example, having clear professional goals, identifying learning needs, and seeking out learning opportunities, all measured as a proxy for self-direction, are characteristics faculty believe to be successful student characteristics (Gardner, 2009). The findings of this study lend some support to this earlier finding, adding credibility to faculty perceptions, in that these characteristics may indeed be relevant in quality and quantity of student involvement.

Furthermore, other circumstances that are identified to be relevant in doctoral degree completion and satisfaction, such as content knowledge background (Golde, 2005; Smart, 1987), financial support (Abedi & Benkin, 1987; Girves & Wemmerus, 1988), and family support (Tinto, 1993) were also relevant in quality and quantity academic involvement. Some of these characteristics, particularly self-direction and content knowledge background, are often used to screen prospective students, reflecting faculty perceptions and preferences for student attributes. The relationship identified in this study provides some empirical support for perceptions and preferences. Perhaps, having lesser financial burden and strong support from family and friends

allow students to devote more to academic pursuit with increased interaction with faculty and peers, ultimately leading to greater likelihood to be satisfied and complete degree.

Academic Involvement and Educational Outcomes

Strong predictive relationships between student involvement in mentorship and intellectual community and level of satisfaction with doctoral education experience and self-efficacy in conducting various forms of scholarly work suggests that frequent student interaction with faculty and peers engaging in intellectual work are educationally meritorious activities in doctoral education. Although mentorship and intellectual community were both relevant, student involvement in faculty mentorship was the most predictive of student satisfaction and self-efficacy.

The dominant role of mentorship in this model suggests that certain educational outcomes hinge on the presence or absence of the quality and quantity of faculty mentorship. In other words, an effective and productive mentoring relationship between students and faculty predicts higher levels of student satisfaction and self-efficacy. Likewise, intellectual community offers an avenue for students to contribute to and benefit from a community of scholars within their program, predicting greater levels of satisfaction with educational experience and perceptions of self-efficacy in various forms of scholarship.

The relatively substantial unique effect of mentorship, however, may be an indication that the benefit of faculty mentorship extends beyond the benefit of intellectual community. However, given the less consequential unique effect, the same does not hold true for intellectual community. In other words, intellectual community offers relatively little added benefit to student development that effective faculty mentoring relationship does not offer. In fact, faculty

mentorship may itself serve as a source of intellectual community for doctoral students, lending similar benefits as intellectual community.

The small unique effect does not undermine intellectual community's role in doctoral students' learning and development. Quite to the contrary, its substantial common effect with mentorship may be an indication that faculty mentoring occurs largely in formal and/or informal community settings, serving as a source of intellectual community as well as expert guidance. This small unique effect has an implication for measurement as it relates to parsimony and will be discussed in the coming section. Overall, the implication of this finding is that while both mentorship and intellectual community play a significant role on satisfaction and self-efficacy, faculty mentorship is indispensible.

Involved educational experience is predictive of more intangible subjective outcomes, satisfaction and self-efficacy, only. The relatively large shared variance among satisfaction and self-efficacy in five types of scholarly activities is an indication that those who have greater self-efficacy are more satisfied with their educational experience. It is possible that students are more satisfied because they feel well-prepared to conduct various forms of scholarly activities. This link between academic involvement and these intangible outcomes supports expert assertions and exploratory evidence that greater interaction with faculty and peers, as well as experiential learning of the research process promotes doctoral students' competence as a scholar, particularly in scholarship of discovery (Boyle & Boice, 1998; Gardner, 2008b; Levine, 2007), and satisfaction (Barnes & Randall, 2011).

However, a greater degree of academic involvement has no bearing on more tangible, quantifiable outcomes such as scholarly productivity or degree progress. This finding contradicts existing literature linking faculty mentorship with research productivity in a national-scale

quantitative study (Nettles & Millett, 2006). It is possible that some students present and publish papers without much input and guidance from faculty and peers, developing competence in this area independently or through mentorship by scholars outside their doctoral programs. It is also possible that the candidacy stage is not an appropriate time to measure this variable, as presenting and publishing takes time to mature and doctoral students' research program at this stage is in early stage of development. Considering the fact that both the number of presentation and publication variables had a moderate positive skew and a mild leptokurtosis, where most students had a single presentation and publication, there is less variance to draw upon in relation to variation in involvement.

Overall, this conclusion lends support to Walker et al.'s (2008) suggestion of the critical value of mentorship and intellectual community in doctoral education, at least in terms of student satisfaction and self-efficacy. This further reinforces the importance of the quality and quantity of faculty-student interaction in doctoral student socialization, degree completion, and satisfaction noted in the literature (Barnes & Randall, 2011; Boyle, & Boice, 1998; Council of Graduate Schools, 2009; Gardner, 2010; Girves & Wemmerus, 1988; Golde, 2005, Lovitts, 2001).

The findings of this study also support Astin's (1984) theory of involvement as applied to doctoral education, and therefore, its utility in research concerning doctoral education. To some extent, doctoral students' frequent interaction with faculty and peers in scholarly endeavors represents greater effort on the part of students, leading to a more involved and engaged educational experience, and more involvement matters when it comes to student satisfaction with their educational experience and greater self-efficacy as an emerging scholar. Furthermore, because satisfaction is linked with doctoral degree completion (Girves & Wemmerus, 1988;

Lovitts, 2004), the benefit of involvement may well extend beyond satisfaction, as in undergraduate education, where the relationship among academic involvement, satisfaction, and degree completion is empirically supported (Astin, 1993, Tinto, 1993).

Academic involvement also represents academic integration. As in undergraduate education, academic integration is essential in doctoral education. Specifically, academic integration to immediate departmental/program community, rather than the university-wide community, is an emergent theme in doctoral student experience, often noted for their effect on degree completion (Gardner, 2008a; Golde, 2005) and development as a researcher (Boyle & Boice, 1998; Katz & Hartnett, 1976).

Two broad forms of academic integration, interaction with faculty as mentors and interaction with the broader department/program community including faculty and peers, as a source of intellectual community, are two important and immediate sources for doctoral students' learning and development. Their presence or absence altogether, and/or students' decision to participate or not participate, has an impact on whether or not students will be satisfied with their educational experience or feel prepared to conduct various forms of scholarly work.

In addition to this link between degree of involvement and educational outcomes, students' perception of the importance of academic involvement also validates Walker et al.'s (2008) value of signature pedagogies as crucial to doctoral education. Students rated highly the importance of being involved in mentorship and intellectual community with little variation. In other words, not only experts on doctoral education, but also doctoral students themselves – the most important stakeholders of doctoral education – recognize the importance of these teaching and learning practices in doctoral education. Most importantly, however, the strong link between

educational experience characterized by frequent academic involvement and various educational outcomes legitimizes expert assertions and student perceptions.

Although satisfaction and self-efficacy are both important educational outcomes, they are both highly subjective. There is no right or wrong answer when it comes to student satisfaction with their educational experience. On the other hand, students' sense of self-efficacy can be less accurate because actual competence can be measured more objectively with external evidence or criteria. Therefore, it is a less stable measure of learning outcome without additional evidence.

Scholarly productivity is often used as evidence of research competence. The lack of practically significant relationship, although statistically significant, between self-efficacy in research and publishing, and scholarly productivity in the form of number of conference presentations and peer-reviewed publications brings into question their collective utility as indicators of research competence among doctoral candidates at these institutions. Concrete outcomes such as doctoral students' conference presentations and publications are used to benchmark doctoral programs in the State of Texas (Texas Higher Education Coordinating Board, 2009). It is therefore yet important to identify indicators of research competence, and to explore factors that promote scholarly competence and productivity, as well as to longitudinally study the relationship between self-efficacy and actual productivity upon graduation.

Interacting with faculty and peers and being involved in scholarly work aids in the professional socialization process. Doctoral education is a period of socialization (Austin, 2002; Gardner 2008a, 2010; Weidman & Stein, 2003), wherein doctoral students not only learn and socialize to the role of doctoral student, but also to the professional values, norms, and expectations of being a researcher and scholar in their chosen field. In other words, it is during this formative stage that students develop a sense of professional self. Doing research and

engaging in dialogue with community of scholars is part and parcel of scholarly work. Therefore, it follows that the quality and quantity of interaction with program community, and engagement in scholarly work promotes doctoral students professional socialization.

Implications and Recommendations of the Findings

The essence of this study's findings – that students perceive being involved in faculty mentorship and intellectual community as important, and that when students are actually involved in mentorship and intellectual community they are more satisfied with their doctoral education and have a greater sense of self-efficacy – imply that these forms of learning should be integral part of teaching and learning practices in doctoral education. The potential for these practices to directly or indirectly affect other outcomes such as capacity for independent scholarship (Gardner, 2008b), and degree completion (Golde, 2005) is promising in light of current climate of higher education, specifically in the State of Texas.

Calls for greater effectiveness and efficiency in higher education in doctoral education (Council of Graduate Schools, 2009) necessitate that individual programs and faculty members pay closer attention to their educational practices and the outcomes they engender. In Texas, for example, in response to recent calls for greater effectiveness and efficiency, some institutions have taken the lead in adopting transparent measures such as making teaching evaluation a more integral part of faculty evaluation process and improving graduation rate at the graduate education level.

