Relationships between Teacher Preparation and Beginning Teacher Quality in North Carolina Public Universities

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To the students of
Capital View Elementary School and North Atlanta High School,
who made me a better teacher,
and made me love teaching in the process.

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Chapter 1

INTRODUCTION

Research provides strong evidence that teachers make a significant contribution to student achievement and that among in-school factors, teachers matters most (Aaronson, Barrow, & Sanders, 2007; Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004). Teacher quality varies widely in the United States, with the top quartile of teachers producing between one third and one half of a standard deviation larger gains in student achievement as teachers in the bottom quartile (Nye, Konstantopoulos, & Hedges, 2004). As such, in order to narrow the achievement gap, the education community has naturally turned to improving the quality of the teaching force, starting at the outset of a teaching career with improving teacher preparation.

In an era of educational accountability, largely in response to Race to the Top, more and more states are evaluating their teacher preparation programs based on their graduates' contribution to raising student achievement (Imig & Imig, 2008; Henry, Kershaw, Zulli, & Smith, 2012; Noell, Porter, Patt & Dahir, 2008; Koedel, Parsons, Podgurksy, & Ehlert, 2012; Goldhaber, Liddle, & Theobald, 2013; Tennessee Higher Education Commission, 2012). New standards presented by the Council for Accreditation of Educator Preparation (CAEP) include program impact on student learning as one of five standards for accreditation (CAEP, 2013). Teacher preparation programs could affect teacher quality and thereby student achievement either through the teacher candidates who select into them, through their training of teacher candidates, or through some combination of both (Ballou & Podgursky, 1998; Levine, 2006). These program evaluations are meant to provide teacher educators and program administrators with data to improve program quality, but these are black box studies and do not separate the effects of the selection of teacher candidates into programs from the effects of program features, nor do they investigate the mechanisms whereby one program's graduates may be more or less effective in raising student achievement. In spite of over a decade of researchers recommending investigation of these questions, there is a paucity of research to help improve the quality of teacher preparation programs as the field of teacher education lacks in-depth research to adequately describe and evaluate the content and quality of teacher preparation programs: only two lines of study have begun to do so, in Florida and New York City (Harris & Sass, 2011; Boyd, Goldhaber, Lankford, & Wyckoff, 2007; Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2009). These recommendations include studying selection effects and the effects of field experiences, subject matter preparation, and other structural features of teacher preparation on teacher effectiveness (Wilson, Floden, & Ferrini-Mundy, 2001, 2002; Wilson & Floden, 2003; Zeichner & Schulte, 2001).

There have been calls for improvement of teacher preparation programs virtually since they were created and teacher education programs have been long criticized for their lack of rigor and relevance to the classroom (Levine, 2006; Labaree, 2004, 2008). For at least the last twenty-five years, researchers and teacher educators have been calling for reform in teacher education as a means to increase the professional standing of teaching and to improve the quality of education in the United States (Howey and Zimpher, 1989). In their introduction to six profiles of preservice elementary teacher education programs, Howey and Zimpher (1989) lament "the lack of a clear understanding of the nature and quality of various programs of teacher education" (p. 5), together with a lack of assessment data, incomplete descriptions of the similarities and differences across programs, and lack of in-depth knowledge of what goes on in teacher preparation programs, including curriculum, instructional activities, and frequency, timeline and quality of preservice teachers' opportunities to learn to teach. These criticisms of the small body of systematic research pertaining to the nature of preparation programs have been echoed many times since (see Allen, 2003, Boyd, Goldhaber, Lankford, & Wyckoff, 2007; Zeichner & Schulte, 2001).

In a review of the extant literature on the relationship between teacher preparation and teacher effectiveness, Wilson, Floden, and Ferrini-Mundy (2001) make design and domain recommendations for future research. Design recommendations include explicitly tying such research to student achievement and controlling for confounding factors like school context that influence teacher performance, while domain recommendations include considerations of subject matter preparation and the design and organization of fieldwork. In a follow up review, they lament the lack of "satisfying" measures of teachers' verbal ability, subject matter knowledge, and outcome measures of teacher effectiveness and recommend further research into selection effects, the effects of variation in field experiences during preparation on teacher effectiveness, and cross-institutional studies of preparation programs (Wilson and Floden, 2003). Most pertinently, they recommend studying "the contribution of particular components of teacher education, by themselves or in interaction with one another, to prospective teachers' knowledge and competence" (Wilson, Floden, & Ferrini-Mundy, 2001, p. 35). Similarly, Zeichner & Schulte (2001) recommend a focus on "gaining a better understanding of the components of good teacher education," (p. 279) with an emphasis on distinguishing between selection effects and program effects. While the field has begun to address these gaps in the research base, there is much work to be done.

I refer to these components of teacher education as *structural features*. The structural features of teacher preparation programs fall primarily into two categories: coursework and field experiences, also referred to as clinical experiences. There are at least 3 domains of coursework included in teacher preparation programs: subject matter coursework, pedagogy coursework, foundations coursework that includes courses like educational psychology and the history of education, and other, often discrete, courses including educational technology and research methods. Taken together, pedagogy courses, foundations courses, and field experiences are often referred to as "professional education." Field experiences fall into two domains: early field experiences and student teaching, often referred to as the internship. Early field experiences are those that occur prior to student teaching and may include classroom observation, tutoring, or teaching for brief periods. Student teaching typically occurs at the end of a program and involves an extended period of time during which a teacher candidate holds full teaching responsibility. Other relevant aspects of student teaching include program supervision of student teaching, cooperating teacher characteristics, and whether programs require a student teaching seminar that links theory to practice. The amount of each structural feature required varies by teacher preparation program, but this variation has not been systematically documented, nor have the relationships between these features and teacher effectiveness been widely studied in spite of researchers calling for such studies for well over a decade.

Like many states, in response to increasing accountability pressures and with the view that more effective teachers are the key to academic improvement, the University of North Carolina (UNC) system has called for research to identify effective practices in teacher education and promote their adoption across teacher preparation programs in all 15 UNC institutions (Henry, Thompson, Fortner, Kershaw, & Zulli, 2010). North Carolina faces the same pressures to increase student achievement as the rest of the nation. It ranks 36th in the nation in SAT scores, 22nd in 8th grade math and 34th in 8th grade reading according to the National Assessment of Educational Progress (NAEP) (NCDPI, 2013a). Statewide in the 2011-2012 school year, North Carolina met only 85% of its Annual Measurable Objectives, performance targets based on growth expectations, set as part of the state's NCLB flexibility waver (NCDPI, 2013b). Research has identified differences in the effectiveness of teacher candidates prepared in the 15 UNC system institutions, 35% of the teacher workforce (Henry, et al., 2014), and work has begun to identify effective evidence-based practices for teacher preparation, but questions explaining variations in their effectiveness remain unanswered (Henry, Thompson, Fortner, Kershaw, & Zulli, 2010; Henry, Campbell, Thompson, Patriarca, Luterbach, Lys, & Covington, 2013).

To begin to address these deficits in the research and the North Carolina call for identification of effective practices, this dissertation asks the following questions:

1. What are the structural features of initial teacher preparation programs for middle and secondary teachers in North Carolina public universities?
2. What are the relationships between the structural features of these preparation programs and beginning teacher effectiveness as measured by student achievement?
3. Do these effects vary for English Language Learners and students with special needs?

History of Teacher Education

Teacher preparation began in the United States as the domain of local school districts. In the nineteenth century, some large urban districts developed their own schools for teacher education, normal schools, many of which grew into teacher colleges (Haberman, 1986; Lutz &

Hutton, 1989). The first state normal school was established in Massachusetts in 1839 (Ogren, 2005)—a low status school, not offering a bachelor's degree and educating primarily women and the children of rural farmers who had obtained little more than an elementary education themselves. There were 12 such schools by the start of the Civil War, but most teachers either received no formal training or were trained by their local district in a summer institute or short high school pedagogy course. These early requirements for teacher training focused primarily on subject matter, with some small emphasis on pedagogical training.

Between 1870 and 1900, the number of public school teachers doubled from 200,000 to 400,000, creating a high demand for the preparation of teachers (Labaree, 2004). To meet this growing demand for teachers, in an effort led by Horace Mann and other champions of the common school, the state normal school sector expanded throughout the remainder of the nineteenth century, growing to 180 schools by 1910 (Ogren, 2005). From the 1870s onward, although still quite limited, normal school curricula had expanded to include three of the structural features of teacher preparation: subject matter coursework, including studies in history, math, science, and English, pedagogy coursework, and required field experiences, including observation and practice teaching in elementary schools.

Since the beginning of the twentieth century, teacher education has become increasingly formalized and regulated within higher education. The first normal college that offered a bachelor degree was established in 1903 in Ypsilanti, MI (Ogren, 2005). From that point forward, normal schools began changing their names to teachers colleges, offering bachelor's degrees and requiring a high school diploma for admission. At the same time, throughout the late nineteenth and early twentieth centuries, the normal school "provided an opportunity to gain social advantages that previously had been restricted to the more privileged members of society"

(Labaree, 2004, p. 27) and liberal arts curricula within normal schools expanded to meet this demand and increase enrollment. This rapid expansion of the liberal arts curriculum within normal colleges led to fewer and fewer students enrolling in teacher education programs within these colleges. With this shift in curricular emphasis, between the 1940s and 1960s many of these state teachers colleges became state universities, often regional universities such as Western Kentucky University, granting liberal arts degrees as well as education degrees (Labaree, 2004, 2008). Today there are over 1200 university-based teacher education programs (Wilson, Rozelle, & Mikeska, 2011). These programs typically include some amount of subject matter preparation, training in methods and pedagogy, coursework in the foundations of education including history, sociology, and philosophy of education and educational psychology, and student teaching of varying duration. While these are the typical structural features of teacher preparation programs, university-based teacher education programs are yet very diverse in their requirements for each structural feature (Levine, 2006).

Just as teacher education programs have evolved, teacher certification has evolved. Efforts to certify teachers as qualified to teach predate formal teacher education. As early as the seventeenth century, local education authorities in New England required prospective teachers to pass a test of content knowledge, pedagogy, and knowledge of children to ensure that teachers met minimum standards (Imig & Imig, 2008; Sedlak, 2008). Throughout the mid-nineteenth century, local education authorities administered examinations of both subject matter and professional teaching knowledge. Certification and university-based teacher preparation have been tightly coupled historically, as state teacher certification requirements guide and shape the teacher preparation curriculum. California, in 1863, was the first state to accept a professional education credential in place of an examination. As credentialing replaced examinations at the end of the 19^{th} century, by 1921 a normal school diploma served as qualification for state certification in every state but one (Sedlak, 2008). Today, after a student completes a teacher preparation program as part of a baccalaureate or master's degree, the institution then certifies to the state that the student has indeed completed the program and met state requisites for professional licensing (Stoddart and Floden, 1995). This recommendation for licensure is an institution's seal of approval that a teacher is qualified to teach.

The North Carolina Context

Requirements for certification have changed in response to trends in teacher education and as part of efforts to professionalize teaching. Since the 1930s, for high school certification (grades 7-12), North Carolina has required graduation from a four-year college, and between 15 and 30 hours of subject matter coursework in the specific subject, and 18 credit hours of foundations and pedagogy coursework, which included both observation and student teaching (Woellner & Wood, 1936). In 1965, requirements to 24 hours of professional education and a minimum of 30 subject area hours (Woellner & Wood, 1966). In 1970, North Carolina added a new certificate area specific to middle grades (4-9). The professional education course requirements included 12 hours of foundations coursework, 6 hours of pedagogy, and a minimum of 18 subject matter coursework hours. These shifts demonstrate the growing emphasis on subject matter expertise for upper grades.

A significant shift in teacher certification in North Carolina occurred during the 1960s. Since the late 1960s, rather than certifying individual teachers, North Carolina has approved teacher preparation programs. These state-approved programs then recommend teacher candidates who have successfully completed program requirements for certification. Diverging from other state's certification requirements, North Carolina revised its certification requirements substantially in the early 1970s (Woellner, 1973, 1974). Rather than an exact prescription for preparation as in most states, these new requirements were now a set of guidelines in the areas of general education, subject area specialization, and professional education. A practicum or student teaching experience was not specifically mentioned. Finally, in 1983, graduation from an approved program became the only requirement for teacher licensure (Woellner, 1984).

Today, there is separate licensure for grades 6-9 and 9-12 (Kaye, 2008). Approved teacher preparation programs must meet a set of requirements, develop a conceptual framework to guide the program, and meet six standards in the areas of candidate performance and program capacity (NCDPI, 2005). These standards and requirements are presented in Table 1. These regulations for certification, rather than outlining a prescription for each program, allow for variation in teacher education programs' requirements to recommend a candidate for a teaching certificate. Despite these standards and requirements meant to ensure that programs produce novice teachers prepared to enter the classroom, teacher education programs still face scrutiny and criticism for failing to do so.

Table 1. North Carolina teacher preparation program approval standards

Requirements	
70% Pass Rate on NTE Specialty Area/Praxis II exams	
95% Conversion Rate in Initial Licensure Program	
Certification of Methods Faculty	
NCATE or TEAC Accreditation	
Standards	
Candidate Performance	
Candidate Knowledge, Skills, and Dispositions	Candidates preparing to work in schools as teachers or other professional school personnel know and demonstrate the content, pedagogical, and professional knowledge, skills, and dispositions necessary to help all students learn. This includes working with families to support student

	learning. Assessments indicate that candidates meet state-approved standards and indicators for all teachers (core standards, diversity standards, and technology standards) and state-approved standards and indicators for the specialty area.
Undergraduate Candidate Qualifications	Teacher candidates have at least a minimum 2.50 cumulative grade point average at the time of admission to and completion of an initial teacher preparation program. Undergraduate degree-seeking candidates attain passing scores on the PPST (PRAXIS I) tests for admission to the teacher education program. Progression in the program is limited until formal admission to the program has been granted. Formal admission to the program occurs at least one semester prior to student teaching.
Licensure-Only Candidates	Requirements for licensure-only candidates are clearly described. In determining requirements, consideration is given to alternative means of demonstrating the knowledge and competencies for licensure. The institution has clearly designated a coordinator for alternative licensure programs who is responsible for working with lateral entry teachers.
Assessment System and Evaluation	The program has an assessment system that collects and analyzes data on candidate and graduate performance. An annual review of the specialty area is conducted and the resulting data are applied, as appropriate, to program improvement.
Program Capacity	
Field Experiences and Clinical Practice	The program and its school partners design, implement, and evaluate field experiences and clinical practice so that teacher candidates and other school personnel develop and demonstrate the knowledge, skills, and dispositions necessary to help all students learn.
Field Experiences and Clinical Practice	Sequentially planned field experiences for undergraduate degree-seeking candidates begin early in a candidate's program and culminate in a continuous and extended minimum ten-week period of student teaching in the area in which the candidate is seeking licensure. All field experiences are supervised and formal evaluations involving university faculty, cooperating teachers, and candidates occur as appropriate. (Note: Service as a teacher assistant does not fulfill the requirements for student teaching.)
Diversity	The program designs, implements, and evaluates curriculum and experience for candidates to acquire and apply the knowledge, skills, and dispositions necessary to help all students learn. These experiences include working with diverse higher education and school faculty, diverse candidates, and diverse students, their families, and other significant adults in their lives in public school settings.
Faculty Qualifications, Performance, and Development	Faculty are qualified and model best professional practices in scholarship, service, and teaching, including the assessment of their own effectiveness as related to candidate performance. They also collaborate with colleagues in the disciplines and schools. The performance of faculty teaching in the program is evaluated and the professional development of faculty teaching in the program is facilitated.
Faculty Assignment	One appropriately specialized faculty member, full-time to the institution,

	is assigned major responsibility for teaching in and coordinating the specialty area. To ensure diversity, there must be a sufficient number of additional faculty, appropriately specialized, to deliver the level(s) offered; e.g., undergraduate, master's, doctorate. Each advanced program leading to the doctorate has at least three (3) full-time faculty who have earned the doctorate in the field of specialization for which the degree is offered. The use of part-time faculty members does not detract from the quality of the program.
Program Governance and Resources	The program has the leadership, budget, personnel, facilities, and resources including information technology resources, for the preparation of candidates to meet professional, state, and institutional standards.
Working Conditions	Faculty members have sufficient time for teaching, service, and research as appropriate to the mission of the institution.

Source: North Carolina Program Approval Standards, NCDPI, 2005.

Challenges to University-Based Teacher Education

Traditional, university-based teacher education programs have long come under attack for not preparing effective teachers, particularly teachers of disadvantaged students. In *The Miseducation of American Teachers,* James Koerner (1963) condemned teacher education programs for their intellectually inferior students and faculty, "puerile, repetitious, dull, and ambiguous" coursework, and excessive education coursework requirements to the exclusion of subject matter coursework (p. 18). Forty years later, Arthur Levine described teacher education programs similarly: they are "characterized by curricular confusion, a faculty disconnected from practice, low admission and graduation standards, wide disparities in institutional quality, and weak quality control enforcement" (2006, p. 21).

What caused this plummet from Horace Mann's vision of sound teacher preparation to these sustained criticisms? David Labaree, in *The Trouble with Ed Schools* (2004), summarizes this fall as a result of early normal school founders choosing a monopoly on the preparation of teachers over selective entry into programs, quantity over quality, and relevance over rigor. In order to establish this monopoly in an era when teachers could easily enter the profession without attending a normal school and to fulfill the demand for large numbers of teachers, normal schools lowered entry requirements and curricular rigor. Today, this lack of selective entry into teacher education largely persists. Some programs admit 90% of their applicants, and many require only a 2.5 GPA for admission (Levine, 2006). Low teacher salaries may make more academically able potential teachers reticent to apply to teacher education programs if they believe there will be better returns to their educational investment in other careers (Ballou & Podgursky, 1998). This, coupled with the idea that many universities rely on their teacher education programs as a funding stream, makes it difficult for universities to raise admissions standards and continue to attract sufficient numbers of teacher candidates (Levine, 2006).

Darling-Hammond (1999) adds to the list of teacher education criticisms: teacher preparation programs are fragmented and curriculum is superficial. Subject matter coursework is separated from education coursework by university departments and their respective faculties do not dialogue with one another, coursework is separated from student teaching, and teacher preparation programs focus either on subject matter knowledge *or* pedagogy, but neither is covered deeply. Null (2008) suggests that curriculum is at the heart of the challenges facing traditional teacher education programs: there is not a common vision around the purpose of teaching, exacerbated by the question of the appropriate relationship between subject matter knowledge and knowledge of teaching methods. Because of these criticisms and increased accountability at all levels of education, teacher education programs face growing pressure to demonstrate that they produce effective classroom teachers.

The effectiveness of teacher preparation programs today

In her 2005 Presidential Address to the American Educational Research Association, Marilyn Cochran-Smith described the "new teacher education" as a public policy problem. She highlighted a relatively new emphasis on grounding teacher education in research and evidence with a focus on outcomes over inputs. Historically, teacher education has had varied purposes, both proximal and distal. These include developing teacher candidates' pedagogical understanding, changing teacher attitudes, promoting social justice and democratic citizenship, and ultimately, improving student outcomes (Cochran-Smith, 2005; Nieto, 2003; Giroux & McLaren, 1986). Today, many of those purposes have fallen by the wayside in the public eye and teacher preparation programs face greatly increased scrutiny as to their effectiveness in improving student achievement (Cochran-Smith, 2005). Given the impact of teachers on student achievement, to remain viable, teacher preparation programs must produce beginning teachers capable of raising student achievement.

In the last two decades, evidence has clearly demonstrated that teachers are the most important in-school factor affecting student achievement, but that there is wide variation in teacher quality (Aaronson, Barrow, & Sanders, 2007; Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004). As such, researchers have sought explanations for this variation. With the emergence of alternative pathways into teaching throughout the 1990s and 2000s, routes that do not require university preparation and initially did not lead to standard certification, many studies began to focus on the relationship between teacher certification and teacher effectiveness. In attempting to determine what drives variation in teacher quality, such studies reveal largely inconsistent findings as to whether traditional certification, regardless of where a teacher is prepared, is a significant predictor of effective teaching, calling into question whether certification functions as the guarantee of a quality teacher it is intended to (Clotfelter, Ladd, & Vigdor, 2007, 2010; Kane, Rockoff, & Staiger, 2008; Goldhaber & Brewer, 2000; Darling-Hammond, 1996). Nationally, a cross-section of traditionally certified teachers at all levels of experience have a positive impact on student achievement compared to those with no certification, but students of teachers with emergency certification fare no worse than those with traditional certification (Goldhaber & Brewer, 1997, 2000). In North Carolina, certification does not seem to matter for student math achievement (Clotfelter, Ladd, & Vigdor, 2007, 2010).

Studies of Teach for America (TFA), whose teachers typically start teaching with non-traditional certification, also have inconsistent findings. For example, in Houston, one study found that beginning alternatively certified teachers (including TFA teachers) of upper elementary students have lower student achievement gains than traditionally certified teachers (Darling-Hammond, Holtzman, Gatlin, & Heilig, 2005), while an earlier study found no differences or positive effects of TFA teachers in elementary and middle school (Raymond, Fletcher, & Luque, 2001). A broader sample of TFA teachers compared to other beginning teachers found TFA teachers have a positive impact on math achievement, but no impact on reading (Glazerman, Decker, & Mayer, 2006). At the secondary level, TFA teachers have greater student achievement gains than traditional teachers (Xu, Hannaway, & Taylor, 2011). In New York City, there are few statistically significant differences in student achievement by teacher certification status, but there are statistically significant differences among different fixed preparation pathways, that is the route through which a teacher enters teaching, where teacher prepared in alternative pathways like TFA and New York City Teaching Fellows (NYCTF) are less effective than teachers prepared in college-recommending programs in both math and English/Language Arts (ELA) (Boyd, et al., 2006; Kane, Rockoff, & Staiger, 2008). These differences fade as teachers gain experience. In North Carolina, TFA teachers are more effective than traditionally prepared teachers, while other alternative-entry teachers are less effective in middle and high school math and science (Henry, et al., 2014). Importantly, there are wide differences in effectiveness of teachers with the same certification status and from the same preparation pathway.

As a university-based teacher preparation program has historically been the precursor to obtaining traditional certification, such mixed findings call into question whether university-based teacher preparation programs have any effect on teacher quality (Brouwer & Korthagen, 2005; Darling-Hammond, Holtzman, Gatlin, & Heilig, 2005). Recent research provides evidence that there are differences in teacher effectiveness differences among specific teacher preparation programs in the effectiveness of their graduates for increasing student achievement (Henry, Patterson, Campbell, & Yi, 2013; Henry, Bastian, & Smith, 2012; Henry, et al., 2010, 2011; Plecki, Elfers, & Nakamura, 2012; Tennessee Higher Education Commission, 2012, 2011; Noell, Porter, Patt & Dahir, 2008; Harris and Sass, 2011; Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2006, 2009). Given these differences, if programs are to improve the effectiveness of the teachers they produce, and as states focus more and more on the outputs and effectiveness of teacher preparation programs, attention must be paid to what structural features make some teacher preparation programs more effective than others in producing teachers who increase student achievement. In efforts to improve teacher quality, many states have increased course requirements for teacher preparation programs, attempting to leverage the features of preparation programs to increase teacher effectiveness, but to date, structural features have not been substantially studied, a significant gap this dissertation aims to fill (Boyd, Goldhaber, Lankford, & Wyckoff, 2007).

Over the last decade, researchers and teacher educators have continued to express appeals for further, systematic research on teacher preparation. In the final chapter of *Studying Teacher Education: The Report of the AERA Panel on Research and Teacher Education,* Zeichner (2005) asserts, "one critical outcome that has been largely neglected in the teacher education research literature is *student learning*" (p. 743). New standards for accrediting teacher education programs, recently recommended by the Council for Accreditation of Educator Preparation (CAEP) include program impact as one of 5 standards, that program completers must contribute to student learning growth on all available measures (CAEP, 2013).

While student learning has begun to be attended to, the field yet lacks sufficient evidence linking variations in preparation programs to student outcomes. Zeichner goes on to suggest that the "nature and quality of the teacher education curriculum" must be documented, together with "the variety of requirements, the content of preparation programs at different levels (e.g., elementary and secondary) and in different subject areas" (p. 748). More recently, as part of another call for the field of teacher education to improve the quality of its research, Grossman (2008) points out that, despite many reforms in teacher education, we "still know very little about what characteristics of teacher education make the most difference in preparing teachers to teach well, particularly in high poverty schools with students who most need strong teachers" (15). The NCATE Blue Ribbon Panel on Clinical Preparations and Partnerships for Improved Student Learning (2010) calls for increased funding to document the clinical preparation practices of teacher education programs at the state and national level in order to better inform the requirements for state certification and accrediting organizations.

The purpose of this dissertation is to improve on previous work on the relationship between teacher preparation and teacher effectiveness by beginning to isolate the effects of the structural features of teacher preparation programs on beginning teacher effectiveness from the contributions of program selection and initial school context, other factors that may also influence teacher effectiveness. These structural features are the components that comprise university-based teacher preparation programs: coursework and fieldwork and the domains therein: subject matter, pedagogy, foundations, and technology courses, together with early field experiences, student teaching, and university supervision of student teaching. Chapter 2 reviews two bodies of literature: first, the evolving literature base that seeks to explain the variation in teacher quality, and second, the literature pertaining to the structural features of teacher preparation programs and the evidence for including them in preparation programs. Chapter 3 describes the research questions, research design, data, and model specifications.

Chapter 2

TEACHER PREPARATION AND STUDENT ACHIEVEMENT: REVIEW OF THE LITERATURE

This chapter focuses on the contributions of teacher credentials and teacher preparation to teacher effectiveness, including the structural features of teacher preparation programs. Again, I define the structural features of teacher preparation programs as the components that make up a teacher preparation program, including required coursework and clinical experiences and various aspects of each. In the first section, I review prior work investigating the relationship between various teacher credentials and teacher quality. I first consider studies of teacher certification, then turn to studies of teacher academic degrees and credentials, and finally consider studies of fixed entry routes into teaching, also referred to as pathways or portals. In the next section, I review the literature on the relationship between teacher preparation and teacher quality. Next, I present three hypotheses that attempt to explain what drives the effectiveness of teacher preparation programs. Finally, I review the literature on the structural features of teacher preparation programs, and address research pertinent to the importance of teacher preparation for English Language Learners and special education students.

Teacher Characteristics and Teacher Quality

Teacher Certification and Teacher Effectiveness

That teachers, of all school-related factors, have the largest impact on student achievement is widely acknowledged and supported with empirical evidence (Aaronson, Barrow,

& Sanders, 2007; Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004). However, teachers vary in their effectiveness in raising student achievement and relatively little is known about what drives this variation in teacher effectiveness (Kane, Rockoff, & Staiger, 2008). Early research attempting to explain this variation in effectiveness focused on the relationship between teacher credentials, including certification, experience, and education, and teacher quality. These early studies compare student achievements gains of all regularly certified teachers, that is, teachers at any level of experience, to those with alternative, emergency, provisional, or no certification (e.g., Evertson, Hawley, & Zlotnik, 1985; Goldhaber and Brewer, 1997, 2000; Lackzo-Kerr & Berliner, 2002; Clotfelter, Ladd, & Vigdor, 2007). Their findings as to the importance of these credentials are mixed and inconclusive. In the first national study of the relationship between certification and student achievement, using 1988 data from the *National Educational Longitudinal Study* (NELS:88), Goldhaber and Brewer (2000), controlling for prior achievement, find that high school students with a traditionally certified math teacher have higher achievement than those whose teachers lack traditional certification, roughly 0.10 standard deviations higher math achievement. They find a similar pattern in science achievement, but coefficients are smaller and lack statistical significance. Similarly, using a decade of panel data from North Carolina elementary and middle grades, Clotfelter, Ladd, & Vigdor (2007) find that teachers with non-standard certification have statistically significant negative impacts on student achievement in the range of 0.033 to 0.059 standard deviations in math and 0.017 to 0.024 standard deviations in reading. A similar study of North Carolina high school teachers, using student fixed effects, finds that teachers with regular certification have positive effects between 0.057 and 0.074 standard deviations on student achievement compared to lateral entry teachers or teachers with other types of licensure (Clotfelter, Ladd, & Vigdor, 2010). These gains are larger than those associated with increases in Praxis II test scores and similar in size to returns to experience.

Other research finds mixed or no impacts of traditional certification. In Chicago public high schools, teacher certification is unrelated to student math achievement (Aaronson, Barrow, & Sander, 2007). An experiment where students were randomly assigned to classrooms in six regions with TFA teachers found TFA teachers had positive impacts on elementary students' math achievement (between 1.92 and 2.43 normal curve equivalents) and no effect on reading achievement compared both to all other teachers and to traditionally certified teachers (Glazerman, Mayer, & Decker, 2006). More recently, an evaluation of the effectiveness of middle and high school math TFA and Teaching Fellows (a national program that includes NYCTF) teachers who are trained similarly to TFA teachers, where students were randomly assigned to teachers, found that TFA teachers, on average, were more effective than comparison teachers (Clark, Chiang, Silva, McConnell, Sonnenfeld, Erbe, & Puma, 2013). Teaching Fellows were no more nor less effective than comparison teachers. However, this study did not restrict years of experience for any group of teachers; therefore, both TFA teachers and Teaching Fellows with greater years experience could have earned traditional certification. In 2006, it was estimated that over 50% of TFA teachers went on to earn full teacher certification (Glazerman, Mayer, & Decker, 2006). As such, studies of traditional certification that include teachers at all levels of experience in comparison to other types may no longer be measuring the effects traditional teacher preparation.

Academic Credentials and Teacher Effectiveness

Another line of research attempting to account for the variation in teacher effectiveness examines the relationship between teacher academic credentials and teacher quality (e.g., Goldhaber and Brewer, 2000; Kane, Rockoff, & Staiger, 2008). Again, research findings are mixed. Summarizing older studies investigating the relationship between teacher characteristics and student achievement, Greenwald, Hedges, and Laine (1996) report a mixture of positive, negative, and insignificant relationships between teacher education and student achievement. Tennessee STAR data, collected as part of a randomized experiment provides little evidence that holding a graduate degree has an impact on student achievement (Nye, Konstantopoulos, & Hedges, 2004). Similarly, using NELS:88 data, Goldhaber and Brewer (2000) find that teachers with math majors or degrees have positive effects on subject-specific student achievement, while those with science majors or degrees do not. Using more recent data in North Carolina, at all school levels, on average, graduate degrees are unrelated to student achievement, but there is evidence that elementary and middle school teachers who earn a master's degree while they are teaching are less effective than those without a master's degree (Clotfelter, Ladd, & Vigdor, 2007, 2010). At the high school level, however, earning a master's degree while teaching has a small, but significant, positive effect on achievement. In Chicago, neither advanced degrees nor undergraduate major are related to student achievement (Aaronson, Barrow, & Sander, 2007).

Entry Routes and Teacher Effectiveness

The inconclusive findings of the relationship between teacher credentials and certification and teacher effectiveness merit critique: as Wilson, Floden and Ferrini-Mundy (2002) note, a "teaching credential is a crude indicator of professional study, and unfortunately, these studies offer little insight into the specific aspects of pedagogical preparation that are critical. Large-scale research that uses certification status and degrees as indicators of teacher preparation may identify differences between, for example, teachers with emergency certificates and those with regular certification, but may not help us understand what aspects of the coursework taken for regular certification matter" (p. 193). Today, initial certification status and fixed measures of academic degrees tell us even less about teachers: a teachers' certification status often changes because, under No Child Left Behind (NCLB), in order to be considered Highly Qualified, a teacher must hold full certification. Because of this provision, in their first few years of teaching, many alternatively prepared teachers earn the same standard certification as traditionally prepared teachers. Similarly, many alternative certification programs have been criticized for not being alternative, but mirroring traditional preparation programs in their selection criteria and structural features, while only differing in their timelines (Walsh & Jacobs, 2007). Many of these alternative certification programs are housed in universities and lead to a master's degree for their teacher candidates. As such, initial certification and degree status may no longer be a good proxy for traditional teacher preparation. In the studies that follow, the entry route is fixed. As such, studies more directly estimate the impact of preparation on teacher effectiveness than do studies of teachers' certification status, which may change over time and therefore not be a good proxy for preparation.

Recognizing this, more recent research has turned to more detailed investigations of different routes into teaching and limited samples to teachers in their first few years of teaching (e.g., Boyd, Grossman, Hammerness, et al., 2008; Henry, Thompson, Bastian, et al., 2010). Boyd and colleagues (2008) describe the multiple programs that prepare teachers for New York City elementary schools. Rather than differentiating between traditional and alternative programs, they differentiate between college-recommending, what I refer to as traditional preparation programs where teachers complete certification requirements, including student teaching, prior to becoming the teacher of record, and early-entry routes, where teachers become teacher of record prior to finishing requirements for certification. These early entry routes include TFA NCYTF, arguably the best-known early entry routes. TFA teachers are prepared in an intensive 5-week summer "teacher boot camp" that includes pedagogy coursework and opportunities for student teaching. They typically hold emergency or another non-standard certification when they start teaching. Training for NYCTF is similar.

Using data from elementary and middle schools in New York City, Kane, Rockoff, and Staiger (2008) find no differences in student reading achievement between beginning teachers who enter teaching with traditional certification and teachers who enter with other types of certification, regardless of whether a teacher's certification changes over time. In math, outcomes vary according to type of certification: traditionally certified teachers outperform uncertified and international teachers, have similar performance to NYCTF teachers, and are slightly outperformed by TFA teachers (0.01 standard deviations). In a similar study, Boyd and colleagues (2006) find that compared to college-recommended teachers, TFA teachers are no more nor less effective, while NYCTFs are less effective in raising student achievement in math. In English/Language Arts, college-recommended teachers are more effective than both TFA teachers and NYCTFs in increasing student achievement. In later work, Boyd and colleagues estimate the effectiveness of TFA teachers and college-recommended teachers relative to NYCTF and changes in that effectiveness over time. They find that cohorts of NYCTFs are less effective than cohorts of college-recommended teachers or TFA teachers and that both groups are increasing in effectiveness relative to NYCTF, particularly in middle school math (Boyd, Dunlop, Lankford, Loeb, Mahler, O'Brien, & Wyckoff, 2010).

A similar line of work in North Carolina investigates the relative effectiveness of teachers from 11 different "portals" of entry into teaching (Henry, Purtell, Bastian, Fortner, Thompson, Campbell, & Patterson, 2013). These portals are fixed and document the path through which a teacher first enters teaching: in-state public undergraduate, in-state public graduate, in-state public licensure-only, in-state private undergraduate, in-state private graduate, out-of-state undergraduate, out-of-state graduate, out-of-state licensure-only, TFA, Visiting International Faculty (VIF) and alternative entry. The authors do find differences across entry portals: compared to in-state public undergraduate prepared teachers, in-state public graduate-prepared teachers are more effective in high school math, in-state private graduates more effective in high school science, VIF teachers more effective in elementary reading, and TFA teachers more effective in math at all levels, in all high school subjects, and in middle school science. On the other hand, compared to in-state public undergraduates, out-of-state undergraduates are less effective in elementary reading, math, and science and high school math and social studies, out-of-state licensure-only teachers are less effective in elementary reading and math, in-state private undergraduates are less effective in elementary science and middle and high school math, and alternative entry teachers are less effective in high school math, science, and social studies. In other grades and subjects, there were no differences. While providing evidence that some routes into teaching provide more effective teachers in some grades and subjects, such analyses provide little information to program administrators on how to improve their programs. Further, as the authors note, the relative effectiveness of teachers from various routes into teaching includes both selection effects and the effects of programs themselves. That is, both the characteristics of teachers who select into each portal and the structural features of programs themselves contribute to the overall portal effect. Again, because the entry portal is fixed, this study more directly estimates the impact of preparation on teacher effectiveness than does teachers' certification status, which may change over time and therefore not be a good proxy for preparation.