The implications of the study are yet more meaningful given the role of scholars in the knowledge economy. Economic and social uncertainty calls for innovative and creative solutions in which knowledge workers are capable of addressing problems systematically and scientifically (Association of American Universities, 1998). Given these broader contexts and the

findings of this study, the value of effective and productive mentoring relationships between faculty and students, and a lively community of scholars in the program community should be recognized and supported from all stakeholders, including students, faculty, institutional administrators, as well as higher education policy-makers.

Recommendations for Practice and Policy

First and foremost, students must be active agents in their own learning process. Without students who possess initiative, self-direction, and motivation, no amount of effort faculty and program put forth is likely to be consistently fruitful. Students must recognize the value of interacting with faculty and with a community of scholars within their program, and of transferring knowledge of scholarship into practice of scholarship, to actually be involved and engaged throughout their doctoral experience. Faculty, either individually and/or collectively, can aid in students' active role in this process by making program goals, expectations, and assumptions clear to students from the very onset of the program.

Students must seek out or create learning opportunities for themselves, and elicit advice and feedback from faculty and peers. Students may serve as valuable apprentices to faculty, developing an effective and productive working relationship that serves both student and faculty. Students, who must learn to conduct scholarship, and faculty, who often benefit from assistance with their own scholarship, make natural allies. Mutually beneficial relationships between these stakeholders should be systematically encouraged. Whether pursuing their own research program and hoping to recruit faculty mentors, or aiding a faculty-led research program, students should seek out faculty who can offer developmentally meaningful experiences and insights, benefiting from faculty expertise in pursuit of their professional and learning goals.

Individual faculty members should mentor students across various dimensions of developmental needs as researchers and scholars. It may serve them well if faculty clearly define and communicate with students their role as a mentor, as well as the students' role as apprentice from the onset. In doing so, faculty should communicate their expectations of the student, be it greater initiation, self-direction, and/or capacity.

Faculty mentorship of doctoral students is a form of teaching, and can take a variety of shapes, from offering guidance and constructive feedback generally on student development, more specifically on student papers and projects, to involving students in hands-on learning that increases in complexity as they progress through their program of study. At the heart of faculty mentoring of doctoral students is intentionality (Austin, 2009; Walker et al., 2008) that provides students with focused, systematic, and explicit guidance, feedback, and ways of conducting scholarship. In doing so, faculty should identify students with differing goals, abilities, and potentials, and collaborate with them on scholarly activities, guiding, scaffolding, and providing feedback along the process. While students have a responsibility to make themselves available, faculty should seek to draw students into scholarship as the opportunity arises to include early career scholars in their work.

Furthermore, faculty should initiate and take part in a lively collegial community of scholars within their department or program, sharing experiences, resources, and opportunities that will help advance doctoral students, and other novice scholars in the program, serving as invaluable source of expertise within intellectual community. In short, quality and quantity of faculty-student interaction matter. Faculty should not take their role as mentors lightly. Students are keen observers of faculty behavior, and it plays a significant role in their professional socialization as scholars (Austin, 2002).

An effective and productive community of scholars requires a supportive and collegial environment to thrive, which can be time-consuming, particularly for faculty members. Although it is impractical to regulate or structure human relationships, certain physical and non-physical conditions may help promote formation of such communities. Institutional and program administrators must ascertain that policies and procedures are supportive of teaching and learning practices that promote high quality doctoral education. Program enrollment and faculty workload policies and practices have implications on faculty members' ability to provide a quality educational experience to students. Faculty workload and reward mechanisms must therefore reflect the time-commitment required from faculty inside as well as outside of formal coursework.

Finally, faculty mentorship should be evaluated for its effectiveness, and this evaluation should be given more weight in tenure, promotion, and other faculty reward decisions. However, given the fluidity in human relationship dynamics, this evaluation should supplement other faculty evaluation measures. Likewise institutional and program administrators should elicit student feedback on the quality of their experiences and use this feedback in their efforts to improve students' educational experiences.

Unfortunately, the call for greater efficiency in higher education may have negative implications for faculty mentorship in doctoral education. In Texas, for example, recent calls to reduce higher education cost emphasize the need to have faculty members spend more time in the classroom. This may well affect faculty research and the quality of individualized mentorship available to doctoral students. Policy makers must recognize mentorship as a crucial form of pedagogy in doctoral education and ensure that public policy supports this vital educational practice. Sweeping policies intended to promote the efficiency of undergraduate education must

be considered in light of how they might come to affect the quality of doctoral education more generally. This is particularly vital in institutional contexts for which research is a key aspect of mission.

Recommendations for Future Research

Given the findings and limitations of this study, a number of suggestions may be recommended for future research efforts. Further research needs to focus on revising and refining the operationalization and measurement of the variables concerning learner characteristics addressed in this study, and on examining their relationship with student experiences and outcomes. Furthermore, research should examine the effect of other variables specific to students, as well as to programs and faculty, in relation to student experiences and outcomes. For example, how are GRE scores related to student involvement? Likewise, how are program- and faculty-level variables (such as faculty-student ratio, faculty workload and productivity) related to student experience?

A substantial portion of unexplained variance in predicting educational outcomes using academic involvement signal that other factors are also relevant in predicting outcomes. It is unclear whether degree of involvement is attributed to other student-related factors, or to the programs and faculty. Therefore, examining this relationship in the context of program or faculty-related factors may shed some light into other factors relevant in outcomes

Indicators of mentorship and intellectual community need to be more specific. In the faculty mentorship construct, for example, two very broad indicators were most relevant, i.e., faculty support for student development as researchers and scholars. However what are the concrete behavioral examples that represent these? Given their relationship with other more concrete indicators of faculty mentoring practices measured in this study, do students feel

supported in their development as researchers and scholars because they have access to a faculty who provides constructive feedback on their paper or project, involves them in experiential learning, and provides feedback on their degree progress? If so, should future samples be asked only of these two broad indicators for the sake of parsimony? If not, what other ways might faculty support student learning and development? Qualitative and mixed approaches to future research might well serve to inform a deeper understanding of these items and further clarify such relationships.

The unique role of intellectual community on student learning and development needs further investigation. Intellectual community is theoretically and practically relevant given that students perceive it to be an important part of their educational experience. Aside from contributing to their satisfaction, given the integral role formal and informal communities of scholars play in student learning and development, exploring student experiences in relation to degree of involvement in intellectual community as well as faculty mentorship is also needed in future research efforts.

The relationship between the two latent variables, mentorship and intellectual community, demonstrates yet more conceptual generalization, be it academic involvement or something different altogether. This relationship is indicative of a theoretical and practical overlap between mentorship and intellectual learning community. Future research examining the degree of representation of the two first order factors, mentorship and intellectual community, with this second order factor, as well as of the degree of representation of each observed variable with this second order factor, would be helpful in further understanding these constructs.

We know doctoral candidates at these institutions feel that all dimensions of mentorship and intellectual community are important, yet we do not know whether students' involvement or

lack thereof was due to students' own situation or choice or if it was rather due to an absence of opportunities in programs. Lacking a clear understanding of why some students are less involved than others, judgments regarding program quality and effectiveness from students' educational experiences and perspectives can only offer a relatively incomplete picture. Again, more qualitative and/or mixed research designs would aid in furthering our understanding of these phenomena.

Furthermore, it is also difficult to discern if students' satisfaction and self-efficacy is result of students' immediate program experiences or if it may have instead reflected their involvement in other university-wide educational activities. Some institutions offer professional development workshops and training programs to graduate students on a range of topics. So when students rate their level of preparedness in teaching as result of doctoral education experience, for example, it is unclear if it reflects individual faculty or program efforts, or institutional efforts. This makes it challenging to operationalize these findings to bolster program effectiveness, and needs to be clarified in future samples.

How reflective is students' self-efficacy of their actual ability to carry out various forms of scholarship? The ultimate goal is to assess student competence as researchers and scholars. The weak relationship between involvement in experiential learning about research, self-efficacy in research and publishing, and scholarly productivity brings into question the use of experience, self-efficacy, and self-reported productivity as indicators of competence in research and publishing. If apprentice learning in research is an exemplary practice or research pedagogy in doctoral education, (Gardner, 2008b; Levine, 2007; Walker et al., 2008), why does it demonstrate a weak, significant relationship with self-efficacy and productivity? The relationship

among apprentice learning, research self-efficacy, and research productivity warrants further investigation.

This study focused on doctoral candidates' experiences and perceptions. These students are at the last stage of their program of study, conducting independent research, in some cases for the very first time. Some students have yet begun, and others may never complete this stage (Bowen & Rudenstine, 1992; Lovitts, 2005). Therefore, it follows that those who have completed independent research may have very different perceptions and experiences, as their doctoral education experience would reflect the entire spectrum of their program of study. In an ideal context, sampling from those who completed their degree program may provide a more useful glimpse at doctoral education from students' perspectives. Similarly, longitudinal studies tracking graduates' career trajectories and their scholarly productive along with their self-efficacy would shed useful light on their doctoral education experiences as a whole.

Finally, given the differences in doctoral student experiences and outcomes and different institutional and disciplinary contexts (Golde, 2005), future research on doctoral education should attempt comparative studies based on institution and disciplinary differences when possible. Indeed, much could be learned from conducting research among a considerable range of institutional types and disciplines. One weakness of the body of literature on doctoral education is that much has been conducted at Tier I research institutions, whereas a significant amount of doctoral education takes place at doctoral degree granting and research institutions that do not enjoy the top Carnegie institutional rankings. This study itself, repeated at Texas institutions classified as research university-very high research activity may yield different results than it has in this sample of public doctoral degree granting institutions in north Texas

area. At the very least, more research on doctoral education should be focused on D/RU and RU-HRA higher education institutions.

Institutions as well as individual programs and faculty can use this study and others as a foundation on which to conduct their own scholarship in service of improving effectiveness and efficiency. Different institutions and disciplines need to identify student characteristics that correlate with academic involvement and assess educational outcomes and factors that contribute to those outcomes in their own contexts. The findings of these explorations should be shared with the larger community of doctoral educators to help to piece together understandings of how varying contexts my influence pedagogical needs of doctoral students. Only by understanding institutional and disciplinary contexts in student characteristics, academic involvement, and educational outcomes, will we gain a broader and deeper understanding the efficiency and effectiveness of doctoral education in Texas and the United States.

Table 1

*Descriptive Statistics for Frequency of Academic Involvement, Pilot Test 2 (*N=*36)*

Item		*M*	*SD*	*Skew*	*Kurt*
Faculty Mentorship					
M1	Hands-on learning: Pre-dissertation research	4.44	2.21	-.37	-1.31
M2	Hands-on learning: Increase in complexity	4.58	1.96	-.36	-1.12
M3	Hands-on learning: Connect theory-practice	4.42	2.0	-.32	-.99
M4	Provides feedback on scholarly development	4.92	1.50	-.50	.00
M5	Gives feedback on degree progress	4.83	1.75	-.34	-1.27
M6	Provide constructive feedback on paper/project	5.36	1.76	-.59	-1.11
M7	Provide timely feedback on paper/project	5.00	1.60	-.84	.57
M8	Promote development as researcher	5.11	1.78	-.72	-.28
M9	Promote development as teacher	3.61	2.06	-.35	-.96
M10	Multiple faculty mentor	4.58	1.96	-.58	-.75
Intellectual Community					
IC1	Exchange ideas/feedback	4.92	1.46	-.60	.23
IC2	Share intellectual resources	4.86	1.52	-.27	-1.1
IC3	Share professional development opportunities	4.81	1.74	-.62	-.28
IC4	Promote professional networking	4.17	1.63	-.28	-.81
IC5	Value diverse perspectives	4.83	1.44	-.72	.30
IC6	Value graduate student perspectives	4.78	1.50	-.36	-.20
IC7	Nurture intellectual curiosity	4.61	1.63	-.55	-.60
IC8	Respect one another	5.11	1.49	-.92	.43
IC9	Provide feedback to one another	4.81	1.72	-.50	-.75
IC10	Promote development as scholar	4.81	1.58	-.67	-.24

Note. Items listed above are an abbreviated version of the survey items.
M=Mentorship. IC=Intellectual community.
M=Mean. *SD*=Standard deviation. Skew=Skewness. Kurt=Kurtosis.

Table 2

*Standardized Factor Pattern and Factor Structure Coefficients for Frequency of Academic Involvement, Pilot Test 2 (PCA, Promax κ=4, 2-Factor Solution) (*N=*36)*

Item		Learning Community		Mentorship		h^2
		P	r_s	*P*	r_s	
IC5	Value diverse perspectives	**.95**	**.86**	-.20	.23	.77
IC3	Share professional development opportunities	**.91**	**.89**	-.30	.34	.67
IC2	Share intellectual resources	**.88**	**.89**	-.19	.30	.66
IC10	Promote my development as scholar	**.88**	**.89**	.03	.42	.80
IC6	Value graduate student perspectives	**.87**	**.89**	.05	.44	.79
IC1	Exchange ideas/feedback	**.83**	**.87**	.09	.46	.67
IC9	Provide feedback to one another	**.77**	**.86**	.19	.54	.77
IC7	Nurture intellectual curiosity	**.74**	**.84**	-.21	.54	.73
IC4	Promote professional networking	**.66**	**.67**	.02	.32	.45
IC8	Respect one another	**.65**	**.68**	.06	.36	.47
M2	Hand-on learning: Increase in complexity	-.08	.32	**.88**	**.85**	.73
M3	Hand-on learning: Connect theory-practice	-.26	.14	**.88**	**.77**	.64
M1	Hand-on learning: Pre-dissertation research	-.22	.17	**.87**	**.77**	.63
M6	Provide constructive feedback on paper/project	.08	.46	**.86**	**.89**	.80
M7	Provide timely feedback on paper/project	-.08	.28	**.80**	**.76**	.59
M5	Give feedback on degree progress	.10	.45	**.78**	**.83**	.69
M8	Promote development as researcher	.25	.59	**.77**	**.88**	.82
M9	Promote development as teacher	.03	.36	**.73**	**.74**	.55
M4	Feedback on scholarly develop	.44	.68	**.53**	**.72**	.68
M10	Multiple faculty mentor	.29	.47	**.40**	**.53**	.34
Eigenvalues			9.71		3.62	
% variance explained			48.55		18.07	
% total variance explained			66.62			
Cronbach's α			.92		.94	
Factor correlation			.45			

Note. IC=Intellectual community. M=Faculty mentorshhip.
P=Factor pattern coefficient. r_s=Factor structure coefficient. h^2=Communality coefficient.

Table 3

*Frequencies for Categorical Variables: Student Background Characteristics (*N=*217)*

Group	*n*	*%*
Institution		
RU-HRA	116	53.5
D/RU1	46	21.1
D/RU2	55	25.3
Sex		
Female	160	73.7
Male	57	26.3
Ethnicity		
American Indian/Alaskan Native	1	.5
Asian/Asian American/Pacific Islander	24	11.1
Black/African American	27	12.4
Hispanic/Latino	12	5.5
Native Hawaiian/Other Pacific Islander	0	0
Multiracial	11	5.1
White, non-Hispanic	142	65.4
Citizenship		
U.S. Citizen	185	85.3
Permanent resident	8	3.7
Temporary resident	24	11.1
Doctoral degree specialization		
Education	115	53.0
Other	102	47.0
Doctoral degree type		
PhD	149	68.7
EdD	67	30.9
DBA	1	.5
Career plan-primary work		
Post-doc	23	7.59
Teaching	56	18.48
Research	31	10.23
Teaching & Research	89	29.37
Administration/Management	51	16.83
Independent work	28	9.24
Start private business	17	5.61
Other	8	2.64
Career plan-primary employer		
Education sector	172	79.3
Government/Non-profit sector	25	11.5
Business/Industry	13	6.0
Other	7	3.2

Table 4

*Descriptive Statistics for Academic Involvement (*N=*217)*

Item		Frequency of Involvement				Importance of Involvement			
		Mean	*SD*	*Skew*	*Kurt*	*Mean*	*SD*	*Skew*	*Kurt*
Faculty Mentorship									
M1	Hands-on learning: Pre-dissertation research	3.91	2.10	.06	-1.29	6.19	1.32	-1.90	3.09
M2	Hands-on learning: Increase in complexity	4.05	2.01	-.06	-1.21	5.88	1.38	-1.50	2.23
M3	Hands-on learning: Connect theory-practice	4.30	2.00	-.14	-1.17	6.18	1.20	-1.91	4.12
M4	Provide feedback on degree progress	4.57	1.90	-.20	-1.23	6.59	.78	-2.24	5.35
M5	Provide constructive feedback on paper/project	4.99	1.81	-.47	-.93	6.66	.66	-2.42	6.99
M6	Give timely feedback on paper/project	4.82	1.79	-.62	-.59	6.63	.65	-1.95	3.99
M7	Promote development as researcher	4.41	1.94	-.22	-1.14	6.23	1.10	-1.74	3.03
M8	Promote development as teacher	3.73	2.07	.15	-1.29	5.76	1.48	-1.29	1.27
M9	Provide feedback on scholarly develop	4.42	2.00	-.35	-1.06	6.37	.94	-2.03	5.66
M10	Multiple faculty mentors	4.22	2.08	-.20	-1.31	6.05	1.27	-1.62	2.58
Intellectual Community									
IC1	Exchange ideas/feedback	4.89	1.62	-.66	-.34	6.35	.89	-1.29	.82
IC2	Share intellectual resources	4.81	1.71	-.59	-.45	6.18	1.03	-1.38	1.79
IC3	Share professional development opportunities	4.52	1.84	-.39	-.78	6.09	1.04	-1.11	.94
IC4	Promote professional networking	3.82	1.95	.07	-1.22	6.17	1.04	-1.07	.07
IC5	Value diverse perspectives	4.55	1.72	-.46	-.65	6.08	1.17	-1.35	1.46
IC6	Value graduate student perspectives	4.60	1.75	-.37	-.94	6.17	1.11	-1.47	1.69
IC7	Nurture intellectual curiosity	4.41	1.88	-.31	-1.01	6.20	1.06	-1.29	.94
IC8	Respect one another	4.84	1.86	-.59	-.72	6.46	.84	-1.63	2.22
IC9	Provide feedback to one another	4.65	1.76	-.42	-.79	6.26	.91	-1.05	.28
IC10	Promote development as scholar	4.46	1.82	-.32	-1.01	6.35	.90	-1.23	.49

Note. Items listed above are an abbreviated version of the survey items.