Teacher Preparation Programs and Teacher Effectiveness

Just as research has begun to investigate variation in the effectiveness of teachers using different fixed pathways into teaching, in the last 5 years, states have begun to assess the relative effectiveness of the teacher preparation programs in their states. Better data systems that link programs to teachers to students make this more detailed analysis of teacher credentials possible, but to date, few states have had such systems in place long enough to allow for longitudinal analysis.

An analysis comparing teachers prepared in teacher preparation programs in Washington state to those prepared outside of Washington found no significant differences between any Washington institution and out-of-state prepared teachers on raising 5th grade math achievement, and in 5th grade ELA achievement, differences in only 2 out of 13 institutions (Plecki, Elfers, & Nakamura, 2012). This analysis only focuses on elementary teachers and does not distinguish between the effectiveness of different programs within an institution. A similar study of teacher preparation programs in Louisiana estimates program effectiveness over three years of data for grades 4-9 in tested subjects for programs recently redesigned (Gansle, Noell, & Burns, 2012). This analysis compares first and second year teachers from ten "exemplar" preparation programs, both undergraduate and master's level, to experienced, certified teachers and to the average new teacher. Even using a generous 68% confidence interval, most programs appear to produce teachers who are less effective than experienced teachers. In comparison to the average new teacher, 3 programs produce teachers who appear to be more effective in at least one content area. Again, this is employing a 68% confidence interval. Together, these findings indicate that there are few differences in effectiveness between teacher preparation programs in Louisiana or Washington. Rather, variation in teacher effectiveness lies primarily within programs.

Analysis in Tennessee paints a different picture. Tennessee considers all 44 teacher preparation programs in the state, alternative entry and university-based, estimating separate program effects on achievement for grades 4-8 end of grade tests and for high school end of course exams (Tennessee Higher Education Commission, 2011, 2012). Beginning teachers are compared both to veteran teachers and to other beginning teachers (1-3 years experience). TFA teachers outperform both veteran and beginning teachers in 4-8th grade math, science, and social studies, and in high school Algebra I and English I, while underperforming in Algebra II. Teaching Fellows in Nashville perform no differently than other teachers across tests, while Memphis Teaching Fellows significantly underperform across tests. Memphis Teacher Residency, a third alternative entry program, is one of two programs to have only no differences from or to outperform both comparison groups. There are 11 university-based programs that have a mix of positive, negative, or no difference in effectiveness from comparison teachers and 9 university-based programs that underperform or have no differences across grades and subjects on achievement. That there are so many significant differences in Tennessee is particularly interesting given the much smaller samples sizes required for a program to be included in the analysis than in other states (5 teachers as compared to 25).

Finally, in North Carolina, teachers prepared in undergraduate and Master of Arts in Teaching (MAT) programs in the 15 UNC system institutions that prepare teachers are compared to teacher prepared in all other sources (Henry, Thompson, Fortner, Zulli, & Kershaw, 2010). With only a few exceptions, there are not significant differences in effectiveness between these programs' graduates and other teachers. Three universities perform significantly worse in one or two subject area(s), while 8 universities perform significantly better in at least one subject area. Of these, two universities are significantly better in both math and reading at the elementary level and one is significantly better overall at the high school level and in two out of three high school subjects.

These studies each have a different comparison group, select different samples of teachers with reference to years of experience, and employ different statistical models to estimate the effects of teacher preparation programs on student achievement. Yet on the whole, while they do find some preparation programs to be more or less effective than others, these differences in effectiveness are not large in a practical sense. Further, they demonstrate that, just as there is larger variation in teacher quality within K12 schools than between schools, there is larger variation in the effectiveness of their graduates within universities and programs than between them (Bastian & Henry, 2014; Henry, et al., in press; Rivkin, Hanushek, & Kain, 2005). As such, researchers continue to search for answers to this question of what drives the variation in teacher quality.

What drives the effectiveness of teacher preparation programs?

In spite of the growing body of scholarship showing that there is variation in the effectiveness of teacher preparation programs, we know very little about what drives the relative effectiveness of these programs. There are three main hypotheses as to what drives the differences in the effectiveness of teacher preparation programs: 1) initial school context as teacher of record, 2) program selection, or 3) programs themselves, that is, the structural features of programs (Henry, Thompson, Fortner, Zulli, & Kershaw, 2010; Wilson & Floden, 2003). Most research examining the differences in program effectiveness cannot distinguish between program selection and what teacher candidates are required to participate in as part of a preparation program itself, that is the effects of their structural and such evaluations leave unanswered the question of why one program may be more effective than another. In the following sections, I review the literature on each of these hypotheses in turn, starting with initial school context.

Initial school context

One primary explanation of the differences in the effectiveness of teacher preparation programs is the schools in which teachers teach, because teachers are not randomly assigned to schools As such, if teachers from a particular program are systematically teaching in schools with greater resources, or any other factor that contributes to student achievement, then these factors, rather than their preparation program, may drive their effectiveness. School context factors influencing student achievement include the demographic composition of the student body, school climate, location, and the amount of support and professional development beginning teachers receive. Across each of these aspects of school context, research findings as to their impacts on teacher effectiveness vary. Rigorous studies of the relationship between in-service professional development and student achievement primarily focus on elementary school and find small, if any, impacts on student achievement (Jacob & Lefgren, 2004; Angrist & Lavy, 2001; Yoon, Duncan, Lee, Scarloss, & Shapley, 2007; Harris & Sass, 2011). Beginning teachers perceive that mentoring has a host of benefits for their development, but little research exists demonstrating its direct impact on teaching effectiveness (Hobson, Ashby, Malderez, & Tomlinson, 2009). In one randomized control trial of a yearlong comprehensive induction program for first year teachers, across grade levels, there were no differences in the classroom practices or student achievement of teachers who participated in the experimental induction program from teachers who participated in the less intensive district induction program (Glazerman, et al., 2010). Other aspects of school context have primarily been studied in terms of teacher retention rather than their relationship with teacher effectiveness (Boe, Bobbitt, Cook, Whitener, & Weber, 1997; Ladd, 2011; Loeb, Darling-Hammond, & Luczak, 2005: Schweig, 2013).

Further complicating matters of school context, just as teachers are not randomly assigned to the schools in which they teach, students are not randomly assigned to teachers. As such, if teachers from particular programs systematically are assigned students who are easier to teach, these differences, rather than the effectiveness of preparation programs, may drive their relative effectiveness. Research suggests that teachers with more experience and training teach students of higher ability and with fewer discipline problems (Clotfelter, Ladd, & Vigdor, 2005, 2006; Betts, Zau, & Rice, 2003). Additionally, there is evidence of student sorting along racial and socioeconomic lines, where teachers with less experience and lower test scores are more likely to teach non-poor and non-white students (Lankford, Loeb, & Wyckoff, 2002).

While these school and student-level elements influence student achievement, they are not the primary focus of this study. As such, in the following sections, I review the literature around the influence of selection into programs and the structural features of teacher preparation programs on teacher effectiveness. In chapter 3, I present an identification strategy to attempt to isolate the effect of the structural features of a program from the influence of school context.

Selection Effects

Both theory and research predict that prospective teacher characteristics make important contributions to beginning teacher effectiveness (Zeichner, 2006). While past research has not directly investigated the impacts of program selection or selectivity on beginning teacher effectiveness, research addressing the relationship between teacher education, teacher certification, and teacher effectiveness has isolated teachers' academic ability as having some explanatory power for their effectiveness (Boyd, et al., 2008; Andrew, Cobb, & Giampietro, 2005; Rockoff, Jacob, Kane, & Staiger, 2011; Summers & Wolfe, 1977; Ferguson & Ladd, 1996). Measures of teachers' academic ability have included teacher licensing test scores, SAT and ACT scores, selectivity of college they attend, and tests of verbal ability. These measures are primarily only rough proxies for academic ability and only address individual, rather than program, selection effects.

Highly selective alternative entry programs like TFA hinge the success of their teachers on their rigorous selection process that includes a focus on both cognitive and non-cognitive traits (Bastian, 2013). In addition to content standards for teacher preparation programs, new CAEP standards include a standard for the quality, recruitment, and selectivity of teacher preparation programs, with recommendations that minimum admissions criteria be raised to a 3.0 GPA and that by 2020, a program's cohort of teacher candidates fall, on average, into the top third of the national distribution on tests such as the SAT and GRE. On the other hand, previous research has found inconsistent results when investigating the relationship between teachers' ability and student achievement (Wilson & Floden, 2003). Much of the research on teacher certification also addresses teacher academic ability, primarily measured by SAT/ACT scores or teacher licensure test scores. In New York City, college selectivity and undergraduate GPA do not appear related to teacher effectiveness, nor are teachers' scores on a general knowledge licensing exam (Boyd et al., 2009; Kane, Rockoff, and Staiger, 2008; Rockoff, Jacob, Kane & Staiger, 2011). However, there is some evidence that SAT scores are positively correlated with student math achievement (Boyd, Lankford, Loeb, Rockoff, & Wyckoff, 2008). In North Carolina, teacher licensure test scores are positive predictors of student achievement at all levels (Clotfelter, Ladd, & Vigdor, 2007, 2010). This effect appears to be driven by the tails of the distribution: teachers scoring 2 standard deviations above or below the average teacher have a 0.130 standard deviation difference from each other in student achievement scores, as compared to an 0.060 overall linear effect. Controlling for these test scores, the selectivity of a teacher's undergraduate institution is not related to student achievement at the elementary or middle schools, but at the high school level, attending a very competitive undergraduate institution does have a significant positive effect on achievement compared to attending a non-competitive institution. However, as licensure tests such as Praxis II are generally taken at the end of a teacher preparation program, including these test scores induces endogeneity as they may be correlated with both student achievement and the effectiveness of a preparation program.

One study in particular examines a host of these potential predictors of teacher effectiveness: Rockoff and colleagues consider the relationship between licensing exam scores, college entrance exam scores, and intelligence (Rockoff, Jacob, Kane, & Staiger, 2011). They find no relationships between any of these teacher characteristics and student achievement. Addressing only teacher licensing tests, Goldhaber, on the other hand, finds small positive relationships between passing teacher licensure tests and student math achievement, but no relationship in reading (Goldhaber & Hansen, 2010; Goldhaber, 2007). Angrist and Guryan examine the effects of state licensure testing requirements on teacher quality, but their measures of teacher quality are characteristics that much of the literature summarized here provides at best mixed evidence for having a relationship to teacher quality, including quality of undergraduate institution, majoring in education, and traditional certification (Angrist & Guryan, 2008). They do find, however, that the average SAT score differential between those who pass the general Praxis II test and those who do not is 224 points. This evidence that there is a relationship between academic ability and teacher effectiveness, particularly the selectivity of a teacher's undergraduate institution, supports the hypothesis that program selection effects could be driving differences in program effectiveness.

While there are standards and a growing number of recommendations for selection requirements for teacher preparation programs, some programs have high admissions standards, while many others have low standards and virtually 100% acceptance rates (Levine, 2006). For example, Bank Street College of Education, often considered an exemplary graduate-level preparation program, requires a minimum undergraduate GPA of 3.0, as well as an onsite interview and written essay (Darling-Hammond & McDonald, 2000). Case studies of exemplary teacher education programs housed in top-ranked, highly selective and very competitive universities like the University of California-Berkeley and the University of Virginia (UVA) call into question whether it is admissions standards, either at the university or program level, that contribute to producing effective teachers, the caliber of students that are attracted to such programs, or the value-added of the preparation programs themselves. For instance, at UVA the average SAT score for students admitted to the school of education in 2005 was 1247, much higher than the average SAT score of all college bound seniors, a 1028 (College Board, 2005; Levine, 2006). Secondary teacher candidates complete almost 60 credit hours in education, participate in 6 different field experiences prior to student teaching, and are observed by university supervisors at least bi-monthly during student teaching; each element is provided at a greater intensity than in most preparation programs (Levine, 2006). While the effectiveness of its graduates in increasing student achievement has not been evaluated, the Curry School of Education has an excellent reputation for teacher preparation and is consistently ranked a top 10 teacher education program in the US News and World Report Graduate School Rankings.

With the evidence that teachers' academic ability is related to their teaching effectiveness (Andrew, Cobb, and Giampietro, 2005; Howey & Zimpher, 1996), research suggests that programs examine if and how their selection criteria relate to the skills and characteristics that promote teaching effectiveness. Caskey, Temple, and Peterson (2001) provide some evidence as to the predictive validity of admissions requirements: references, a writing test, and personal statement had the strongest correlations with faculty ratings of candidate strength of performance in the preparation program.

While there is a paucity of evidence that stringent selectivity at the program level makes for more effective teachers, selection effects cannot be discounted because inherent in university-based teacher preparation program admissions is admission to the university as a whole. In North Carolina public institutions of higher education (IHEs), average university-level freshman SAT scores for the 2010-2011 school year range from 410-645 Verbal and 425-660 Math, indicating large variation in the academic quality of students across universities (IPEDS, 2011). If programs at the most selective IHEs are more effective than those in less selective IHEs, there is little research that explores whether these differences in effectiveness are due to the effects of the programs themselves or due to differences in the students each program prepares. There is some evidence from universities in North Carolina that positive program effects disappear when controls for SAT score high school class rank are included, suggesting that these positive effects are driven by program selection (Henry et al., 2010).

Additionally, while there is no empirical evidence, teacher candidates may select into certain programs they perceive as being more effective. This same desire to be prepared in the most effective program may in turn affect their teacher quality, apart from the impact of the preparation program itself. If this scenario were true, the effectiveness of programs in which they enroll would appear biased upward. I believe this scenario is more likely to be plausible at the master's level rather than at the undergraduate level. While MAT students may seek out a specific teacher preparation program because of its reputation for quality, at the undergraduate level, I posit that students make their schooling decisions primarily at the university level. Teacher candidates may also select into programs within a university non-randomly. The literature around how students select a college major focuses primarily on business and STEM majors. This literature does indicate that students choose college majors based on interest in the content area, salary prospects, jobs prospects in the field upon graduation, perceived difficulty of the major, and major prestige (Stinebrickner & Stinebrickner, 2011; Arcidiacono, Hotz, & Kang, 2012; Crampton, Walstrom, Schambach, 2006; Aldosary & Assaf, 1996). Because I limit my sample to teacher candidates who are certified in the field in which they teach, and have full teacher certification, many of the factors influencing choice of major such as salary prospects and major prestige do not vary across students in my sample, mitigating against bias from these sources.

However, teacher candidates may be more likely to be more inclined towards teaching in a middle school or towards teaching in a high school and choose their program accordingly. As high school certification programs tend to require more credit hours in subject matter coursework, implicit in this decision may be a preference for how much subject matter coursework a teacher candidate wants to take. While there is overlap between middle grades certified teachers teaching in high schools and high school certified teachers teaching in middle schools, if the same motivation that makes a teacher candidate pursue one program level over the other is related to their effectiveness, estimates of program effects would still be biased, particularly if stronger content area students gravitate toward secondary programs. Whether undergraduates choose a university because of its overall academic reputation or for the reputation of its teacher preparation programs, with the exception of subject matter, it is likely that they choose based on the reputation of the school of education as a whole, rather than because of the structural features of those programs.

Considering all the evidence pertaining to academic ability and selection at the university and program levels, it does appear that selection into teacher preparation programs may be a driver of their effectiveness. As such, any investigation of the relationship between the structural features of teacher preparation programs and beginning teacher effectiveness must take selections effects into account in order to obtain unbiased estimates. In the following chapter, I address how I plan to begin accounting for these selection effects. Having considered the role of selection in the effectiveness of teacher preparation programs, I turn to the literature surrounding the structural features of preparation programs.

Structural Features of Teacher Preparation Programs

In this section, I review the literature that examines each of the structural features of preparation programs and their role in preparing teachers to teach. The structural features of teacher preparation programs, the components that make up a teacher preparation program, include required coursework and field experiences that teacher candidates must complete in order to be recommended for licensure. The amounts of these structural features are constrained by law and by professional accreditation organizations. The National Council for Accreditation of Teacher Education (NCATE), together with professional organizations in various subjects like the National Council of Teachers of English (NCTE), provides standards for accrediting professional education programs. These accreditation standards emerge largely from and are congruent with the many case studies of exemplary teacher education (Darling-Hammond, 2006; Darling-Hammond, Hammerness, Grossman, Rust, & Shulman, 2005). The standards created by these councils fall into six broad categories: content knowledge, pedagogical content knowledge, pedagogy, field experiences, qualified faculty, and professional knowledge and skills (NCTE, 2012; National Science Teachers Association, 2012; National Council of Teachers of Mathematics, 2003; National Council for the Social Studies, 2004). Each organization's standards were developed from research on effective teaching and learning and effective preparation programs. They are intended to provide guidance to ensure that preparation programs are preparing effective novice teachers. These standards and requirements for certification largely shape the form traditional teacher preparation programs take. In North Carolina, the State Board of Education has 6 standards for program approval: 1) candidate knowledge, skills and dispositions; 2) assessment and evaluation; 3) field experiences and clinical practice; 4) diversity; 5) faculty qualifications and performance; and 6) program governance. Additionally, each specialty area for licensure has its own set additional set of more specific standards, relevant to the grade level and subject area.

Most recently, the CAEP recommended 5 standards for accrediting teacher preparation programs, 2 of which are relevant to the structural features of preparation programs: 1) Content and Pedagogical Knowledge and 2) Clinical Partnerships and Practice. Each standard provides responsibilities both for teacher candidates and for preparation programs. Standard one is articulated by the ten Interstate Teacher Assessment and Support Consortium (InTASC) core teaching standards. These standards focus on the learner and learning, content knowledge, instructional practice, and professional responsibility.

Through their structural features, elements of coursework and fieldwork, preparation programs meet these standards. Although North Carolina programs are bound by accreditation standards, these standards do not spell out a prescriptive format for teacher preparation. This creates what Boyd and colleagues (2008) refer to as "constrained variation:" there are similarities among teacher education programs in that each requires some amount of coursework and fieldwork, but how much of each varies. This dissertation seeks to contribute to the research base beginning to answer what the appropriate level of each structure feature is to maximize student achievement.

Program requirements are the central mechanism through which teacher preparation programs influence what types and how much coursework teacher candidates take and the format and duration of their field experiences. As program requirements set the floor for the amount of each structural feature each teacher experiences, it is important to determine whether any program requirements for structural features are associated with achievement gains. Further, utilizing these program requirements for structural features to estimate the relationship of structural features to student achievement provides more and better information for programs to make decisions as to how to best structure their programs across domains of coursework and field experiences than do transcript studies of teacher candidates' actual course-taking or other sources of data such as teacher reports of their experiences in a preparation program or supervisor evaluations of student teaching. If a program believes pedagogical preparation is important for effective teaching and wants to increase the amount of pedagogical preparation its teacher candidates receive, the program must increase the number of pedagogy credit hours it requires teacher candidates to take. Transcript studies only include coursework and provide no detail as to the nature of fieldwork experiences. Programs of study provide this information about field experiences, a key component of preparation. Further, teacher candidates who deviate from the prescribed program of study may differ systematically from teachers who do not, and their students may as well. That is to say, using transcript data may induce bias into estimates of the relationships between coursework and student achievement if the characteristic that compels teacher candidates to deviate from the prescribed course of study is also correlated with student achievement, but not included as a covariate. Other sources of data such as teacher reports of their experiences or supervisor observations of student teaching do not offer a level through which to influence teacher behaviors during a preparation program. For these reasons, program requirements that measure the structural features of teacher preparation are the best source of data to provide programs with information on how to optimize their programs of study to produce effective teachers.

The Structure of University-Based Teacher Preparation Programs

At the undergraduate level for middle grades and high school certification[1], a preparation program is typically the last two years of study. Teacher candidates complete general university coursework required of all students, prerequisites for admission to teacher education, and some

[1] Prior research has focused primarily on elementary teacher preparation programs, leaving a particular gap in the research on secondary teacher preparation programs. I focus on middle and high school programs, largely due to the self-contained nature of middle and high school courses. That is, coursework is more tailored for a specific subject area than the more general preparation of elementary programs. For example, middle grades math teacher candidates take mathematics coursework, participate in a mathematics student teaching internship, and go on to teach mathematics courses.

content area coursework in their first two years of study, prior to formal admission to the preparation program. At the MAT level, teacher candidates typically have a bachelor's degree in their subject matter or an equivalent number of subject matter credit hours. MAT programs typically span only one school year, and may include summer coursework as well. At both levels, there are 5 different types of required coursework: subject matter, pedagogy, foundations of education, educational technology, and other required courses (e.g., teacher leadership or research methods). Often some foundations coursework is a prerequisite for admission to the program for undergraduates. In addition to coursework, there are two categories of field experiences: early field experiences that occur throughout a program, but prior to student teaching, and student teaching itself. Elements of student teaching that may be related to teacher effectiveness include its duration, the duration of time for which teacher candidates assume full classroom responsibility, cooperating teacher characteristics, and university supervision of the student teaching experience.

In the following sections, I review the research on each of these structural features of teacher preparation. Following this review, I turn to the limited quantitative research that has begun to examine the relationships between theses structural features and teacher effectiveness.

Prior Research on the Structural Features of Preparation Programs

I first review the literature pertaining to the 5 areas of coursework: subject matter, pedagogy, foundations, technology, and other courses, before turning to the components of fieldwork: early field experience and student teaching.

Coursework: what teachers need to know to teach

Coursework is one of two primary components of traditional teacher preparation programs. Shulman (1987) organizes the knowledge base required for teachers into 7 categories: 1) content knowledge, 2) general pedagogical knowledge, 3) curriculum knowledge, 4) pedagogical content knowledge, 5) knowledge of learners and their characteristics, 6) knowledge of educational contexts, and 7) knowledge of educational ends, purposes, and values. These categories have driven much of the research on teacher knowledge since their publication and are frequently cited in conceptual frameworks for teacher preparation programs. As such, I rely on Shulman's framework to categorize coursework features of teacher preparation.

Teacher education coursework aims at developing these seven types of knowledge in prospective teachers. This coursework generally falls into three categories: subject matter courses, foundations courses, and pedagogy courses, but in actuality, university coursework may not be well aligned with Shulman's categories. Most programs only require courses in general pedagogical knowledge without addressing pedagogical content knowledge. Curriculum knowledge may be included in pedagogy courses or in foundations courses, depending on the program. On the whole, foundations courses include those that address knowledge of learners, educational contexts, and knowledge of educational ends, purposes, and values. Programs may offer courses in some of these foundations areas, but not necessarily all. Additional required courses often include technology and research methods, which do not align well with Shulman's categories of knowledge. Appendix XX includes sample programs of study for both middle and high school math programs and middle and high school English programs, at both the undergraduate and MAT levels. Because I am interested in the effects of the structural features of teacher preparation programs themselves, I primarily use these three categories of required coursework for my analyses. Here I turn to reviewing the literature about the domains of coursework. I first consider subject matter coursework, required for teachers with the intention of building their subject matter content knowledge.

Subject matter coursework

Shulman (1986) asserts that teachers should have content knowledge that is deeper than that of a "mere subject matter major," an idea that has been historically reflected in North Carolina guidelines for secondary teachers (Woellner, 1975). However, the average, SAT score of students planning to major in education is 60 points below the average SAT score for all college bound students and there is some evidence that education majors are of lower academic ability than STEM and humanities majors (Arcidiacono, 2004; Gitomer, 1999). If teacher candidates are of lower academic ability than subject matter majors, it calls into question the depth of teachers' content knowledge acquired while fulfilling general education requirements. Shulman recommends specific sections of content area courses for teacher candidates that will promote these deeper understandings of content than generalist subject matter courses. In reality, teacher candidates primarily fulfill their subject matter coursework requirements outside of a school of education, in courses intended for a broad student audience, rather than in courses designed for teacher candidates to develop this deep content knowledge.

Secondary preparation programs often have greater subject matter requirements than middle grades programs, which may be necessary as K12 secondary courses deal with more rigorous subject matter (Conklin, 2012). Middle grades programs in North Carolina require between 15 and 24 credit hours of subject matter coursework, while high school programs require a minimum of 30, with some programs requiring up to 70 hours. Preservice high school teachers who receive more subject matter coursework have been shown to have greater increases in content knowledge over the course of their preparation programs (Kleickmann, Richter, Kunter, Elsner, Besser, Krauss, & Baumert, 2013). Much of the research on the importance of subject matter preparation for teaching effectiveness focuses on mathematics. A review of the literature on teacher preparation programs a decade ago provides some support for the importance of subject matter knowledge, however, then and now, the extant literature base lacks sufficient detail to indicate how much subject matter coursework is most beneficial, or at what point diminishing returns set in (Allen, 2003). Internationally, in countries with the highest mathematical content knowledge, secondary teachers take twice as many mathematics courses than in other countries (Schmidt, Cogan, & Houang, 2011). In the US, data from the Longitudinal Study of American Youth (LSAY), which uses 1987 NAEP data, provide evidence that there is a positive relationship between the number of undergraduate math courses a teacher took and 10^{th} and 11^{th} grade math achievement, though with diminishing returns after 5 mathematics courses (Monk, 1994).

The importance of subject area coursework for teaching effectiveness may differ by subject area, however. English majors with strong subject matter expertise may have difficulty transferring their own expertise or not understand the need for making explicit their own reading process as a part of secondary instruction, prior to teacher education coursework (Holt-Reynolds, 1999). LSAY data provide inconsistent evidence for the importance of subject matter coursework in the sciences: without controlling for any indicator of teacher academic ability, coursework in the life sciences has no relationship or a negative relationship with science achievement, while a science major and coursework in the physical sciences (chemistry, physics, and earth science) have a positive relationship with science achievement (Monk, 1994). An early meta-analysis found a moderately strong (r=0.34) correlation between the number of biology courses a teacher took and their students' achievement on a general achievement test (not controlling for prior achievement), as well as a small (r=0.17) correlation between the overall number of sciences courses they took and student achievement, but no relationship with the number of physics or chemistry courses (Druva & Anderson, 1983). More recent work provides evidence that an increase in teachers' math coursework is associated with increases in gains in their students' math achievement (Henry, et al., 2013).

Further, as Feiman-Nemser (1990) points out, general education and professional education for teachers are conceptually different from one another, making it hard to "the study of academic content around problems of teaching and learning despite the fact that such an orientation might be as helpful to students who do not intend to teach as to those who do" (p. 217). Together, this research suggests that subject matter expertise may be a necessary, but not sufficient, condition for teacher effectiveness; pedagogy coursework must supplement subject matter coursework. It also lends support to preservice teachers taking subject matter courses specifically intended for teacher candidates, as they may provide more opportunity for teachers to develop pedagogical content knowledge.

Pedagogical coursework

Methods and pedagogy courses are largely designed to increase preservice teachers' pedagogical content knowledge and their pedagogical knowledge. These courses often also include curricular knowledge. Coursework in mathematics methods for preservice teachers at multiple levels has been linked to increased mathematical knowledge for teaching in certain domains and to student math achievement (Monk, 1994; Youngs and Qian, 2013). Mathematical knowledge for teaching is a subject-specific area of pedagogical content knowledge (Ball, Thames, & Phelps, 2008). Unfortunately, there is limited support for the importance of pedagogical coursework in the preparation of effective teachers, particularly for subject-specific courses like the pedagogy of science instruction and some evidence that there is a negative relationship between math pedagogy coursework and teacher effectiveness (Allen, 2003; Henry et al., 2013).

Included in pedagogy coursework is coursework aimed at improving preservice teachers' effectiveness in working with diverse populations of students, including English Language Learners (ELLs) and students with a special education designation. Skills for working with ELLs are particularly important with continued increases in the child population of non-native English speakers, and in North Carolina, where there was a 100% increase in the number of children attending preK from immigrant families between 1990 and 2000 (Capps, Fix, Murray, Ost, Passel, & Herwantoro-Hernandez, 2005; Garcia & Jensen, 2009). Further, NCLB requires that ELLs be tested and their achievement reported as a subgroup for Adequate Yearly Progress. Working effectively with ELLs requires extensive pedagogical expertise: teachers must be familiar with students' linguistic and academic backgrounds, know the language demands that are part of tasks they require of students (e.g., semantic and syntactic complexity of materials), and provide the appropriate scaffolding so that ELLs can be successful in such tasks (Lucas, Villegas, & Freedson-Gonzalez, 2008). Appropriate scaffolding may require greater familiarity with visual tools like maps, illustrations, and graphic organizers than is required for mainstream students, paying more attention to their own speech patterns like use of idioms and speaking slowly, and providing activities where ELLs can interact with the teacher and other students to negotiate meaning in groups. University coursework that teaches the theory and practice of second language acquisition, instructional strategies for working with ELLs, and how to incorporate this knowledge into lesson plans can work to develop preservice teachers' awareness of ELLs' learning challenges and understanding of how to incorporate instructional strategies to develop ELLs linguistically and academically (Zhang & Stephens, 2013). However, similar to other components of teacher education, the question remains as to how deep an understanding and expertise student teachers can develop in one semester.

Because of an increased focus on inclusive education as a result of 1997 amendments to the Individuals with Disabilities Act (IDEA), more and more secondary teachers teach special education students in their mainstream classrooms, but there is little research examining the role that special education coursework plays in preparation for general education teachers (Shade & Stewart, 2001; Barker, Shoho, & Van Reusen, 2000; Yell & Shriner, 1997). However, there is evidence that general education teachers with little special education training may have negative attitudes towards inclusion and special education students and the majority of teacher preparation programs do not offer a specific course in special education for general education teacher candidates (Allday, Neilsen-Gatti, & Hudson, 2013; Baker, Shoho, & Van Ruesen, 2000). A correlational study of teacher attitudes towards special education in one Texas high school found significant differences in teachers' own beliefs about their effectiveness in teaching special needs students between teachers who had taken only one special education course and those with greater training (Baker, Shoho, & Van Reusen, 2000). Studies examining how attitudes for both special education teacher candidates and general education teacher candidates as a result of special education coursework find positive changes in attitude toward inclusion and special education students for general education teacher candidates (McHatton & Parker, 2013; Shade & Stewart, 2001). Despite this, general education teacher candidates remain unconfident in their ability to implement inclusion, but none of these studies examine the actual practice of teachers (Conderman & Johnson-Rodriguez, 2009; Hodkinson, 2006). As a whole, this research on pedagogical coursework suggests that such coursework may positively impact teacher effectiveness, but it is unclear whether this varies across grades and subjects, and in what amount it may be beneficial.

Foundations coursework

Foundations coursework is meant to address the 3 remaining areas of Shulman's (1987) knowledge base for teachers: knowledge of learners and their characteristics, knowledge of educational contexts, and knowledge of educational ends, purposes, and values. Foundations coursework includes courses on the social foundations of education like history and philosophy of education, multicultural education, and education psychology. Such coursework may be important in preparing would be teachers to work with diverse student populations, to understand teaching as a profession, and "to see teaching as entailing reasoned and reasonable judgment about educational ends and preferred pedagogical means" (Liston, Whitcomb & Borko, 2009, p. 108). Significant foundations coursework provide preservice teachers with multiple frameworks for understanding teaching and opportunities for reflection on their own beliefs and values rather than promoting a single paradigm for education (Liston, Whitcomb, & Borko, 2009). However, programs may be lacking in coursework that focuses on the moral and ethical dimensions of teaching that such foundations coursework could provide and there is little research to support the importance of such courses for teacher effectiveness (Allen, 2003; Howey & Zimpher, 1989).

One study has found a relationship between such coursework and student achievement, where a one course increase in the number of professional studies courses a teacher candidate takes, technology and foundations courses is associated with a 0.11 standard deviation increase in elementary reading achievement (Henry, et al., 2013a). However, like most other structural features of teacher preparation, most of the research about these foundations courses is limited to descriptive case studies (e.g., Causey, Thomas, & Armento, 2000; Darling-Hammond & McDonald, 2000). Graduates of Bank Street College of Education, widely considered an exemplary graduate teacher education program, are hailed by the principals because of their strong understanding of adolescent development and multi-culturalism (Darling-Hammond & McDonald, 2000). Bank Street requires a three-course sequence in child development together with two other social foundations of educations courses like "Anthropology in Education" or "Issues in Adolescence." Other exemplary programs also have extensive course requirements for human development and foundations courses including urban education, education law, and social context (Koppich, 2000; Snyder, 2000).

Social foundations Social foundations courses typically include the philosophy, history, and sociology of education (McAninch & McAninch, 1996) and are meant to provide prospective teachers with an understanding of the role of schooling in education and critical lenses through which to view education (Dotts, 2013; Tozer & McAninch, 1986). Such coursework is included in teacher education because of its emphasis on the cultural context of schooling (Clabaugh & Rozycki, 1996, p. 395). To date the importance of social foundations courses for teacher effectiveness or teacher behavior has not been studied.

Multi-cultural education Coursework in multi-cultural education is considered by many to be particularly important as the majority of preservice teachers continue to be white and female (US Department of Education, 2010), while the students they teach continue to increase in diversity. Coursework on diversity and multi-cultural education may focus on developing cultural awareness and sensitivity, making students more aware of their own beliefs and challenging those beliefs when necessary (Causey, Thomas, & Armento, 2000). Further, such coursework can work to combat negative conceptions teachers may hold which have detrimental effects on their students: low expectations, the myth of meritocracy, believing colorblindness benefits students, and deficit conceptions of their students (Milner, 2010).

Field experiences, where students spend time in urban schools and unfamiliar cultural settings in the broader community, are also often a component of such courses. Such diversity-focused courses provide preservice teachers the opportunity to confront their stereotypes, restructure idealistic prior beliefs and build new knowledge, but questions remain as to the long-term effects of one semester-long course on changing beliefs (McDiarmid, 1990). Further, the CAEP commission describes diversity as a "pervasive characteristic" of teacher preparation, not meant to be isolated into one or two specific courses, but integrated throughout preparation.

Educational psychology A third component of foundations courses that many programs require are educational psychology courses. These may be broad educational psychology classes or more specifically tailored toward adolescent development, particularly in middle grades programs. Course topics include diversity, school and family contexts, learning processes, individual and group differences, assessment, and motivation (Patrick, Anderman, Bruening, & Duffin, 2011; Fendler, 2012; Hanich & Deemer, 2005; Hoy, 2000). In North Carolina, many programs require both a course in educational psychology and a specific course in human development, particularly at the middle grades level. Educational psychology has historically been closely linked to teaching, but since the restructuring of many teacher education programs in the 1980s, education psychology has had a more peripheral place in teacher preparation programs, often serving as a prerequisite for entry into the formal teacher education program, rather than as part of the core coursework (Hoy, 2000; Patrick, Anderman, Bruening, & Duffin, 2011; Knapp, 2005). Yet the National Academy of Education (2005), together with a number of professional organizations (see Hoy, 2000 for a compilation), lists knowledge of children's learning and development and individual differences therein as central to effective teaching. Conversely, Fendler (2012) argues that educational psychology courses may continue to be included as part of teacher education curriculum for a number of reasons unrelated to teacher efficacy: because of their role in professionalizing teaching, out of habit, or even out of a "fervent wish that the study of psychology might help teachers to understand how children learn and thereby enable them to teach more effectively (p. 347). To date, there is no research examining the relationship between education psychology and effective teaching and this lack leads educational psychologists to worry that such courses may be cut from programs (Fendler, 2012; Patrick, Anderman, Bruening, & Duffin, 2011; Floden & Meniketti, 2005). Here, I turn to discussing the final domain of coursework, technology.