M=Mentorship. IC=Intellectual community. *SD*=Standard deviation. Skew=Skewness. Kurt=Kurtosis.

Table 5

*Descriptive Statistics for Continuously-scaled Variables: Learner Characteristics, Academic Involvement, and Outcomes (*N=*217)*

Variable		*M*	[95% CI]	*SD*	*Skew*	*Kurt*
LC 3	Have clear professional goals upon pursuing doctorate	5.13	[4.86, 5.40]	1.88	-.73	-.55
LC 4	Identify learning needs	5.86	[5.69, 6.04]	1.22	-1.24	1.48
LC 5	Seek learning opportunities outside of class	5.67	[5.46, 5.88]	1.49	-1.08	.17
LC 6	Family/friend support for the demands of doctoral study	5.99	[5.78, 6.19]	1.45	-1.49	1.32
LC 7	Family/home responsibility	5.97	[5.76, 6.19]	1.52	-1.45	1.03
LC 8	Number of credit hours enrolled during coursework /semester	8.70	[8.42, 8. 98]	2.07	.21	-.51
LC 9	Number of hours spent on doctoral study outside coursework/week	4.95	[4.54, 5.37]	3.08	1.06	.22
LC10	Number of hours employed during coursework/week	6.11	[5.61, 6.61]	3.72	-.44	-1.07
LC11	Amount of financial assistance received from external sources	4.37	[3.66, 5.08]	5.31	1.48	1.38
LC12	Amount of educational debt incurred	6.26	[5.24, 7.29]	7.65	.90	-.77
Faculty Mentorship (construct)		3.43	[3.27, 3.60]	1.23	-.15	-1.05
Intellectual community (construct)		3.79	[3.63, 3.96]	1.25	-.47	-.52
O1	Perceived ability to carry out research	5.17	[4.94, 5.40]	1.70	-.82	-1.00
O2	Perceived ability to write manuscript for peer-reviewed publication	5.06	[4.82, 5.29]	1.76	-.83	-.27
O3	Perceived ability to teach disciplinary knowledge to undergraduate students	5.39	[5.16, 5.62]	1.67	-1.08	.30
O4	Perceived ability to apply expertise in addressing practical problems	5.41	[5.18, 5.63]	1.67	-.98	.21
O5	Perceived ability to work collaboratively with other scholars	5.49	[5.27, 5.71]	1.62	-1.08	.44
O6	Satisfaction with doctoral education experience	4.85	[4.60, 5.09]	1.85	-.72	-.46
O7	Number of conference presentations	4.36	[3.90, 4.82]	3.41	.93	-.20
O8	Number of peer-reviewed publications	2.18	[1.97, 2.38]	1.57	.93	-.05
O9	Time-to-candidacy/in semesters	11.02	[10.33, 11.72]	5.22	1.79	3.74

Note. LC=Learner characteristics variables. O=Outcome variables.
M=Mean. CI=confidence intervals. *SD*=Standard deviation. Skew=Skewness; Kurt=Kurtosis.

Table 6

Frequencies for Categorical Variables: Learner Characteristics

Group	*n*	*%*	*N*
LC1 Prior experience: Research			217
Agree	115	53.0	
Disagree	82	37.8	
Neither agree, nor disagree	20	9.2	
LC2 Prior experience: Literature review			217
Agree	110	50.7	
Disagree	97	44.7	
Neither agree, nor disagree	10	4.6	
LC 13 Similarity between masters and doctoral degree majors			203
Same	140	69.0	
Different	63	31	
LC14 Graduate assistantship			217
Held graduate assistantship	128	59.0	
Did not hold graduate assistantship	89	41.0	

Note. LC=Learner characteristics.

Table 7

*Standardized Factor Pattern & Factor Structure Coefficients for Frequency of Academic Involvement (Principal Component Analysis, Promax κ=4) (*N=*217)*

Item		Intellectual Community		Mentorship		h^2
		P	r_s	*P*	r_s	
IC5	Value diverse perspectives	**.92**	**.90**	-.03	.53	.82
IC2	Share intellectual resources	**.88**	**.79**	-.15	.39	.64
IC6	Value graduate student perspectives	**.86**	**.89**	.06	.58	.80
IC1	Exchange ideas/feedback	**.85**	**.82**	.05	.46	.67
IC9	Provide feedback to one another	**.84**	**.85**	.03	.53	.73
IC7	Nurture intellectual curiosity	**.84**	**.90**	.11	.62	.82
IC3	Share professional development opportunities	**.82**	**.77**	-.09	.41	.60
IC10	Promote development as scholar	**.81**	**.89**	.14	.63	.81
IC8	Respect one another	.**76**	**.77**	.02	.48	.60
IC4	Promote professional networking	**.73**	**.79**	.09	.43	.62
M5	Provide constructive feedback on paper/project	-.05	.48	**.87**	**.84**	.71
M7	Promote development as researcher	.01	.54	**.87**	**.88**	.77
M3	Hands-on learning: Connect theory-practice	-.07	.45	**.85**	**.81**	.66
M9	Provide feedback on scholarly develop	.06	.57	**.84**	**.88**	.77
M2	Hands-on learning: Increase in complexity	.02	.51	**.81**	**.82**	.67
M6	Give timely feedback on paper/project	-.11	.37	**.79**	**.73**	.54
M1	Hands-on learning: Pre-dissertation research	-.09	.39	**.79**	**.73**	.54
M4	Provide feedback on degree progress	.07	.54	**.77**	**.81**	.66
M8	Promote development as teacher	.19	.59	**.65**	**.77**	.61
M10	Multiple faculty mentor	.11	.50	**.64**	**.71**	.51
Eigenvalues		7.02		6.50		
% of variance explained		35.21		32.49		
% total variance explained		67.70				

Note. IC=Intellectual community. M=Mentorship.
P=Factor pattern coefficient. r_s=Factor structure coefficient. h^2=Communality coefficient. Coefficients greater than |.60| are in boldface and retained for that factor. Percentage variance is pre-rotation. The eigenvalue of the third, unretained factor was .906.

Table 8

Factor Correlations, Internal Consistencies, & Descriptive Statistics of Latent Variables

Factor	*M*	[95% CI]	*SD*	*Skew*	*Kurt*	1	2	α
Faculty mentorship	3.43	[3.27, 3.60]	1.23	-.15	-1.05	1.00		.94
Intellectual community	3.79	[3.63, 3.96]	1.25	-.47	-.52	.627**	1.00	.95

Note. ** p<.01.

Table 9

*Correlation Coefficients and Effects Sizes between Academic Involvement and Learner Characteristics/Outcome Variables (*N=*217)*

Variable		Mentorship		Intellectual Community	
		r	r^2(%)	*r*	r^2(%)
LC1	Prior experience: research	-.012	--	-.062	--
LC2	Prior experience: literature review	.069	--	.053	--
LC3	Have clear professional goals upon pursuing doctorate	.150	--	.010	--
LC4	Identify learning needs	.291**	--	.180*	--
LC5	Seek learning opportunities outside of class	.123	--	.039	--
LC6	Family/friend support for the demands of doctoral study	.184*	--	.160*	--
LC7	Family/home responsibility	.033	--	.062	--
LC8	Number of credit hours enrolled during coursework/semester	.051	--	-.039	--
LC9	Number of hours spent on doctoral study outside coursework/week	.064	--	.023	--
LC10	Number of hours employed during coursework/week	-.012	--	.101	--
LC11	Amount of financial assistance received from external sources	.104	--	.105	--
LC12	Amount of educational debt incurred	-.153	--	-.188	--
LC13	Graduate assistantship	-.009	--	.056	--
LC14	Similarity between masters and doctoral degree majors	.132	--	.045	--
O1	Perceived ability to carry out research	.503**	25.30	.361**	13.03
O2	Perceived ability to write manuscript for peer-reviewed publication	.488**	23.81	.377**	14.21
O3	Perceived ability to teach disciplinary knowledge to undergraduate students	.400**	16.00	.423**	17.89
O4	Perceived ability to apply expertise in addressing practical problems	.487**	23.72	.428**	18.32
O5	Perceived ability to work collaboratively with other scholars	.495**	24.50	.488**	23.81
O6	Satisfaction with doctoral education experience	.689**	47.47	.602**	36.24
O7	Number of conference presentations	.078	--	.003	--
O8	Number of peer-reviewed publications	.210**	--	.175**	--
O9	Time-to-candidacy/semester	.003	--	-.025	--

Note. LC=Learner characteristics variables. O=Outcome variables.
Correlation coefficients <10% are marked as --.
** $p<.01$. * $p<.05$

Table 10

*Canonical Correlation Analysis between Learner Characteristics and Academic Involvement, Initial Model, Function 1 (*N=*176)*

Variable		β	r_s	r_s^2 (%)
LC1	Prior experience: research	-.290	.027	.07
LC2	Prior experience: literature review	-.251	.319	10.18
LC3	Have clear professional goals upon pursuing doctorate	-.022	.262	6.86
LC4	Identify learning needs	.634	**-.685**	46.92
LC5	Seek learning opportunities outside of class	-.020	.387	14.98
LC6	Family/friend support for the demands of doctoral study	.450	.411	16.89
LC7	Family/home responsibility	-.129	-.048	.23
LC8	Number of credit hours enrolled during coursework/semester	.195	.258	6.66
LC9	Number of hours spent on doctoral study outside coursework/week	.167	.170	2.89
LC10	Number of hours employed during coursework/week	.301	-.044	.19
LC11	Amount of financial assistance received from external sources	.257	.315	9.92
LC12	Amount of educational debt incurred	-.236	-.267	7.13
LC13	Graduate assistantship	.239	.282	7.95
LC14	Similarity between masters and doctoral degree majors	-.152	-.153	2.34
R_c^2				16.70
M	Faculty mentorship	.856	**.987**	73.27
IC	Intellectual community	.208	**.745**	55.50

Note. LC=Learner characteristics variables.
Structure coefficients >.45 are in boldface.
β=Standardized canonical function coefficient. r_s=Structure coefficient. r_s^2=Squared structure coefficient.

Table 11

*Canonical Correlation and Canonical Commonality Analyses between Learner Characteristics and Academic Involvement, Final Model, Function 1 (*N=*203)*

Variable		*β*	r_s	r_s^2 *(%)*	*Unique*	*Common*	*Total*
LC3	Have clear professional goals upon pursuing doctorate	.121	**.475**	22.56	.002	.022	.024
LC4	Identify learning needs	.694	**.804**	64.64	.056	.027	.083
LC5	Seek learning opportunities	.020	.358	12.81	.000	.016	.016
LC6	Have supportive family/friend for the demands of doctoral study	.254	.417	17.39	.009	.027	.037
LC12	Amount of educational debt incurred	-.384	-.387	14.98	.022	-.003	.020
LC14	Similarity between masters and doctoral degree majors	.364	.337	11.36	.039	-.020	.018
R_c^2				16.0			
M	Faculty mentorship	1.06	**.997**	99.40	.182	.303	.485
IC	Intellectual community	-.094	**.570**	32.49	.041	.303	.344

Note. Structure coefficients >.45 are in boldface.
β=Standardized canonical function coefficient. r_s=Structure coefficient. r_s^2=Squared structure coefficient.

Table 12

*Canonical Correlation Analysis between Academic Involvement and Doctoral Education Outcomes, Initial Model, Function 1 (*N=*217)*

Variable		β	r_s	r_s^2 (%)
M	Faculty mentorship	-.689	**-.948**	89.87
IC	Intellectual community	-.410	**-.846**	71.57
R_c^2				55.2
O1	Perceived ability to carry out research	-.035	**-.664**	44.09
O2	Perceived ability to write manuscript for peer-reviewed publication	-.023	**-.658**	43.30
O3	Perceived ability to teach disciplinary knowledge to undergraduate students	.006	**-.603**	36.36
O4	Perceived ability to apply expertise in addressing practical problems	-.006	**-.685**	46.92
O5	Perceived ability to work collaboratively with other scholars	-.248	**-.726**	52.71
O6	Satisfaction with doctoral education experience	-.768	**-.968**	93.70
O7	Number of conference presentations	.062	-.074	.55
O8	Number or peer-reviewed publications	-.147	-.290	8.41
O9	Time-to-candidacy/in semesters	.017	.011	.01

Note. Structure coefficients >.45 are in boldface.
β=Standardized canonical function coefficient. r_s=Structure coefficient. r_s^2=Squared structure coefficient.

Table 13

*Canonical Correlation and Canonical Commonality Analyses between Academic Involvement and Doctoral Education Outcomes, Final Model, Function 1 (*N=*217)*

Variable		*β*	r_s	r_s^2 (%)	*Unique*	*Common*	*Total*
M	Faculty mentorship	-.677	**-.942**	88.73	.182	.303	.485
IC	Intellectual community	-.427	**-.848**	71.91	.041	.303	.344
R_c^2				53.9			
O1	Perceived ability to carry out research	-.005	**-.639**	40.83	.000	.220	.220
O2	Perceived ability to write manuscript for peer-reviewed publication	-.078	**-.638**	40.70	.002	.218	.219
O3	Perceived ability to teach disciplinary knowledge to undergraduate students	.001	**-.602**	36.24	.000	.195	.195
O4	Perceived ability to apply expertise in addressing practical problems	-.025	**-.671**	45.02	.000	.243	.243
O5	Perceived ability to work collaboratively with other scholars	-.238	**-.712**	50.69	.013	.261	.273
O6	Satisfaction with doctoral education experience	-.819	**-.979**	95.84	.178	.339	.518

Note. Structure coefficients >.45 are in boldface.
β=Standardized canonical function coefficient. r_s=Structure coefficient. r_s^2=Squared structure coefficient.

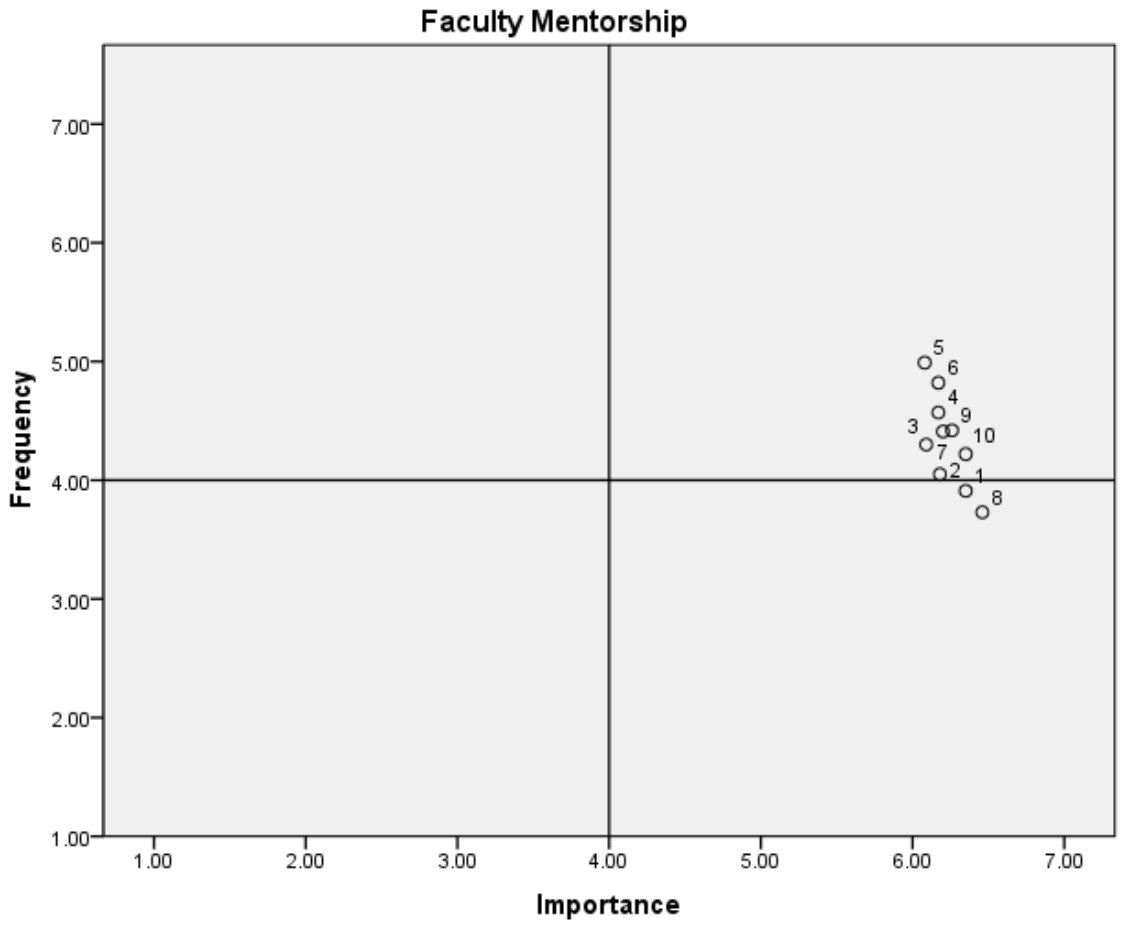

Figure 1. Scattergram of frequency and importance of involvement in faculty mentorship. Numbers represent 10 dimensions of faculty mentorship:
1=M1 (Hands-on learning: Pre-dissertation research)
2=M2 (Hands-on learning: Increase in complexity)
3=M3 (Hands-on learning: Connect theory-practice)
4=M4 (Provide feedback on degree progress)
5=M5 (Provide constructive feedback on paper/project)
6=M6 (Give timely feedback on paper/project)
7=M7 (Promote development as researcher)
8=M8 (Promote development as teacher)
9=M9 (Provide feedback on scholarly develop)
10=M10 (Multiple faculty mentors)