Technology coursework

Given the ubiquity of technology and a recent federal focus on equipping all classrooms with appropriate educational technology and making sure teachers are trained on the advantages of such technology, some preparation programs require their teacher candidates to take courses specifically focused on educational technology (White House, 2014). Younger teachers are more comfortable using technology than their older counterparts (Russell, Bebell, O'Dwyer, & O'Connor, 2003). Niess (2005) suggests the need to develop a subdomain of pedagogical content knowledge, technology pedagogical content knowledge, "an overarching conception of their subject matter with respect to technology and what it means to teach with technology" (p. 510). Most programs, if they have a technology requirement at all, only require a general educational technology course like "Computers in Education." A case study of 8 teachers enrolled in an advanced educational technology course aimed at the integration of technology to support student learning, the third in series of technology courses, finds that teachers are able to identify strategies for implementing technology and draw strongly on their previous 2 technology courses in the implementation of technology (Hsu, 2012).

Other research suggests that instruction on using educational technology be integrated throughout a preparation program, rather than in a discrete class, including integration into early field experiences and student teaching, if such instruction is to impact teachers' practice (Dexter & Riedel, 2003; Brush, et al., 2003). Rather than include a separate technology standard, the CAEP commission asserts that technology is "imbedded in every aspect of education preparation" (p. 3) and weaves technology into all standards.

Having considered the 4 domains of coursework in teacher preparation programs, I turn to reviewing the literature on the second major structural feature of teacher preparation programs, field experiences. I first review the role of early field experiences, then to turn to student teaching and its facets, the supervision of student teaching, and the link between student teaching and coursework.

Field experiences

The second primary element of traditional teacher preparation programs is field experience. The NCATE Blue Ribbon Panel on Clinical Preparation and Partnerships for Improved Student Learning concluded that practice must be central to the teacher preparation experience (NCATE, 2010), while recommended CAEP standards specify that "high-quality clinical experiences are early, ongoing, and take place in a variety of school- and community-based setting" (CAEP, 2013, p. 15). Preparation program alumni praise programs where they spend extensive amounts of time in schools, while a common alumni criticism is a desire for "more, longer, earlier, and better-integrated" field experiences (Levine, 2006, p. 41). Field experiences serve many purposes in a teacher preparation program. These include socializing teachers to the secondary school environment, providing opportunities to try out various classroom management strategies, and learning how to tailor teaching strategies to specific students (Beisenherz & Dantonio, 1991; Cheng, Tang, & Cheng, 2012). Many teacher preparation programs include two types of clinical experiences: those that occur early in the program, prior to the student teaching semester which I refer to as *early field experiences*, and the student teaching experience or internship, which typically occurs the final semester in the program sequence.

Early Field experiences

Early field experiences, those that occur before the semester-long student teaching internship, take on multiple purposes. The NCATE Blue Ribbon Panel on Clinical Preparation and Partnerships for Improved Student Learning (2010) includes recommendations that fieldwork be integrated throughout teacher preparation programs, yet a decade ago, less than 50% of preservice teachers participated in early field experiences (Levine, 2006). Those who do not participate in early field experience lament the lack of real-life classroom experience prior to their student teaching. These early field experiences may be integrated into specific required coursework or stand-alone. Requirements vary from observation in both school and non-school settings, to more in depth experiences where prospective teachers have the opportunity to plan and implement lessons or projects for brief periods (Daisey, 2012). Early field experiences can serve so basic a purpose as to provide positive experiences with students for prospective teachers (Feiman-Nemser, 2001) or to challenge preservice teachers' initial beliefs about teaching and learning (Fletcher & Luft, 2011; Ng, Wilson, & Williams, 2010). Multiple field experiences in different teachers' classrooms can expose preservice teachers to various pedagogical and managerial styles (Snyder, 2000).

Early field experiences may be most beneficial to prospective teachers when they are developmental in nature, starting early in the program and moving from shorter, observational field experiences to longer, more intensive experiences (Howey & Zimpher, 1989). Burant (1999) describes an early field experience for an initial preparation master's program where preservice teachers spend one day a week in practicum experiences where they engage in a range of activities including preparing a school-community newsletter with sixth graders, providing childcare for parent teacher organization meetings and English as a Second Language classes for parents, and coordinating a book and breakfast club with elementary students. Preservice teachers in an early field experience designed to increase cultural awareness found it to be the most influential and knowledge-building aspect of the diversity course in which it was embedded (Causey, Thomas & Armento, 2000). Early field experiences where preservice teachers have the opportunity to implement material they have learned in coursework can also serve to change attitudes toward specific strategies they may have otherwise been unlikely to implement (Daisey, 2012; Fletcher & Luft, 2011).

Student Teaching/ Internship

Preservice teachers consistently report that student teaching experiences are the most beneficial aspect of preparation programs for their first year of teaching (Guyton & McIntyre, 1990; Van Zandt, 1998; NCATE, 2010), but research finds both positive and negative contributions of student teaching (Valencia, Martin, Place, & Grossman, 2009; Ng, Nicholas, & Williams, 2010; Youngs & Qian, 2013). Student teaching frequently lasts one university semester, 10-16 weeks, and often takes place during the spring semester (Levine, 2006; Ronfeldt, Reininger, & Kwok, 2013). A survey of recent teacher education program alumni found that 60% of teachers had a semester long internship, 16% less than a semester, and only 7% a full year (Levine, 2006). The American Association of Colleges for Teacher Education (AACTE) (2012a) recommends a full year (30 weeks or 900 hours) of student teaching, with a semester (15 weeks or 450 hours) student teaching experience at a minimum. In considering the ways student teaching affects teacher effectiveness, there are three key areas of consideration: its structure and content, placement sites, and the relationship between preservice teachers and the other people they interact with as a part of the student teaching experience, particularly the cooperating teacher (Zeichner, 1984). A yearlong internship allows preservice teachers to participate in pre-planning, be present on the first day of school, acclimate to the school environment, and have a longer time to know their students and reflect on their teaching (Graham, 1997). Preservice teachers are placed in a cooperating teacher's classroom where they gradually assume more responsibility for teaching. The cooperating teacher observes their teaching and provides feedback, as does a university supervisor (Griffin, 1989).

The practical experience student teachers gain during student teaching may serve to further develop their pedagogical content knowledge, particularly the amount of time they have full responsibility for teaching a class, and to stretch their content knowledge (Brown, Friedrichsen, & Abell, 2013; Friedrichsen, et al., 2009; Smith, 1999; Youngs & Qian, 2013). At the same time, there is evidence that the overall length of student teaching experience does not significantly increase elementary teachers' mathematical knowledge for teaching (Youngs & Qian, 2013). In spite of the number of case studies and other qualitative research describing early fieldwork, student teachers' experiences, and the relationships among student teacher, cooperating teachers and university supervisors, there is a dearth of evidence linking field experiences to increased student achievement (Wiseman, 2012).

There is limited quantitative research examining student teaching, but Griffin's (1989) study of student teaching in two large universities provides evidence that student teaching may not have the influence on preservice teachers that they perceive. He finds little change after student teaching on measures of personal and professional dimensions, including empathy and perceptions of impact on students. The exception to this is increased flexibility in uncomfortable situations and social settings. Further, Ronfeldt and Reininger (2012) find that the duration of student teaching is unrelated to a variety of teacher outcomes, including self-efficacy, feelings of preparedness, and their plans to remain in teaching.

Supervision of Fieldwork

A key function of the student teaching internship is providing an opportunity for preservice teachers to examine, challenge, and amend their belief systems (Borko & Mayfield, 1995; Feiman-Nemser, 2001). Both university supervisors and cooperating teachers play significant, but differing, roles, in this process through their presence and serving as models (Feiman-Nemser & Buchmann, 1987; Griffin, 1989; McDiarmid, 1990). However, the actual influence both cooperating teachers and university supervisors exert is unclear. Student teachers report dissatisfaction with university supervisors in that they visit classrooms too infrequently and are unfamiliar with their teaching, thereby wielding little influence (Borko & Mayfield, 1995; Griffin, 1989). However, when university supervisors are present, their advice and critical feedback can be crucial to student teacher improvement (Cheng, Tang, & Cheng, 2012) and they can play an important role in promoting critical reflection (Dinkelman, 2000).

In contrast, cooperating teachers vary in their influence on student teachers, depending upon the extent of their interactions and whether they view theirs as an active role with student teachers to plan lessons and provide a greater degree of feedback (Borko & Mayfield, 1995;

Valencia, Martin, Place & Grossman, 2009). Student teachers report greatest satisfaction with cooperating teachers who observe them for a sufficient length of time to accurately assess their teaching, provide feedback and advice for improvement, and acknowledge their concerns (Cheng, Tang, & Cheng, 2012; Smith, 1990). In fact, student teachers may be more receptive to feedback from cooperating teachers than university supervisors because they view cooperating teachers as sources of support rather than judgment (Liakopoulou, 2012). However, this feedback may be more situation-specific, addressing particular classroom events (e.g., returning homework, arranging student groups), rather than focusing on broader understandings or principles of teaching (Griffin, 1989).

Additionally, student teachers' relationships with their cooperating teachers can be fraught with frustration: the school site may be disconnected from the teacher education program, student teachers and cooperating teachers may differ in their teaching philosophies, and student teachers may have a difficult time fitting into a classroom culture that has already been established (Graham, 1997; Valencia, Martin, Place, & Grossman, 2009).

Whether student teachers are conscious of it or not, cooperating teachers do wield strong influence over their student teachers. A yearlong ethnography of 6 science teacher candidates describing and explaining how they change over the course of their student teaching provides evidence that, as they increase in teaching responsibilities, student teachers mirror cooperating teachers' lesson scripts, structures, instructional representations (i.e., examples, metaphors, jokes), and patterns of practice, including questioning strategies and classroom management techniques (Rozelle & Wilson, 2012). Cooperating teachers also fill support roles for student teachers, helping to ease student teachers' transitions into the school environment. They are also in a position to provide student teachers advice on balancing the many responsibilities of teaching, from lesson planning to administrative tasks (Fairbanks, Freedman, & Kahn, 2000). Cooperating teachers further support student teachers by advising them about disciplinary issues that arise in the classroom, modeling appropriate interactions with students and colleagues, and working with them to plan effective, engaging lessons and units.

Unfortunately, given the importance of cooperating teachers in the student teaching experience, contrary to common assumptions in teacher education (Little, 1990), "being an effective consulting teacher or mentor is not synonymous with being a good elementary/ secondary school teacher but involves a whole new way of thinking about one's own instructional knowledge and skill" (Stoddart, 1990, p. 3). A case study of an exemplary mentor teacher describes the role as one that "promotes beginning teacher development by cultivating a disposition of inquiry, focusing attention on student thinking and understanding, and fostering disciplined talk about problems of practice" (Feiman-Nemser, 2001, p. 28). Such skills require training and experience to develop, but often, cooperating teacher placements are chosen as a matter of convenience (Dinkelman, 2000; Goodlad, 1990). Programs may choose cooperating teachers based on their ability to provide useful feedback in a non-threatening manner and for their expertise in some aspect of teaching and learning, but there is no evidence that cooperating teacher characteristics are related to beginning teacher effectiveness (Snyder, 2000).

Assuming full responsibility for teaching

Very little research exists examining the amount of time student teachers assume full responsibility for teaching in a classroom. Ronfeldt and colleagues (2013) examine the relationship between the amount control over classroom and instructional decisions student teachers had by the end of student teaching and their feelings of instructional preparedness, self-efficacy, desire to serve under-served populations, and plans to remain teaching. They find that instructional autonomy is a significant predictor of each outcome save the desire to serve under-served populations. As their prior research finds no relationship between the overall duration of student teaching and similar teacher outcomes (e.g., Ronfeldt & Reininger, 2012), this evidence suggests that this is both an important area for further study and a potentially important lever for increasing beginning teacher effectiveness.

Links between fieldwork and coursework/ theory and practice

Field experiences may be enhanced by a close connection between the school site experience and the university program. There is evidence that oversight of field experience is positively related to teacher effectiveness in both reading and math, but a persistent critique of university-based teacher preparation programs is the divide between the training they provide and what beginning teachers experience in their classrooms (Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2009; Levine, 2006). One way programs may overcome this divide is through a student teaching seminar. Such courses often meet once a week or every other week and offer opportunities for students to work through issues that have arisen in their field experience, address aspects of curriculum and planning, or work on capstone portfolios (Borko, Michalec, Siddle & Timmons, 1997; Whitford, Boscoe, & Fickel, 2000).

In some programs, a portfolio serves as a capstone project. Such portfolios often serve multiple purposes: promoting reflection in preservice teachers, as an evaluative measure, as a tool for professional development, and as a way to highlight accomplishments and skills in the job search (Borko, Michalec, Siddle & Timmons, 1997; Loughran & Corrigan, 1995; Meyer & Tusin, 1999). Portfolios often contain a statement of teaching philosophy, reflections, sample lesson plans, and student artifacts (Borko, et al., 1997). Preservice teachers hold varied opinions of the utility of such portfolios: completing them can be a confusing and arduous task and they can be perceived as a drain on time and energy that could otherwise be devoted to activities more closely related to teaching or as a checklist of things to complete (Borko, et al., 1997). On the other hand, portfolios can influence what student teachers do in the classroom so that something can be included in the portfolio, and many student teachers are able to see value in the portfolio as an instrument for connecting theory and practice through reflection (Borko, et al., 1997; Loughran & Corrigan, 1995). Portfolios may be more effective when embedded in a professional seminar that accompanies student teaching, where the program and supervisors provide space and support for completion.

Taken together, these structural features of teacher preparation programs, coursework in subject matter, pedagogy, foundations, and technology, and field experiences, both early experiences and student teaching, are meant to provide prospective teachers with a broad knowledge of education and learners, the content knowledge, pedagogical skills, and opportunities to put them into practice so that they are prepared to enter a classroom as the teacher of record as effective beginning teachers. However, only a few lines of research have begun to document these structural features or address how they are related to teacher effectiveness. Next, I address research pertaining to teacher preparation specifically for English Language Learners and special education students, before outlining these lines of work.

Teacher Preparation and English Language Learners

Teacher preparation has traditionally treated English as a Second Language (ESL) as a specific specialty content area, similar to art or special education preparation, separate from preparation for mainstream content-area teachers like mathematics or science (Evans, Arnot-Hopffer, & Jurich, 2005). As such, these mainstream content-area teachers have typically received little preparation for addressing the specific needs of students who are English

Language Learners (ELLs). This is particularly problematic as the number of ELL students is rapidly increasing, while there is a shortage of ESL-prepared teachers and decreasing numbers of ELL students receive special services (Harper & DeJong, 2009; Walker, Ranney, & Fortune, 2005). North Carolina typifies this problem, where total K12 enrollment increased 14.4% between 1997-98 and 2007-08 (1,274,949 to 1,458,035), while in the same period, ELL enrollment increased 269.8% (28,709 to 106,180) (NCELA, 2010). In 2002-03, 59,712 students in North Carolina participated in programs for ELLs, while 126,792 did in 2007-08 (102,397 for 2010-11) (National Digest of Education Statistics, 2012). Nationally, in 2009, there was a 36 point achievement gap on NAEP between ELL and non-ELL students in 4th grade reading, 47 points in 8th grade, and 50 points in 12th grade. In North Carolina, in 2011, these gaps were 35 points in 4th grade and 31 points in 8th grade. Gaps are similar in mathematics scores and the state has yet to make Adequate Yearly Progress for 10th grade ELL students.

A national survey of 417 teacher preparation programs found that only 64 (about 15%) secondary programs at the undergraduate level required a specific course for teaching ELLs, while only 37 (about 9%) middle school programs did. At the graduate level, numbers were lower: only 50 (12%) secondary and 27 (7%) middle school preparation programs did (Menken & Antunez, 2001). Even in 2009 when North Carolina standards for teacher candidates were redesigned, these standards for middle school and secondary content areas do not mention knowledge or skills pertaining to supporting ELLs.

DeJong and Harper (2005) posit a conceptual framework for teacher preparation specific to teaching English Language Learners (ELLs). They avow that "just good teaching" is not sufficient to address the specific, unique learning needs of ELLs. Instead, mainstream teachers must develop ELL-specific knowledge, skills, and dispositions along three domains: "the process of learning a second language, the role of language and culture as a medium in teaching and learning, and the need to set explicit linguistic and cultural goals" (DeJong & Harper, 2005, 118). Menken & Antunez (2001) reiterate the importance of teachers of ELLs understanding linguistics and language acquisitions processes, and add knowledge of how to adapt pedagogical materials and assessments for ELLs and an understanding of cultural and linguistic diversity to this list of important skills teachers of ELL must possess. Lucas, Villegas, & Freedson-Gonzalez (2008) posit 6 specific principles teachers of ELLs must know: 1) conversational and academic language proficiency are fundamentally different from one another and academic language proficiency may take years longer to develop than conversational proficiency, 2) ELLs need access to "comprehensible input" that is just above their current competency levels in order to yield meaningful output, 3) ELLs need social interaction where they can actively participate to foster both their academic and conversational English, 4) students with strong first language skills are more likely to develop parity with native English speakers, 5) in order to learn, ELLs must have a safe, welcoming classroom environment with little anxiety about using English, and 6) second language learning requires explicit attention to linguistic function and form.