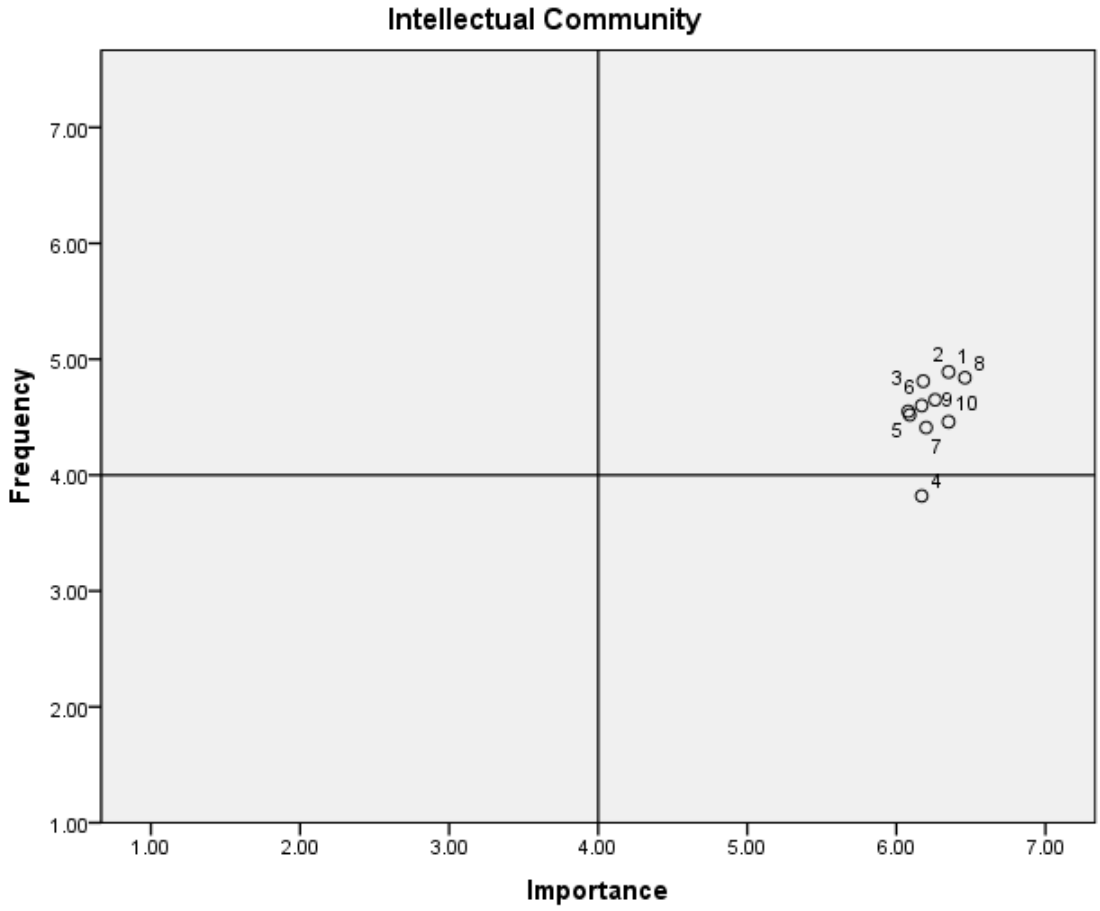

Figure 2. Scattergram of frequency and importance of involvement in intellectual community. Numbers represent 10 dimensions of intellectual community:
1=IC1 (Exchange ideas/feedback)
2=IC2 (Share intellectual resources)
3=IC3 (Share professional development opportunities)
4=IC4 (Promote professional networking)
5=IC5 (Value diverse perspectives)
6=IC6 (Value graduate student perspectives)
7=IC7 (Nurture intellectual curiosity)
8=IC8 (Respect one another)
9=IC9 (Provide feedback to one another)
10=IC10 (Promote development as scholar)

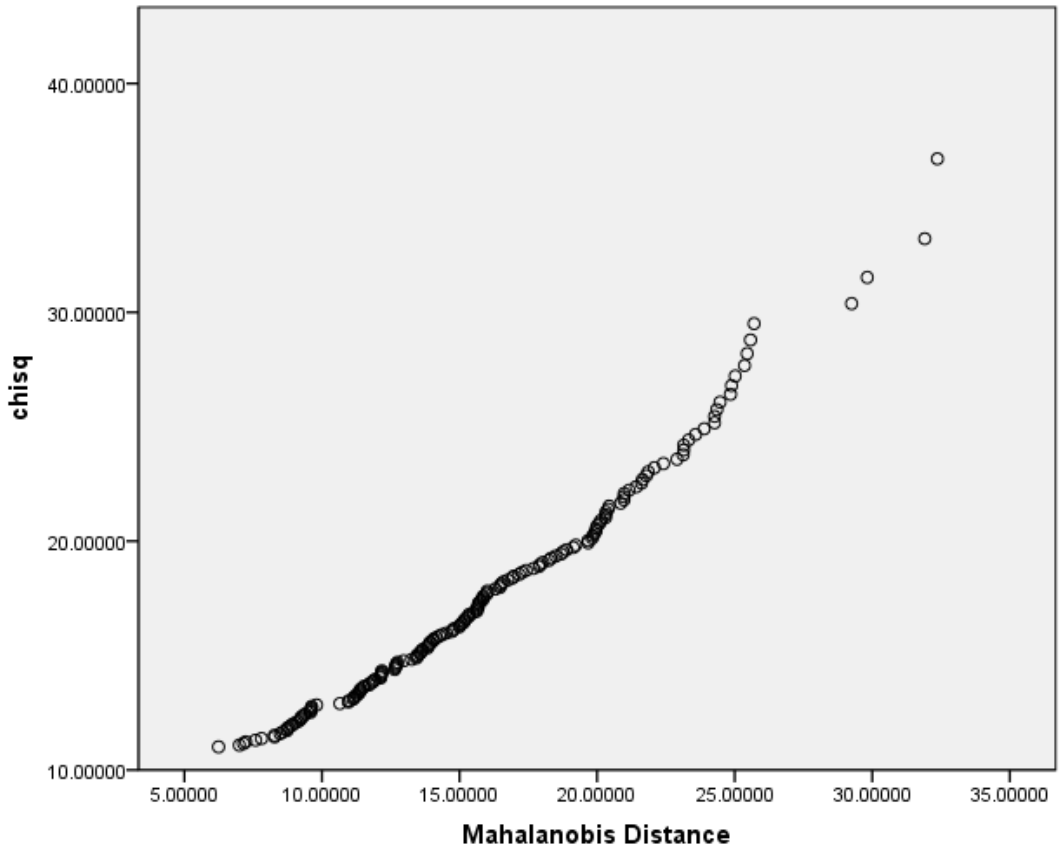

Figure 3. Scattergram of Mahalanobis distance and paired chi-square value for each case for variables involved in Research Question 1.

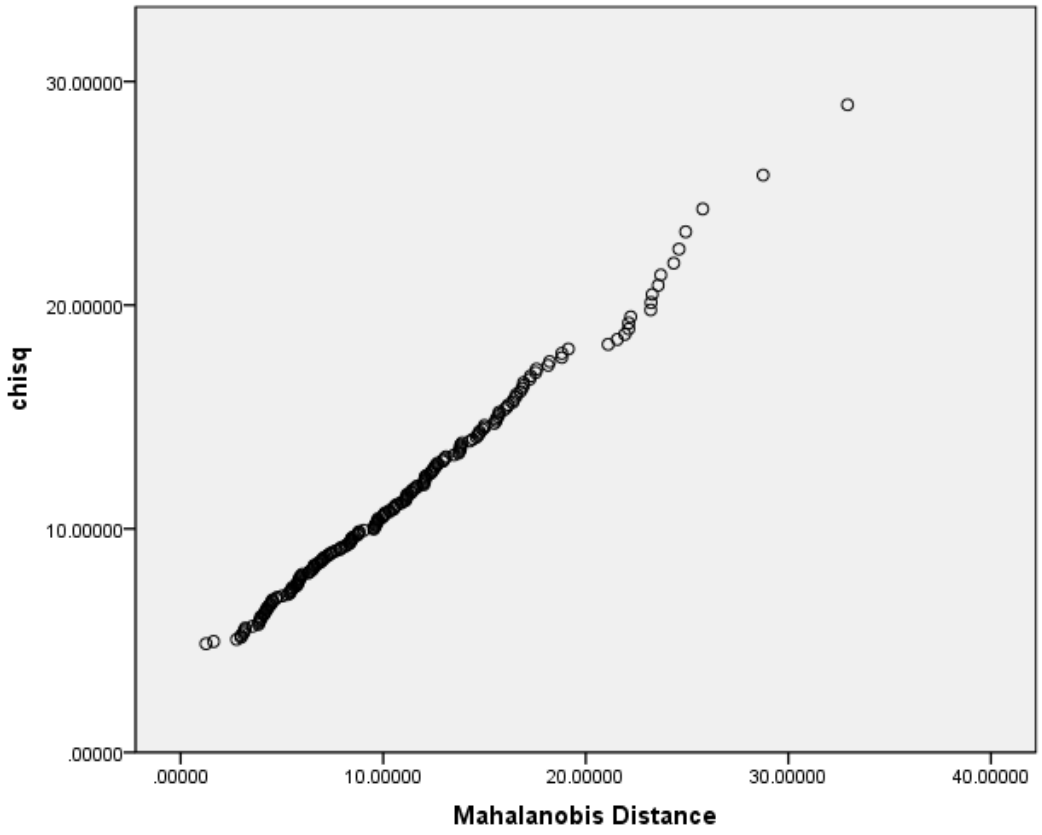

Figure 4. Scattergram of Mahalanobis distance and paired chi-square value for each case for variables involved in Research Question 2.