While there is little empirical work investigating the relationship between the features of teacher preparation programs and ELL achievement, teachers who have received more preparation, either in initial training or through professional development, report greater confidence in their skills for successfully teaching ELLs (Gandara, Maxwell-Jolly, & Driscoll, 2005). Lucas, Villegas, & Freedson-Gonzalez (2008) recommend adding a separate course on teaching ELLs to the teacher education curriculum rather than infusing such content throughout the curriculum, on the basis that the knowledge and skills required to teach ELLs are not those that most teacher education faculty possess currently. Following this recommendation, I investigate both the relationship between a program requiring a separate course for ELLs and ELL achievement and the relationships between all structural features and ELL achievement.

Teacher Preparation and Special Education Students

Comprehensively reviewing the extant literature pertaining to the relationship between teacher preparation and special education is impossible, as there is an entire journal dedicated to the topic. However, addressing the relationship between the structural features of general education teacher preparation programs and the achievement of students with special needs is crucial as the amount of time students with disabilities spend in general education classrooms, continues to increase and general education teachers tend to have little preparation in helping special education students learn (Stodden, Galloway, & Stodden, 2003). Since the passage of the Education for all Handicapped Children Act (EHA) was passed in 1975, requiring that students with disabilities be educated in the "least restrictive environment," the amount of time special education students spend in general education classroom has increased. This trend continues, where the 2004 reauthorization of EHA (IDEA 2004) explains, "To the maximum extent appropriate, students with disabilities [… will] be educated with children who are not disabled "(Section 1412 (a) (5), IDEA 2004). In 2011, 50% of students with disabilities spent more than 80% of their school day in a general education classroom, practice known as inclusion (NCES, 2012). Further, under NCLB, special education students learn and are accountable for the same curriculum as general education students. As such, general education teachers must have the knowledge and skills to be able to teach special education as effectively as general education students, knowledge and skills which the inclusion process implicitly assumes they possess (Hadadian & Chang, 2007). There is no empirical evidence for whether or not this is the case.

Based on their review of the literature, Allday, Neilsen-Gatti, & Hudson (2013) posit four strands of knowledge general education teachers must know in order to be successful teaching in an inclusion classroom: 1) the characteristics of special education students and their own role, as general education teachers, in the special education process, 2) understanding of differentiation in order to meet the needs of students with different abilities, 3) classroom management in order to engage students and minimize learning disruptions, and 4) ways to communicate and collaborate with special education teachers.

A decade earlier, the Interstate New Teacher Assessment and Support Consortium (INTASC) elaborated on the ten INTASC core principles for all teachers in order to "articulate the knowledge, skills, and dispositions that all beginning teachers need to promote effective learning for students with disabilities" (INTASC, 2001, p. 2). These are 1) Understanding of disability laws, and special education policies and procedures in order to provide equitable access to general curriculum, 2) understanding of variation in learning and development of students with disabilities, which may influence cognitive, social, emotional, and physical areas, 3) a disability may "affect a student's approach to learning and a teacher's approach to teaching," 4) ability to "use a variety of instructional strategies and technologies" adapt curriculum to meet student needs, 5) making sure special education students are included and "structure activities that specifically foster engagement, self-motivation and independent learning in students with disabilities," 6) "set a high priority on establishing a safe and comfortable environment in which students with disabilities are encouraged and supported to use language and contribute their ideas [and] make accommodations to promote effective communication, and encourage and support the use of technology to promote learning and communication," 7) collaboratively planning individualized plan of instruction with special educators, the student (when appropriate), and other stakeholders, 8) ability to provide accommodations so that special education students can demonstrate their knowledge and skills on formal and informal assessments 9) reflecting on learning strengths and needs of individual special education students evaluating the appropriateness and effectiveness of their instructional choices and practices to build on strengths and meet needs.," and 10) advocate for students with disabilities to receive the support they need to be successful in the general curriculum and to achieve the goals of their individual education plans.

Each standard is followed by specific implications for students with disabilities, as well as examples of the standards in action for all teachers and specifically for special education teachers. Some of the content of these implications is what is typically included in teacher preparation for general educators. For instance, all teachers should have "a sound understanding of physical, social, emotional and cognitive development from birth through adulthood," (p. 14) content typically covered in a human development course. However, the majority of implications fall outside of the scope of a typical teacher preparation curriculum for general education teachers, like "plan ways to modify instruction, as needed, to facilitate positive learning results within the general curriculum for students with disabilities" (p.29). This content is typically reserved for courses specific to teaching special education, a course that not all programs require.

There is no research that has examined the relationships between the structural features of teacher preparation programs and student achievement for special education students, even the effects of a course in teaching special education students. There is, however, an abundance of extant literature about the relationship between preparation coursework in special education and teacher attitudes towards inclusion. Many general education teachers may lack knowledge about inclusion, or have negative attitudes towards it, but a specific class in special education has been demonstrated to improve both prospective teachers' knowledge of and attitudes towards inclusion (McHatton & Parker, 2013; Forlin & Chambers, 2011; Shippen, Crites, Houchins, Ramsey & Simon, 2005; Shade and Stewart, 2001). As such, the relationships between the structural features of teacher preparation programs and achievement for special education students are important questions to address, as is the specific relationship between a course in special education and special education student achievement.

The Role of Structural Features of Teacher Preparation Programs in Teacher Effectiveness

Research on the effectiveness of the structural elements of teacher preparation programs has been limited by a lack of appropriate measures: outcome measures and measures of what occurs during teacher preparation (Plecki, Elfers, & Nakamura, 2012). There is no state or national database documenting the structural features of teacher preparation programs (Boyd, Goldhaber, Lankford, & Wyckoff, 2007). Recently, the National Council on Teaching Quality (NCTQ) has attempted a more systematic collection of the structural features of teacher preparation programs. They have collected data from a selection of colleges and universities and published a set of rankings of teacher preparation program quality according to their own set of standards (see Greenberg, McKee, & Walsh, 2013), but their efforts have been fraught with shortcomings. Their data collection efforts have focused on elementary, secondary, and special education preparation programs, profiling only one or two programs per college. Two thousand four hundred and twenty programs in 1130 institutions are rated according to 18 standards around elements of preparation like admissions standards, student teaching, and coursework. NCTQ collected course syllabi, required textbooks, course catalogs, student teaching handbooks, student teaching evaluation forms, and capstone project guidelines from each institution

(Greenberg, McKee, & Walsh, 2013). These documents were coded according to a strict set of indicators to create a rating according to each of NCTQ's standards, and then an overall rating for each program on a 4-point scale. Standards were constructed based on reviews of research, expert consensus, "public school advocates and superintendents," (p.77), and their own pilot studies. While theirs is an extensive data collection effort, their analyses provide no empirical link between their standards for effective teacher preparation and effective teaching.

Another line of work at the Teacher Pathways Project has begun to examine the variation in the programmatic features of teacher preparation across multiple pathways of entry into teaching in New York City (Boyd, et al., 2008). Theirs is the one stream of work that links the required structural features of preparation programs to student achievement (Boyd, Grossman, Lankford, Loeb, and Wyckoff, 2009; Ronfeldt, 2012). Boyd and colleagues, while examining a wide range of portals of entry, only consider 31 preparation programs preparing elementary school teachers within the city of New York. They investigate both a wide range of program features and beginning teacher reports of their experiences in preparation programs, such as opportunities to about topics related to teaching ELA. The program features they include are: the amount of required content coursework in both math and ELA, whether a program requires a capstone project, program oversight of field experiences, and percent of tenure-track faculty. They do not consider other types of coursework like pedagogy, foundations, or technology requirements; early field experiences, or the duration of student teaching. Their measure of program oversight of field experiences combines cooperating teacher requirements and frequency of observation. Because of limited degrees of freedom owing to the small number of programs in their study (31), they estimate separate models for each program characteristic. Their findings are mixed and vary between first and second year teachers and between math and

ELA. Program oversight of student teaching, the number of math courses required, a required capstone project, and the percentage of tenure-line faculty are significant predictors of math achievement gains for first year teachers, but the required number of math courses is the only feature that remains a significant predictor for second year teachers. A required capstone project is the only significant predictor of gains in ELA for first year teachers. In the first year sample, the required number of ELA courses has a negative relationship with achievement for these teachers, but in the second year sample, although its coefficient is of a similar magnitude, its sign changes directions (-0.0091 to 0.0113). It is unclear whether these changes are a result of an effect that only begins to manifest itself in the second year or due to sample attrition.

Finally, while not examining program requirements, Harris and Sass (2011) examine the college transcripts of teachers trained in public institutions of higher education in Florida, focusing on the relationship between the credit hours that teachers actually take in three areas of pedagogy, subject area, and classroom observation and practice and teacher effectiveness. They conduct separate analyses at the elementary, middle, and high school levels for reading and math scores. With one exception, they find that no quantity of any type of college coursework is related to teacher effectiveness at any level of K12 education. This exception is coursework on classroom management at the high school level, where additional credits in management have a positive relationship with value-added. Their estimation procedures involve a rather novel strategy of using teacher and school fixed effects in a first stage equation to estimate teacher value-added, and regress value-added on non-time varying coursework components in a second stage equation. Finally, the data for this study is culled from individual teacher transcripts rather than from systematic program-level course requirements.

While this work has begun to answer questions of the mechanisms through which teacher preparation programs are more or less effective in producing graduates who raise student achievement, the findings of the two lines of work are inconsistent, and only one employs program requirements to measure the structural features of teacher preparation, but does not include program requirements for coursework other than subject matter. Additionally, only the transcript study addresses middle and high school preparation programs. As such, to my knowledge, there is no study that addresses the range of structural features of teacher preparation program requirements, both coursework and field experiences, at the middle and high school level. Given the current policy conversations about standards for teacher preparation programs and the features that they entail, and the importance of program requirements for structural features as the mechanism through which programs influence how much of each feature teacher candidates participate in, the field requires more evidence to adequately inform these conversations and provide programs with information on how to optimize requirements for each feature.

Chapter 3

RESEARCH METHODOLOGY

The primary goal of this study is to estimate the relationships between the structural features of university-based initial certification teacher preparation programs and beginning teacher value-added at the middle and secondary levels. Using a longitudinal dataset from the North Carolina Department of Public Instruction (NCDPI) and the University of North Carolina General Administration (UNC GA), this dissertation employs fixed effects and hierarchical linear modeling (HLM) to investigate these relationships. To that end, it asks the following research questions:

1. What are the program features of initial teacher preparation programs for middle and secondary teachers in North Carolina public universities?
2. What are the relationships between the structural features of these preparation programs and beginning teacher effectiveness as measured by student achievement gains?
3. Do these effects vary for English Language Learners and students with special needs?

First, this chapter provides an overview of the study's research design. Next follows a description of data and sample, followed by detailed descriptions of the measures used for the analyses. Finally, the chapter concludes with a description of both the analytical approach undertaken and specific models that are estimated and a discussion of the study's limitations.

Research Design

Obtaining a causal estimate of the impact of the structural features of teacher preparation programs on teacher effectiveness is complex. In a simple example investigating the impact of taking 6 credit hours of foundations courses (treatment) instead of taking no foundations courses (control) on value-added, a measure of teacher effectiveness, one would need to observe the same teacher's value-added, both having received the treatment and not receiving the treatment. That is, at time 1, a teacher is exposed to the treatment and their value-added is measured at time 2. Simultaneously, at time 1, the *same* teacher is NOT exposed to the treatment condition and their value-added is measured at time 2. The difference between said teacher's value-added in the absence of treatment and the presence of treatment would be the causal estimate (Rubin, 1974). In this example, let Y_{it} represent a teacher's value-added if they receive the treatment and Y_{ic} represent a teacher's value-added if they do not receive the treatment. Thus, the causal effect, the treatment on the treated, of six credit hours of foundations courses on a teacher's value-added is denoted

$$\Delta_i = y_{it} - y_{ic} \qquad (1)$$

(Smith & Todd, 2001). Clearly, observing both outcomes for the same individual is impossible.

In the absence of this impossible scenario, researchers might turn to a series of randomized experiments to obtain an unbiased estimate of the average causal effect of each structural component of teacher preparation programs on beginning teacher value-added. Thus, in a series of random experiments, one component at a time, the amount of that component each program provides (the treatment) would be manipulated. Again taking the foundations coursework example, Program 1 might require 6 credit hours of foundations coursework, while Program 2 requires 0 hours. If teacher candidates are randomly assigned to Program 1 or 2, and all other program features are identical, differences in teachers' effectiveness can be causally attributed to variation in the amount of foundations coursework they have participated in, because random assignment renders assignment to treatment ignorable, that is, assignment to treatment is independent of the participants' outcomes. In this case, the average treatment effect over of the study population of randomly assigned teachers can be expressed

$$\delta = E(Y_t - Y_c), \qquad (2)$$

where δ is the expected value of the difference between the average outcome for teachers in the treatment group (Y_t) and the average outcome for teachers in the control group (Y_c).

Yet because so many factors influence where prospective teachers complete their teacher training and the contexts in which they begin teaching, in the absence of random assignment, simply comparing value-added scores of teachers who receive varying amounts of each structural feature in their preparation would produce naïve and potentially biased estimates of the impact of that feature. Prospective teachers may not have the academic qualifications to be admitted to a particular university or personal preferences may influence whether they choose a program leading to middle grades certification or to subject-specific secondary certification. For example, if more selective universities have greater requirements for a structural feature that is associated with student achievement than less selective universities do, and only teacher candidates with stronger academic ability are admitted to more selective universities, estimates of the relationship of that feature to achievement may be biased. Thus, factors that influence selection into universities or teacher preparation programs may also influence their effectiveness in increasing student achievement, biasing estimates.

Just as preservice teachers sort into preparation programs, they sort into schools when they become teacher of record and students are non-randomly assigned to teachers, factors which could further influence teacher effectiveness. If teachers who have lower requirements for a structural feature that is associated with student achievement tend to teach in schools that are not well resourced or have poor working conditions, then estimates of the relationship of that feature to achievement may be biased. Similarly, if teachers who have lower requirements for a structural feature that is related to achievement have students assigned to them with low prior achievement or who come from low socio-economic backgrounds, again, the estimate of the relationship of that feature to achievement may be biased. Because of such confounding factors, differences in beginning teacher value-added cannot be directly attributed to differences in the structural component requirements of teacher preparation programs. These confounding factors require assumptions of unconfounded assignment, of teachers to preparation programs, teachers to schools, and student to teachers, which are all highly implausible, in order to estimate the causal impact of the structural components of teacher preparation programs on beginning teacher value-added: any estimator that does not take them into account will produce biased estimates of their impact.

In the absence of a randomized experiment, an appropriate counterfactual must be established in order to establish a causal relationship between the components of teacher preparation and value-added. In the case of initial teacher preparation programs, this counterfactual would include preservice teachers who are similar in all ways except for the amount of treatment they receive. As the three main sources of bias in estimating the effects of structural features of preparation programs on teacher effectiveness are the nonrandom selection of prospective teachers into universities and preparation programs, the non-random sorting of teachers into public schools, and the non-random assignment of students to teachers, I employ a number of strategies to minimize this bias and create an appropriate counterfactual.

Using a standard value-added model such as

$$Y_{icjst} = \beta_0 + \beta_1 Y_{ist-1} + \beta_2 \mathbf{S}_{icjst} + \beta_3 \boldsymbol{C}_{jsct} + \beta_4 \boldsymbol{T}_{jsct} + \beta_5 \boldsymbol{Sch}_{st} + \boldsymbol{Program}_{jcst}\gamma_1 + \varepsilon_{ijcst} \quad (3)$$

where Y_{icjst} is student *i*'s test score in classroom *c,* taught by teacher *j* in school *s* at time *t*,

$Y_{icjst-1}$ is a lagged test score whose inclusion creates a model where student achievement gains are measured rather than levels of achievement,

$\mathbf{S}_{icjst}$ is a vector of student-level covariates,

$\mathbf{C}_{cjst}$ is a vector of classroom characteristics,

$\mathbf{T}_{jcst}$ is a set of teacher characteristics,

$\mathbf{Sch}_{st}$ is a vector of school-level covariates, and,

$\mathbf{Program}_{jcst}$ is a series of indicator and interval variables measuring the structural features of teacher preparation programs, γ_1 is the vector of effect estimates of interest.

The goal of analysis is that γ_1 would yield unbiased estimates of the relationship between each structural feature and student achievement. However, the 3 sources of bias mentioned above, selection of teacher candidates into programs, sorting of teachers into schools, and the non-random assignment of students to teachers, are a concern in such a standard value-added model. In prior research, when assessing variation in the effectiveness of teacher preparation programs, selection effects, if any, are considered part of program effectiveness, together with the effects of the program itself (e.g., Boyd et al., 2006, 2010; Henry, et al., 2013; Plecki, Elfers, & Nakamura, 2012; Tennessee Higher Education Commission, 2011, 2012; Raymond, Fletcher, & Luque, 2001; Xu, Hannaway, & Taylor, 2011. Such a model does include teacher-, school-, and student-level covariates that are significant predictors of teacher value-added and attempt to control for bias in order to make selection into programs and the non-random assignment of teachers to schools and students to teachers plausibly ignorable. However, it is possible to improve this value-added model and begin to make all three sources of bias plausibly ignorable. In the following section, I discuss each source of bias in turn, starting with selection effects, then the sorting of teachers into schools, and finally the non-random assignment of students to teachers.

First, I consider selection effects. As noted earlier, most unbiased estimates of the effects of teacher preparation programs include both selection and the effects of their structural features. As universities have multiple preparation programs within them over multiple years, with varying requirements of many structural features, employing university fixed effects creates a better counterfactual by estimating using only within-university variation: all preservice teachers in a university are subject to the same admissions requirements and experience the same university characteristics, both observed and unobserved. By estimating a value-added model with university fixed effects, I create a better counterfactual to test the extent to which selection does influence preparation effects. Using fixed effects controls for within unit characteristics for the unit of the fixed effect, so using university fixed effects compares teachers at each university only to other teachers at that university. If academic ability contributes to teacher effectiveness, comparing teachers who attend the same university to one another and who vary with respect to their program's structural features, rather than comparing teachers at a research-intensive, highly selective university where the average SAT score is 1300 to teachers at a teaching-focused, non-selective university where the average SAT scores is 1000, is a more appropriate comparison. Further, most universities have one set of admissions requirements for all of their teacher preparation programs, regardless of the specific subject and grade level focus of the program. As such, university fixed effects create a counterfactual wherein preservice teachers are compared to other preservice teachers who face the same set of admissions requirements for their programs, which begins to remove selection effects from the overall impact of a teacher preparation program on beginning teacher value-added.