APPENDIX

COMPLETE LIST OF VARIABLES FOR FINAL DATA COLLECTION AND CORRESPONDING SURVEY ITEMS

	Learner Characteristics	Academic Involvement	Outcomes	Demographic/Contextual Characteristics
1.	Prior experience conducting research (3.1)	Mentorship (1.1 – 1.10)	Perceived preparation to carry out research project (3.6)	Masters (or undergraduate) degree major (5.1).
2.	Prior experience writing literature review (3.2)	Intellectual Community (2.1 – 2.10)	Perceived preparation to write manuscript for peer-reviewed publication (3.7)	Doctoral degree major (5.2)
3.	Clarity of professional goals upon beginning doctoral study (3.3)		Perceived preparation to teach disciplinary knowledge to undergraduate students (3.8)	Type of doctoral degree (5.3).
4.	Identify learning needs to help achieve professional goals (3.4)		Perceived preparation to apply expertise in addressing practical problems (3.9)	First time enrolled in doctoral coursework (5.4)
5.	Seek learning opportunities outside of formal coursework to help achieve professional goals (3.5)		Perceived preparation to work collaboratively with other scholars (3.10)	Time admitted to doctoral candidacy (5.5)
6.	Family/friends understanding and support for the demand of doctoral study (3.6)		Satisfaction with doctoral education experience (3.11)	Career plan: primary work (5.7)
7.	Home/family responsibility while pursuing doctoral study (3.7)		Number of conference presentations (4.1)	Career plan: primary employer (5.8)
8.	Number of credit hours enrolled during coursework (4.3)		Number or peer-reviewed publications (4.2)	Sex (5.9)
9.	Number of hours spent for doctoral work outside of class (4.4)		Time-to-candidacy (No item measures this variable directly. A derived variable to created using items 5.4 and 5.5)	Race/Ethnicity (5.10)
10.	Number of hours employed during coursework (4.5)			Citizenship/Residency (5.11)
11.	Number of hours employed during dissertation (4.6)			Age (5.12)
12.	Amount of financial support received for doctoral study (4.7)			
13.	Amount of educational debt incurred (4.8)			
14.	Relevance of masters degree major to doctoral degree (A derived variable created using items 5.1 and 5.2)			
15.	Graduate assistantship duties (5.6)			
	Total=15	Total=20	Total=9	Total=11
				TOTAL: 55

REFERENCE LIST

Abedi, J., & Benkin, E. (1987). The effects of students' academic, financial, and demographic variables on time to the doctorate. *Research in Higher Education, 27*(1), 3-14.

Alreck, P. L., & Settle, R. B. (2004). *The survey research handbook* (3rd ed.). New York, NY: McGraw Hill.

Altbach, P. G. (2004). Doctoral education: Present realities and future trends. *College and University, 80(*2), 3-10.

Anderson, S., & Anderson, B. (in press). Preparation and socialization of the education professoriate: Narratives of doctoral student-instructors. *International Journal of Teaching and Learning in Higher Education.*

Association of American Universities. (1998). *Committee on Graduate Education: Report and recommendations*. Washington, DC: The Author.

Astin, A. W. (1984). Student involvement: A developmental theory for higher education. *Journal of College Student Development, 25*, 297-308.

Astin, A. W. (1993). *What matters in college? Four critical years revisited*. San Francisco, CA: Jossey-Bass.

Austin, A. E. (2002). Preparing the next generation of faculty: Graduate school as socialization to the academic career. *Journal of Higher Education, 73*, 94-122.

Austin, A. E., & McDaniels, M. (2006). Using doctoral education to prepare faculty to work within Boyer's four domains of scholarship. *New Directions for Institutional Research, 129*, 51-65. doi: 10.1002/ir.171

Austin, A. E. (2009). Cognitive apprenticeship theory and its implications for doctoral education: A case example from a doctoral program in higher and adult education. *International Journal for Academic Development, 14*(3), 173-183.

Baird, L. L. (1990). The melancholy of anatomy: The personal and professional development of graduate and professional school students. In J. C. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. 6, pp. 361–392). New York, NY: Agathon Press.

Barnes, B. J., & Randall, J. (in press). Doctoral student satisfaction: An examination of disciplinary, enrollment, and institutional differences. *Research in Higher Education.* Retrieved from http://www.springerlink.com/content/g238711414224452/

Becher, T., & Trowler, P. (2001). *Academic tribes and territories: Intellectual enquiry and the culture of disciplines*. Philadelphia, PA: Open University Press.

Bell, N. E. (2010). *Graduate enrollment and degrees: 1998 to 2008*. Washington, DC: Council of Graduate Schools & Graduate Record Examinations Board. Retrieved from the Council of Graduate School's website: http://www.cgsnet.org/Default.aspx?tabid=168

Berelson, B. (1960). *Graduate education in the United States*. New York, NY: McGraw Hill.

Biglan, A. (1973). The characteristics of subject matter in different academic areas. *Journal of Applied Psychology, 57*, 195–203.

Bowen, W. G., & Rudenstine, N. L. (1992). *In pursuit of the PhD*. Princeton, NJ: Princeton University Press.

Boyle, P., & Boice, B. (1998). Best practices for enculturation: Collegiality, mentoring, and structure. *New Directions for Higher Education, 101,* 87-94.

Boyer, E. L. (1990). *Scholarship reconsidered: Priorities of the professoriate*. Princeton, NJ: Carnegie Foundation for the Advancement of Teaching.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Carnegie Foundation for the Advancement of Teaching. (2010). *The Carnegie Classification of Institutions of Higher Education*. Retrieved from Carnegie Foundation's website: http://classifications.carnegiefoundation.org/

Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate Behavioral Research. 1*, 245-276.

Clark, B. R. (1984). *Perspectives on higher education: Eight disciplinary and comparative views*. Berkeley, CA: University of California Press.

Clark, B. R. (1987). *The Academic profession: National, disciplinary, and institutional settings*. Berkeley, CA: University of California Press.

Cook, M. M., & Swanson, A. (1978). The interaction of student and program variables for the purpose of developing a model for predicting graduation from graduate programs over a 10-year period. *Research in Higher Education, 8*(1), 83-91.

Council of Graduate Schools. (2005). *The Doctor of Philosophy degree: A policy statement*. Washington, DC: Council of Graduate Schools.

Council of Graduate Schools (2009). *Ph.D. completion and attrition: Findings from exit surveys of Ph.D. completers*. Washington, DC: Author. Retrieved from the Council of Graduate School's website: http://www.phdcompletion.org/information/publications.asp

Fiegener, M. K. (2009). *Doctorate recipients from U.S. universities: Summary report 2007-08*. Arlington, VA: Division of Science Resources Statistics, Directorate for Social, Behavioral, and Economic Sciences, National Science Foundation. Retrieved from the National Opinion Research Center website: http://www.norc.org/projects/survey+of+earned+doctorates.htm

Gale, R., & Golde, C. M. (2004). Doctoral education and the scholarship of teaching and learning. *peerReview,* 8-12.

Gall, D. G., Gall, J. P., & Borg, W. R. (2007). *Educational research: An introduction* (8th ed.). Boston, MA: Allyn & Bacon.

Gardner, S. (2008a). Fitting the mold of graduate school: A qualitative study of socialization in doctoral education. *Innovative Higher Education, 33*(2), 125-138.

Gardner, S. K. (2008b). "What's too much and what's too little?": The process of becoming an independent researcher in doctoral education. *Journal of Higher Education, 79*(3), 326-350. doi: 10.1353/jhe.0.0007

Gardner, S. K. (2009). Conceptualizing success in doctoral education: Perspectives of faculty in seven disciplines. *The Review of Higher Education, 32*(3), 383-406.

Gardner, S. K. (2010). Contrasting the socialization experiences of doctoral students in high- and low-completing departments: A qualitative analysis of disciplinary contexts at one institution. *Journal of Higher Education, 81*(1), 61-81.

Girves, J. E., & Wemmerus, V. (1988). Developing models of graduate student degree progress. *The Journal of Higher Education, 59*(2), 163-189.

Golde, C. M. (1998). Beginning graduate school: Explaining first-year doctoral attrition. *New Directions for Higher Education, 101,* 55-64.

Golde, C. M. (2000). Should I stay or should I go? Students' experiences of the doctoral attrition process. *Review of Higher Education*, *23*, 199-207.

Golde, C. M., & Dore, T. M. (2001). *At cross purposes: What the experiences of today's doctoral students reveal about doctoral education*. Retrieved from http://www.phd-survey.org/

Golde, C. M. (2005). The role of the department and discipline in doctoral student attrition: Lessons from four departments. *Journal of Higher Education, 76(*6), 669-700.

Golde, C. M., Bueschell, A.C., Jones, L., & Walker, G.E. (2009). Advocating apprenticeship and intellectual community: Lessons from the Carnegie Initiative on the Doctorate. In R. G. Ehrenberg, & C. V. Kuh (Eds.), *Doctoral education and the faculty of the future* (pp. 53-64). Ithaca, NY: Cornell University Press.

Gorsuch, R. L. (1983). *Factor analysis* (2nd ed.). Hillsdale, NJ, Erlbaum.

Haley, K. (2006). *Graduate education experience and career paths of women faculty in higher education administration*. (Unpublished doctoral dissertation). North Carolina State University, Raleigh, NC.

Haworth, J. G., & Bair, C. R. (2000). *Learning experiences that make a difference: Findings from a national study of doctoral education in the professions.* Paper session presented at the meeting of the Association for the Study of Higher Education, Sacramento: CA.

Henson, R. K. (1999). Multivariate normality: What is it and how is it assessed? In B. Thompson (Ed.), *Advances in social science methodology* (Vol. 5, pp. 193–211). Stamford, CT: JAI.

Henson, R. K. (2001). Understanding internal consistency reliability estimates: A conceptual primer on coefficient alpha. *Measurement and Evaluation in Counseling and Development, 34*(3), 177-89.

Henson, R. K., & Roberts, J. K. (2006). Use of exploratory factor analysis in published research: Common errors and some comment on improved practice. *Educational and Psychological Measurement, 66*(3), 393-416. doi: 10.1177/0013164405282485

Henson, R. K., Hull, D., & Williams, C. (2010). Methodology in our education research culture: Toward a stronger collective quantitative proficiency. *Educational Researcher. 39*(3), 229-240. doi: 10.3102/0013189X10365102

Kaiser, H. F. (1960). The application on electronic computers to factor analysis. *Educational and Psychological Measurement, 20*, 141-151.

Kieffer, K. L. (1999). Introductory primer on the appropriate use of exploratory and confirmatory factor analysis. *Research in the Schools, 6*(2), 75-92.

LaPidus, J. (1998). If we want things to stay as they are, things will have to change. *New Directions for Higher Education, 101*, 95-102.

Lenz, K. S. (1997). Nontraditional-aged women and the dissertation: A case study approach. *New Directions for Higher Education, 99*, 65-74.

Levine, A. (2007). *Educating researchers.* Retrieved from Education Schools Project website: http://edschools.org/EducatingResearchers/index.htm

Loo, R. (2001). Motivational orientations toward work: An evaluation of the work preference inventory. *Measurement and Evaluation in Counseling and Development, 33*(4), 222-233.

Lovitts, B. E. (2001). *Leaving the ivory tower: The causes and consequences of departure from doctoral study*. Lanham, MD: Rowman & Littlefield Publishers.

Lovitts, B. E. (2004). Research on the structure and process of graduate education: Retaining students. In D. H. Wulff & A. E. Austin (Eds.), *Paths to the professoriate: Strategies for enriching the preparation of future faculty* (pp. 115-136). San Francisco, CA: Jossey Bass.

Lovitts, B. E. (2005). Being a good course-taker is not enough: A theoretical perspective on the transition to independent research. *Studies in Higher Education, 30*(2), 137-154.

Maher, M. A., Ford, M. E., & Thompson, C. M. (2004). Degree progress of women doctoral students: Factors that constrain, facilitate, and differentiate. *Review of Higher Education, 27*(3), 385-408.

Malaney, G. D. (1988). Graduate education as an area of research in the field of higher education. In J. C. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. 4). New York, NY: Agathon Press.

National Association of Graduate and Professional Students. (2001). *The 2000 National doctoral program survey*. Washington, DC: Author. Retrieved from National Association of Graduate and Professional Students website: http://www.nagps.org/survey2000

Nerad, M., & Miller, D. S. (1996). Increasing student retention in graduate and professional programs. In J. G. Haworth (Ed.), *Assessing graduate and professional education: Current realities and future prospects* (pp. 61-76). San Francisco, CA: Jossey Bass.

Nerad, M. Rudd, E., Morrison, E., & Picciano, J. (2007). *Social science PhDs five+ years out: A national survey of PhDs in six fields*. Seattle, WA: Center for Innovation and Research in Graduate Education, University of Washington. Retrieved from Center for the Innovation and Research in Graduate Education website: www.cirge.washington.edu

Nettles, M. T., & Millett, C. M. (2006). *Three magic letters: Getting to Ph.D*. Baltimore, MD: Johns Hopkins University Press.

Nimon, K., Henson, R. K., & Gates, M. (2010). Revisiting interpretation of canonical correlation analysis: A tutorial and demonstration of canonical commonality analysis. *Multivariate behavioral research, 45*(4), 702-724.

Nunnally, J. C. (1978). *Psychometric theory.* (2nd ed.). New York, NY: McGraw Hill.

Nyquist, J. D., Manning, L., Wulff, D. H., Austin, A. E., Sprague, J., Fraser, P. K., & Calcagno, C. (1999). On the road to becoming a professor: The graduate student experience. *Change, 31*(3), 18-27.

Nyquist, J. D., & Woodford, B. J. (2000). *Re-Envisioning the Ph.D.: What concerns do we have?* Seattle, WA: University of Washington, Center for Instructional Development and Research. Retrieved from the Re-Envisioning the Ph.D. Project website: http://www.grad.washington.edu/envision/project_resources/concerns.html

Pascarella, E. T., & Terenzini, P. T. (2005). *How college affect students: A third decade of research*. San Francisco, CA: Jossey Bass.

Odom, L. R., & Henson, R. K. (2002). *Data screening: Essential techniques for data review and preparation*. Paper session presented at the meeting of the Southwest Educational Research Association. Austin, TX.

Roaden, A. L., & Worthen, B. R. (1976). Research assistantship experiences and subsequent research productivity. *Research in Higher Education, 5*(2), 141-58.

Sherry, A., & Henson, R. K. (2005). Conducting and interpreting canonical correlation analysis in personality research: A user-friendly primer. *Journal of Personality Assessment, 84*(1), 37-48.

Shulman, L. S. (2008). Foreword. In G. E. Walker, C. M. Golde, L. Jones, A. C. Bueschel, & P. Hutchings (Eds.). *The formation of scholars* (pp. ix-xiii). San Francisco, CA: Jossey Bass.

Smart, J. C. (1987). Student satisfaction with graduate education. *Journal of College Student Personnel, 2*(3), 218-222.

Stevens, J. (1996). *Applied multivariate statistics for the social sciences* (3rd ed.). Mahwah, NJ: Erlbaum.

Texas Higher Education Coordinating Board. (2009). *18 characteristics of Texas public doctoral programs for 2010.* Austin, TX: Author. Retrieved from the Texas Higher Education Coordinating Board website: http://www.thecb.state.tx.us/index.cfm?objectid=E0014CFE-F86C-6F22-A794036BF682835E&flushcache=1&showdraft=1

Tinto, V. (1993). *Leaving college: Rethinking causes and cures of student attrition* (2nd ed.). Chicago, IL: The University of Chicago Press.

Thompson, B. (1984). *Canonical correlation analysis: Uses and interpretation.* Newbury Park, CA: Sage.

Thompson, B. (1990). MULTINOR: A FORTRAN program that assist in evaluating multivariate normality. *Educational and Psychological Measurement, 50,* 845-848.

Thompson, B. (1991). A primer on the logic and use of canonical correlation analysis. *Measurement and Evaluation in Counseling and Development, 24*(2), 80-93.

Thompson, B. (1992). A partial test distribution for cosines among factors across samples. In B. Thompson (Ed.), *Advances in social science methodology* (Vol. 2) (pp. 81-97). Greenwich, CT: JAI.

Thompson, B. (1993). Calculation of standardized, non-centered factor scores: An alternative to conventional factor scores. *Perceptual and Motor Skills, 77,* 1128-1130.

Thompson, B. (1997). Editorial policies regarding statistical significance tests: Further comments. *Educational Researcher, 26*(5), 29-32.

Thompson, B. (2004). *Exploratory and confirmatory factor analysis: Understanding concepts and applications*. Washington, DC: American Psychological Association.

Thorndike, R. M. (1978). *Correlation procedure for research.* New York, Gardner.

Velicer, W. F. (1976). Determining the number of components from the matrix of partial correlations. *Psychometrika, 41,* 321-327.

Walker, G. E., Golde, C. M., Jones, L., Bueschel, A.C., & Hutchins, P. (2008). *The formation of scholars*. San Francisco, CA: Jossey-Bass

Weidman, J. C., & Stein, E. L. (2003). Socialization of doctoral students to academic norms. *Research in Higher Education, 44*(6), 641-656.

Wenger, E. (1996). Communities of practice. The social fabric of a learning organization. *The Healthcare Forum Journal, 39,* 20-25.

Wilkinson, L., & Task Force for Statistical Inference. (1999). Statistical methods in psychology journals: Guidelines and expectations. *American Psychologist, 54,* 594-604.

Woodrow Wilson National Fellowship Foundation. (2005). *The responsive Ph. D: Innovations in U.S. doctoral education*. Princeton, NJ: The Author.

Wulff, D. H. & Nerad, M. (2006). Using an alignment model as a framework in the assessment of doctoral edication. In P. Maki, & N. A. Borkowski (Eds.). *The assessment of doctoral education: Emerging criteria and new models for improving outcomes*. Sterling, VA: Stylus.

Zwick, W. R., & Velicer, W. F. (1986). Comparison of five rules for determining the number of components to retain. *Psychological Bulletin, 99,* 432-442.