While this creates a more appropriate counterfactual for addressing selection bias than comparing all teachers across universities, there are other issues of selection it does not capture: for instance, non-cognitive traits that are associated with teacher effectiveness may also affect selection into a university or a program, but within university variation in these traits are not captured in university fixed effects. Specifically, teacher candidates may choose a middle school program over a high school program or vice versa, because of personal preferences or desire to teach a particular age of students, and much of the variation in structural features comes from such differences in programs within universities, rather than changes in requirements over time. For example, a teacher candidate may have a strong motivation to teach middle grades students and this motivation may both lead them to choose a middle grades program and to work exceptionally hard at overcoming obstacles and difficulties in classroom management and teaching practice that may arise in their first years of teaching in order to increase student achievement, while a high school-licensed teacher teaching in middle grades may have less motivation and not work as hard because they are not teaching in their preferred school context. If these preferences and desires are also correlated with student achievement, university fixed effects will not remove these sources of bias. I cannot address the bias that may arise from any unobserved characteristics that are related to selecting into a middle or high school program, and there are statistically significant differences between observed teacher, student, and school characteristics between middle grades certified and high school certified teachers in middle grades mathematics each tested subject[2]. As such, in addition to controlling for these teacher,

[2] Table A2 in the Appendix provides means and tests of significance of these characteristics by type of licensure for each subject.

student, and school characteristics included in a standard value-added model, I control for high school licensure.

Turning to a second source of bias in estimating value-added, the problem of non-random assignment of teachers to schools, arguably employing school fixed effects would address this issue, as teachers would only be compared to other teachers teaching in the same school. Because many schools have multiple UNC-system educated teachers teaching in them during the study period, employing school fixed effects controls for school characteristics that might influence value-added, both observed and unobserved, by estimating using only within-school variation. However, in this dataset, employing school fixed effects reduces the sample size by about one-third because over half the schools represented in the sample only have one teacher who graduated from a public university in North Carolina teaching in them. This may limit the teachers included in the sample to those teaching in larger schools, possibly nearer to the universities where they were prepared (Mihaly, McCaffrey, Sass, & Lockwood, 2013), may eliminate an entire university from the analysis as is the case with middle grades ELA, and may limit the generalizability of the school fixed effects model if the teachers and schools that are eliminated from the sample are atypical from those that are included.

Student-level covariates in typical value-added estimates such as equation (3) attempt to address bias stemming from the non-random assignment of students to teachers by controlling for characteristics shown to be correlated with student achievement and assignment to teachers, such as socioeconomic status and parental levels of education. Importantly, such a model includes students' prior achievement, so that achievement gains are measured, rather than comparing levels of achievement. This is important because students may begin a school year at vastly different levels of achievement; measuring gains taking prior achievement into account rather than levels compensates for these differences in baseline achievement levels. For instance, if students from lower socio-economic backgrounds are assigned to teachers with more pedagogical training and both socio-economic background and pedagogical training are associated with achievement gains, estimates of the effect of pedagogy coursework would be biased. A more appropriate counterfactual is achieved using student fixed effects, where variation within each student across time is exploited to estimate the effects of the structural features of teacher preparation programs. Using student fixed effects, students are only compared to themselves rather than to other students who may be systematically different, addressing the bias that arises from the non-random assignment of students to teachers.

Ideally, to address all three sources of bias simultaneously, university fixed effects could be combined with student and school fixed effects. However, this would require each student to remain in the same school multiple years and to have been taught by multiple teachers from the different programs within the same university, but in this dataset there are too few students for whom this is the case. I discuss my modeling approach later in this chapter.

A final confounding factor of concern is teacher attrition. Those teachers who attrit may be systematically different from those who persist from year to year. In previous work, Boyd and colleagues (2009) found a negative relationship between the number of ELA courses required in a program and first year teacher value-added, but a positive relationship between the ELA courses required and second year teacher value-added. It is unclear if this relationship changes because teachers for whom more ELA courses are not a benefit have left the sample or if the effect of more ELA courses only appears in the second year of teaching. Unfortunately, there are too few teachers who attrit after their first year to conduct separate analyses for first year teachers who persist to at least their second year. However, even though there is so little attrition, I conduct separate analyses for teachers at varying levels of experience. While finding similarities or differences in the relationships of structural features to student achievement gains for teachers at varying levels of experience will not provide conclusive evidence, because the change in sample is small, such analyses should provide some evidence as to whether the relationships of features to achievement change as teachers gain experience.

Data

This study combines a teacher-level dataset from the UNC GA and a student-level state database from NCDPI, together with data collected from each of the 15 UNC institutions with teacher preparation programs to conduct a longitudinal analysis of the relationship between the structural features of preparation programs and teacher effectiveness.

University of North Carolina General Administration Data

The UNC GA provides longitudinal data on every teacher prepared in the UNC system, at the graduate or undergraduate level. This data includes the university where teachers were prepared, indicators of teachers' academic ability including high school GPA and class rank, Classification of Instructional Program (CIP) codes that indicate a teacher's degree and certification, and year of recommendation for initial licensure.

North Carolina Department of Public Instruction Data

This longitudinal dataset includes both student test score information as well as teacher-, student-, and school-level demographic information. Teacher characteristics provided include years of teaching experience, certification information (types and dates), and performance on licensure examinations.

North Carolina administers both end-of-grade and end-of-course tests. End of grade tests occur yearly in grades 3 through 8 in Math ELA. Through the 2008-09 school year, end of course tests for high school subjects included English I, chemistry, physics, biology, physical science, geometry, Algebra I and Algebra II, civics and economics, and US History. Most of these tests have been gradually phased out: chemistry and physics were eliminated in the 2009-10 school year, geometry was eliminated in 2010-11, and Algebra II, civics and economics, US History, and physical science were eliminated in 2011-12. English I, Algebra I, and Biology End of Course tests remain during the full course of this study. As this study focuses on middle and high school preparation programs only math and ELA end of grade tests for grades 6 through 8 are used, together with Algebra I and English I End of Course tests administered at the high school level. Students are matched to the teachers that taught them in tested grades and subjects using class rosters.

This study uses five years of data (2007-08 through 2011-12) to estimate the relationships between the structural features of teacher preparation programs and teacher effectiveness in tested grades (5-8) and subjects. These student achievement test scores serve as the dependent variable for determining the relationship between structural features of teacher preparation programs and teacher effectiveness in value-added models that include prior achievement, effectively creating gains score models.

Teacher Preparation Program Data

Prior to this study, data on the structural features of teacher preparation programs had not been compiled into a usable database. I define a teacher preparation program as a particular course of study leading to a specific teaching license. Thus, each university houses multiple teacher preparation programs. Taking mathematics as an example, a bachelor's degree in middle grades (6-9) math education is a distinct program from a bachelor's degree in secondary (9-12) math education, and both are distinct programs from an MAT.

Because I consider only courses required by a teacher preparation program for licensure, rather than an undergraduate's entire course of study, I am able to include both MAT programs with undergraduate programs. MAT programs are intended to prepare preservice teachers with no previous teaching experience or training in two to four semesters. Their coursework is similar to that of undergraduate programs in both content and required number of credit hours.

This dataset detailing teacher preparation programs was created from university documents (undergraduate and graduate bulletins, course catalogs, NCATE reports, programs of study, and program handbooks) and program websites and collected from the programs themselves. During Spring 2013, I collected each program's plan of study by year from its website or university bulletin. For every required course for a teacher preparation program or subject matter major, I looked up the course description and determined if the course fit into one of six categories: foundations course requirements, pedagogical course requirements, subject area course requirements, subject area course requirements designed specifically for teachers, technology coursework, and fieldwork. Courses aimed at specific pedagogies for teaching special populations of students like English Language Learners or Special Education students were coded as pedagogy coursework for my primary analyses because such methods may be beneficial for teaching all students, particularly when a teacher has students of vastly varying ability levels. They are dummy coded as their own separate courses in secondary analyses. Courses that did not fit into these categories, such as teacher leadership courses and research methodology courses were categorized as "Other." The appendix provides examples of each type of course. Additionally, from these documents, I determined whether a program's final field experience/student teaching was accompanied by a seminar course, whether the program required a thesis or a capstone project for completion, and, to the extent possible, the hours of required early field experiences. Whether or not the minimum hours required was provided in course descriptions varied by university. Additionally, there is little variation in the capstone requirement, as all undergraduate programs require a portfolio as a capstone project.

In order to ensure reliability of this coding, about 13% of these programs of study were also coded by another graduate student. This sample of double-coded programs of study included an equal number of baccalaureate and graduate programs, an equal number of mathematics and English/Language Arts programs, and an equal number of middle and secondary programs. Overall, there was 95% inter-rater reliability, justifying single coding for the remainder of the programs of study. In cases of disagreement, the two coders talked through their decision-making process, double checked course category descriptions, and came to a consensus as to how to reconcile discrepancies. These consensus codes were then used for analyses.

In August 2013, I contacted the Dean of each College/School of Education who directed me to the individual(s) who could most readily provide information on each program's fieldwork requirements. I then contacted those they recommended, often the director of field experiences, to collect fieldwork data. This data includes the duration of the student teaching experience, the length of time student teaching interns assume full responsibility for their classrooms, and program supervision of student teaching (number of university observations, who chooses a student's fieldwork placement, and requirements for cooperating teachers). It also includes completing missing information about the required number and hours of early fieldwork placements for each program. The protocol for collecting this data can be found in the Appendix.

Constructing the Analytic Dataset

In order to complete my analysis, I linked teachers to the program where they received their initial preparation and recommendation for licensure, using licensure data from the UNC General Administration. Each teacher observation includes a variable for the university where they were prepared, as well as a 3-digit code indicating the type of licensure for which they were prepared (e.g. Middle Grades ELA or MAT Mathematics). These codes, together with an indicator of the year that a teacher is recommended by the university for licensure, allow me to determine which program of study a teacher completed. Before limiting my sample to middle grades and high school licensure only teachers, there are 19,555 teachers recommended for certification by UNC institutions between 2007 and 2011. Of these, 6,346 have invalid licensure data and, as this data is essentially missing, it is impossible to know how many were recommended for middle grades or high school math or ELA licensure.

Analytic Sample

Because we expect the influence of teacher preparation programs to diminish over time, as teachers gain additional knowledge and skills through classroom experience (Berliner, 1988; Clotfelter, Ladd, & Vigdor, 2007; Harris & Sass, 2011; Kagan, 1992; Rockoff, 2004), I restrict my sample to teachers in their first five years of teaching. My sample includes teachers from all 15 UNC institutions that prepare teachers at the middle and secondary school levels who are teaching middle grades math or ELA (grades 6-8) or Algebra I or English I at the high school level, in a North Carolina public school. I include only teachers who complete a degree program for initial certification at both the undergraduate or masters levels between 2007 and 2011, for a sample of 986 mathematics teachers and 822 English teachers and were recommended for certification by a UNC institution across five years. This is all the mathematics and ELA teachers who were prepared by and recommended for certification by a UNC institution, save the teachers with invalid certification codes, as mentioned above. Table 2 provides the licensure areas and number of teachers prepared in this sample, from each institution. Additionally, Tables 3-5 provide descriptive statistics for teachers and students in the sample for each tested subject.

Table 2: Teachers by licensure area and university

	MG Math	MAT MG Math	HS Math	MAT HS Math	MG ELA	MAT MG ELA	HS English	MAT HS English	Totals
Univ 1			5		3		2		10
Univ 2	74		92		60		86		312
Univ 3			23				13		36
Univ 4	62	7	63		37	6	46	22	243
Univ 5	3				1				4
Univ 6	12		10		6		21		49
Univ 7	5		5				6		11
Univ 8	20	1	24	2	4	1	10	4	66
Univ 9	31		158		77		49		315
Univ 10	26	19			25			47	117
Univ 11	92	11	39	5	40	7	16	4	214
Univ 12	15		32		22		71		140
Univ 13	26		39		18		40	5	128
Univ 14	43		40		27		38	6	154
Univ 15	2				2		1		5
Totals	411	38	530	7	322	14	398	88	1804

Table 3: Teacher Descriptive statistics

	Middle Grades	High School	Middle Grades	High School

	Mathematics	Algebra I	ELA	English I
Female	0.81 (0.39)	0.73 (0.44)	0.81 (0.39)	0.79 (0.41)
White	0.81 (0.39)	0.83 (0.38)	0.83 (0.38)	0.84 (0.37)
Black	0.14 (0.35)	0.11 (0.31)	0.13 (0.33)	0.10 (0.30)
Asian	0.01 (0.09)	0.00 (0.06)	0.01 (0.08)	0.01 (0.10)
Hispanic	0.02 (0.13)	0.03 (0.16)	0.01 (0.11)	0.00 (0.07)
American Indian	0.01 (0.09)	0.01 (0.09)	0.00	0.00 (0.07)
Other Race	0.02 (0.13)	0.02 (0.14)	0.03 (0.17)	0.04 (0.19)
High School License	0.14 (0.35)	0.94 (0.24)	0.23 (0.42)	0.97 (0.18)
Undergraduate	0.95 (0.22)	0.97 (0.18)	0.88 (0.33)	0.86 (0.35)
Prior Teaching Experience	1.65 (1.00)	1.70 (0.96)	1.55 (.84)	1.69 (0.91)
SAT score	1109 (128)	1152 (133)	1085 (136)	1121 (141)
N	248	258	175	209

Standard deviations in parentheses

Table 4: Student Descriptive Statistics

	Middle Grades Mathematics	High School Algebra I	Middle Grades ELA	High School English I
Male	0.50 (0.50)	0.52 (0.50)	0.50 (0.50)	0.52 (0.50)
White	0.54 (0.50)	0.51 (0.50)	0.55 (0.50)	0.55 (0.50)
Black	0.27 (0.44)	0.31 (0.46)	0.27 (0.44)	0.28 (0.45)
Hispanic	0.12 (0.32)	0.11 (0.31)	0.10 (0.30)	0.12 (0.32)
Asian	0.03 (0.16)	0.02 (0.13)	0.02 (0.15)	0.02 (0.14)
Multi-racial	0.03 (0.18)	0.03 (0.18)	0.03 (0.18)	0.03 (0.17)
American Indian	0.01 (0.11)	0.01 (0.11)	0.03 (0.16)	0.01 (0.11)
Free lunch eligible	0.42 (0.49)	0.42 (0.49)	0.41 (0.49)	0.38 (0.49)
Reduced lunch eligible	0.07 (0.26)	0.08 (0.27)	0.07 (0.26)	0.07 (0.26)
Limited English proficient (LEP)	0.06 (0.24)	0.05 (0.23)	0.04 (0.20)	0.06 (0.24)
Was LEP	0.04 (0.19)	0.04 (0.19)	0.03 (0.18)	0.04 (0.20)
Gifted	0.14 (0.35)	0.05 (0.23)	0.17 (0.38)	0.14 (0.35)
Special education	0.10 (0.30)	0.12 (0.33)	0.09 (0.29)	0.09 (0.29)
Underage	0.02 (0.11)	0.01 (0.10)	0.01 (0.10)	0.01 (0.11)
Overage	0.23 (0.42)	0.31 (0.46)	0.22 (0.42)	0.27 (0.45)
Days absent	7.55 (7.45)	8.89 (9.53)	7.50 (7.65)	8.30 (9.23)
Moved in year	0.05 (0.22)	0.04 (0.20)	0.05 (0.21)	0.05 (0.21)
Mean peer achievement (Z score)	-0.05 (0.70)	-0.27 (0.45)	-0.00 (0.63)	-0.08 (0.62)
Peer achievement standard deviation (Z score)	0.61 (0.17)	0.63 (0.15)	0.72 (0.20)	0.64 (0.15)
Remedial curriculum	0.01 (0.10)	0.02 (0.15)	0.02 (0.15)	0.04 (0.21)

Advanced curriculum	0.23 (0.42)	0.01 (0.10)	0.06 (0.23)	0.29 (0.45)
Class size	23.74 (4.90)	21.44 (5.50)	23.61 (5.10)	21.38 (6.05)
N	35180	25788	24269	22329

Standard deviations in parentheses

Table 5: School demographic characteristics

	Middle Grades Mathematics	High School Algebra I	Middle Grades ELA	High School English I
F/RL	0.52 (0.20)	0.42 (0.19)	0.53 (0.21)	0.42 (0.18)
Total PPE	7962.79 (1662.11)	8143.49 (1648.37)	8200.21 (1566.88)	8290.69 (1983.79)
White	0.55 (0.25)	0.59 (0.21)	0.54 (0.24)	0.56 (0.25)
Black	0.26 (0.20)	0.26 (0.18)	0.27 (0.22)	0.28 (0.21)
Asian	0.03 (0.04)	0.03 (0.04)	0.03 (0.04)	0.02 (0.03)
Hispanic	0.11 (0.10)	0.09 (0.06)	0.10 (0.08)	0.10 (0.07)
Multiracial	0.03 (0.02)	0.03 (0.02)	0.04 (0.02)	0.03 (0.02)

Standard deviations in parentheses

Dependent Variable

Student achievement scores for students of teachers in their first five years of teaching serve as the dependent variable in this study. I use test scores from end of grade tests from 2007-08 through 2011-12 and end of course test scores in English I and Algebra I for the same years. Before restricting the sample to beginning teachers, scores for each grade and subject test are standardized at the state level, by year, to allow for the combination of multiple tests into one model. Because of differences in the tests included as measures of prior achievement and to allow for the possibility of different relationships of features to achievement by subject area, I estimate separate models for each test.

Independent Variables

Program Structural Features

Program structural features are the primary independent variables of interest in these analyses. Program structural features fall broadly into two categories: coursework and clinical experiences.

Coursework For each teacher preparation program, coursework requirements were divided into five categories: pedagogy coursework, subject matter coursework, subject matter coursework designed specifically for teachers, foundations coursework, and other required education courses. For each preparation program's course of study, for every year from 2003-04 to 2010-11, I categorize each required course, as a whole, into one of the five categories, based on the description provided in the university's graduate and undergraduate course catalogs. Below, I operationalize each category.

Pedagogy Coursework: Broadly, pedagogy coursework includes required classes that focus on the pedagogical development of prospective teachers, that is, their pedagogical content knowledge, general pedagogical knowledge, and curricular knowledge. This includes methods and materials courses, courses aimed at pedagogy for specific groups including special education students and ELLs, and courses addressing curriculum and lesson planning. In primary analyses, *pedagogy coursework* is defined as the number of credit hours required by each program of study for recommendation for licensure. In secondary analyses, I separate special education courses, courses for teaching English Language Learners, and classroom management into their own categories, and measure them as dichotomous indicators for whether or not a program requires such a course.

Subject matter coursework: Subject matter coursework refers to required coursework in the academic discipline for which a teacher will receive licensure, above and beyond coursework that is required as part of general education requirements. In many cases, particularly for secondary licensure, the required subject matter coursework is equivalent to an academic major in the discipline. In mathematics, this includes required courses in mathematics, statistics and computer science. In English/Language arts, subject matter coursework includes literature courses, grammar, and writing courses. English/ Language Arts programs are the programs that most frequently require subject matter courses specifically for teachers, like "Grammar for Teachers" or "Literature for Adolescents." *Subject matter coursework* is defined as the number of credit hours in the academic discipline required by each undergraduate program of study for recommendation for licensure.

The primary difference between the course requirements of undergraduate preparation programs and initial certification masters programs (MAT programs) is that students are required to come into an MAT program with a subject matter major or equivalent number of credit hours. However, the data do not provide the number of credit hours these students accumulated in their undergraduate degrees. As such, to address this missing data, I employ what is essentially mean substitution: for an initial certification masters student, s*ubject matter coursework* is defined as the average number of credit hours required by undergraduate programs for the same subject matter, plus the number of subject matter credit hours required for the masters degree.

Foundations coursework: Foundations coursework includes required courses that address general education issues or the social foundations of education. Also included in this category are psychology and development courses. *Foundations coursework* is defined as the number of required credit hours for recommendation for licensure in a preparation program. Similar to pedagogy coursework, I separate out specific foundations courses for secondary analyses of their relationship to achievement. For foundations, these courses are human development and educational psychology. In secondary analyses, I include binary indicators for whether each course is required, as there is theoretical justification for a relationship to student achievement and there is sufficient variation in whether they are required to estimate such a relationship.

Technology coursework: Technology coursework includes general courses like "Computers in Education" that focus on integrating technology into instruction and basic computer applications. Because no program requires more than one course, *technology coursework* is a dichotomous variable set to 1 if the program requires such a course and 0 if not.

Other coursework: Included in this category are required courses that do not fit the definitions for the other four categories. Such courses primarily include research methods and statistics courses and, often for masters programs, teacher leadership courses. Similar to the first four coursework categories, I define *Other coursework* as the number of required credit hours for recommendation for licensure in a preparation program.

Clinical experiences Variables of interest pertaining to clinical experiences include required fieldwork for prospective teachers and university supervision of this fieldwork.

Early field experience: Early field experiences may be integrated into a course or constitute a course in and of themselves. Such experiences may include observation in schools, tutoring or other community service with children, or field experiences where prospective teachers plan and implement lessons for brief periods, but do not assume full teaching responsibilities. This variable was collected from each College or School of Education for the various preparation programs they administer. For each course in the catalog that indicated field experience or observation hours were required, programs reported on the number of hours each student was required to complete. Programs also reported required hours of early field experiences for courses where the course catalog did not indicate they were required. I first create binary variable to indicate whether a program requires any early field experience.

Student Teaching: Student teaching is a measure of the amount of time prospective teachers are required to spend in schools during their student teaching/internship experience. This information is collected from directly from each College/School of Education. For each student teaching course number listed in graduate and undergraduate catalogs in a given year, programs were asked to provide information on the length of student teaching. Because universities vary in the length of their semesters and schools vary in the length of their school days, programs provided the required number of weeks student teaching placements lasted and the number of hours per week students were required to be at the school site. However, the majority of programs require a full time student teaching internship for one semester, so variation in this requirement largely reflects variation in the length of a university semester. As such, I omit this structural feature from analyses.

Full time teaching: Full time teaching refers to the length of time student teachers have full teaching responsibilities during their student teaching experiences. Because student teaching involves observation and a gradual increase in the amount of time student teachers teach,. Similar to the student teaching variable, programs provided the length in weeks for which student teachers assume full responsibility for a classroom, as well as the hours per week where they have full responsibility. If a program requires student teachers to implement a specific number of lessons or units while they have full responsibility for the classroom, they were asked to provide their best estimate of the number of weeks that would entail[3]. *Full time teaching* is operationalized as the minimum required number of weeks of full time responsibility to measure of the duration of full time classroom responsibility for instruction during student teaching.

University supervision: A number of aspects of university supervision factor into this feature. Programs were surveyed as to how field placements were determined for student teachers, who serves as university faculty (faculty, retired teachers and principals, or graduate students), the number of student teachers supervisors are responsible for, and the minimum number of times a university supervisor observes each student teacher. The minimum required number of observations is the only measurable aspect of university supervision where there is variation between programs. Universities determine field placements for students; the only student input is a ranking of the top districts they would prefer to be placed in. Additionally, programs use a mix of faculty, retired principals, and graduate students as university supervisors, both full time and part time. Because of this, there is no consistent way across programs to determine how many student teachers a supervisor is responsible for.

Observation: During the student teaching experience, university supervisors periodically observe student teachers in order to provide advice and feedback, and for the purpose of formal evaluations. I collected data on frequency of university supervisor observations for each student teaching course from each program. *Observation* is defined as the minimum number of times preparation programs report university supervisors observe each student teacher during the student teaching experience.

Cooperating teacher qualifications: Each College/School of Education provided information on their requirements, if any, for selecting cooperating teachers. Programs were

[3] While co-teaching during the student teaching semester has recently become more prevalent in teacher preparation programs, during the period of my study, there is no evidence from student teaching handbooks that universities were utilizing this practice, although some have begun to in the period since.

asked to describe these requirements and asked specifically if cooperating teachers must have a minimum number of years of experience or if they must demonstrate teaching effectiveness, and how, in order to be chosen as a cooperating teacher. As such, there are three possible requirements for selecting cooperating teachers: minimum years experience, demonstrated teaching effectiveness, and any other requirement a program may have. Again, similar to university supervision, there is no variation across programs in these requirements and they are omitted from analyses: cooperating teachers must have a minimum of three years experience, the recommendation of their principal, and be certified in the same licensure area for which their student teacher seeks licensure.

Seminar: Some initial preparation programs require a seminar as part of the professional semester/year to accompany. Such seminars are meant to integrate theory and practice and provide space for student teachers to address issues and concerns that arise during their student teaching experience. This variable is collected from each university's yearly course catalog and programs of study. It is dichotomous, set to 1 if the program requires a seminar to accompany student teaching and 0 if there is no such course.

Covariates

Student Characteristics

In order to adjust for biases attributable to students being non-randomly assigned to teachers, in estimates of the relationships of structural features of teacher preparation programs to student achievement, I include a number of student characteristics as covariates.

Prior Achievement For end of grade tests, I include student's prior test scores, in the corresponding subject, standardized at the state level. For end of course tests, I include students' 8th grade math scores for Algebra I and 8th grade reading scores for English I.

Race/Ethnicity I include a series of dummy variables, black, American Indian, Asian, Hispanic, and other, with white as the excluded category.

Male is a dichotomous variable indicating a student's gender, set to 1 if the student is male and 0 if they are female.

Free/Reduced Price Lunch is a dichotomous measure of whether a student is eligible to receive Free or Reduced Price lunch (FRL). It is set to zero if a student is not eligible and 1 if (s)he is eligible.

English Proficiency I include dummy variables indicating whether or not a student is or has been classified as Limited English Proficient, set to 1 if the student is or has been so classified and 0 if not.

Attendance I include an indicator of the number of days a student was absent from school in the prior school year. Attendance may be endogenous however, if the students of more effective teachers are absent less frequently. In my primary models, attendance is a significant predictor of achievement across tested subjects, but there are no differences in direction and significance of coefficients of interest in models without attendance as a covariate.

Mobility is a dichotomous variable set to 1 if a student changed school prior to or during a school year, for any reason other than a structural move (e.g., moving from elementary to middle school).

Teacher Characteristics

In order to adjust for biases attributable to individuals with different characteristics being enrolled in different types of programs of estimates of the effects of the structural features of teacher preparation programs, I include a number of teacher characteristics as covariates.

Degree level I control for the level of a teacher's degree with a dichotomous variable set to 1 if a student is enrolled in a masters program and 0 if a prospective teacher is enrolled in an undergraduate program.

Licensure Prospective teachers receive either secondary (9-12) or middle grades (6-9) certification. *Licensure* is a dichotomous variable defined as 1 if a teacher receives secondary licensure and 0 for middle school licensure.

Male is a dichotomous variable indicating a teacher's gender, set to 1 if the teacher is male and 0 if they are female.

Race is included as a series of dummy variables, black, American Indian, Asian, Hispanic, and other, with white as the excluded category.

SAT is a measure that combines students' verbal and math SAT scores and is then divided by 10 for ease of interpretation. SAT scores are captured prior to entering college and are therefore exogenous, unlike college GPAs.

Classroom Characteristics

Class Size is a measure of the number of students enrolled in a particular section of a course, captured at the time of testing.

Prior achievement is included as both the mean and standard deviation of all students' in a class, save that individual student's, test scores on the corresponding test in the prior school year.

Curriculum is two dichotomous variables: the first set to 1 if a course is an advanced course and the second set to one if a course is a remedial course.

School characteristics

In order to adjust for biases attributable to teachers sorting into schools with different contextual features, in estimates of the relationships of structural features of teacher preparation programs to student achievement, I include a number of school characteristics as covariates.

Race is included as a series of variables of school level percentage of the population, black, American Indian, Asian, Hispanic, and other, with white as the excluded category.

Free/Reduced Price Lunch is the school-level percentage of students who are eligible to receive Free or Reduced Price lunch.

Per pupil expenditures is the average dollar amount, divided by 100, that a school spends on each student.

Analytic Plan

Finally, because students are nested within teachers and are therefore not independent observations from one another, I cluster standard errors at the teacher level (Parsons, Ehlert, Koedel, & Podgursky, 2013). I employ a 3-level HLM model, with students nested in classrooms and classrooms nested within schools to provide estimates while accounting for clustering at the classroom and school levels, as student observations within a classroom are not independent from one another. The level one (student) HLM model is

$$Y_{icjst} = \beta_0 + \beta_1 Y_{icjs(t-1)} + \pi_1 \mathbf{S}_{icjst} + \varepsilon_{icjst} \qquad (4)$$

where Y_{icjst} is student i's test score in classroom c,

taught by teacher j in school s at time t,

$Y_{icjs(t-1)}$ is student i's test score in the previous year,

$\mathbf{S}_{icjst}$ is a vector of student demographic characteristics for student i in classroom c taught by teacher j in school s at time t, and

ε_{icjst} is a student-specific error term.

The level two (classroom/teacher) model takes the form

$$\beta_0 = \pi_{00} + \boldsymbol{\pi_{01} Program_{jcst}} + \pi_{02} \boldsymbol{C}_{jsct} + \pi_{03} \boldsymbol{T}_{jsct} + \mu_{jsct} \qquad (5)$$

where $\boldsymbol{Program_{jcst}}$ represents the series of structural features of teacher preparation program that teacher j in classroom c of school s at time t attended,

$\boldsymbol{C_{cjst}}$ is a vector of classroom characteristics for classroom c taught by teacher j in school s at time t,

$\boldsymbol{T_{jcst}}$ is a set of teacher characteristics in classroom c of school s at time t, and,

μ_{jsct} is a classroom-specific error term.

The level three (school) model takes the form

$$\pi_{00} = \gamma_{00} + \gamma_{01} \boldsymbol{SCH}_{st} + r_{st} \qquad (6)$$

where $\boldsymbol{SCH_{st}}$ is a vector of characteristics for school s at time t and r_{st} is a school-specific error term.

The following fixed effects equation is used to estimate the effects of the structural features of initial preparation programs on beginning teacher value added:

$$Y_{ijst} = \beta_0 + \beta_1 Y_{it(n-1)} + \gamma_1 \boldsymbol{Program_{pu}} + \gamma_2 \boldsymbol{S}_{ijst} + \gamma_3 \boldsymbol{C_{ijst}} + \gamma_4 \boldsymbol{T_{upjs}} + \phi_s + \varepsilon_{\mathrm{itjp}} \qquad (7)$$

where Y_{ijst} is student i's test score taught by teacher j in school s at time t,

$Y_{it(n-1)}$ is student i's test score in the previous year,

$\boldsymbol{Program_{pu}}$ represents the series of structural features of teacher preparation programs of interest for program p in university u,

$\boldsymbol{S}_{\mathbf{ijst}}$ is a vector of time-variant and invariant individual characteristics for student *i* taught by teacher *j* in school *s*,

$\boldsymbol{Ci}_{jst}$ is a vector of classroom characteristics for classroom *j* in school *s*,

$\boldsymbol{T}_{upjs}$ is a set of teacher characteristics in university *u* in program *p* teaching in classroom *j* in school *s,*

ϕ_s is a fixed effect, either school or university, depending upon the specification, and,

$\varepsilon_{\mathrm{itjp}}$ is a random disturbance term.

I include teacher characteristics in the model as these factors may influence both the programs in which prospective teachers choose to enroll as well as the student achievement scores of these same teachers; failing to include these factors would bias any estimate of the effect of program features on student achievement scores. Including teacher fixed effects would similarly address this problem, however, because the structural features of preparation programs are time-invariant for each teacher, there is no variation to exploit. Instead, employing school and university fixed effects means that I am exploiting more variation and addressing confounding factors. By using university fixed effects, I address problems of bias arising from differential selection of teachers into universities based on things like proximity to home and academic credentials. Prospective teachers within the same university are more likely to be similar to each other, creating a better counterfactual than comparing teachers prepared in different universities where teacher candidates may be systematically different across universities. By using school fixed effects, I address problems of bias arising from differential selection of teachers into public schools. Again, teachers teaching in the same school are more likely to be similar to each other, creating an appropriate counterfactual. Finally, I estimate the same models that include only undergraduates, omitting MAT teachers. If results are qualitatively similar, I will have evidence that MAT programs are not systematically different from undergraduate programs.

Unfortunately, I am not able to employ student fixed effects with this sample of students as it reduces the sample size too far. To do so would require a large sample of students who have more than one teacher in the same subject area, in a course with an end of course or end of grade test, with fewer than five years of experience and who was prepared in a UNC institution between 2007 and 2011. Similarly, this sample is too small to estimate models that include school and university fixed effects, as there are few schools with teachers with fewer than five years of experience who were prepared in more than one UNC institution between 2007-2008 and 2011-2012. As such, I estimate three models for each tested subject, a covariate-rich HLM model that adjusts for many differences that may induce bias, school, and university fixed effects, and compare coefficients from fixed effects models to the HLM model as a specification check to determine if coefficients are similar in magnitude and direction.

Finally, to answer my third research question, Do the effects of the structural features of teacher preparation on beginning teacher value-added vary for English Language Learners and students with special needs?, I estimate the same models mentioned above on each of the two relevant subsamples of students to determine if the relationships of the structural features of teacher preparation programs to achievement for these students. In a number of cases, there is not sufficient sample size to estimate school fixed effects models, and these are omitted.

Limitations

First, using student achievement as a dependent variable carries with it many limitations, thoroughly addressed in the extant research literature on value-added. Of greatest import for this dissertation in assessing the relationships of the structural features of teacher preparation programs to beginning teacher quality is that student achievement as measured by value-added does not capture all aspects of student learning or teacher quality, like teacher retention, graduation, and postsecondary attainment, or any other important student non-cognitive outcome.

Additionally, while a covariate-adjusted HLM mitigates against some of the potential bias arising from the selection of teachers into programs, the sorting of teachers into schools, and the non-random assignment of students to teachers, such a model only controls for observed characteristics of teachers, students, and schools. As such, if unobserved characteristics, such as teacher motivation or perseverance, are correlated with both structural features and student achievement, HLM estimates may be biased.

Finally, using fixed effects brings with it some significant limitations. One significant limitation to using a fixed effects approach is loss of data. However, in a large sample, this loss in sample size may be preferable given the reduction in bias fixed effects estimates produces, as long as the loss does not systematically exclude certain teachers for whom the relationships between structural features and student achievement gains are different from those who are included, inducing further bias. Just as only comparing teachers teaching in the same school causes a loss of data, it also limits the amount of variation there is to exploit in estimating coefficients. In this case, using school fixed effects reduces the sample by over half and severely limits the amount of variation in features, making it impossible to estimate school fixed effects models on numerous samples of teachers.

In spite of these limitations, this is one of the first studies of its kind to investigate the relationship between structural features of teacher preparation programs and beginning teacher effectiveness, and improves on the prior studies in important ways. While Boyd and colleagues (2007) investigate similar questions in New York City, across pathways, they are limited in the number of programs they consider and years for which they have data and therefore in the degrees of freedom they have to work with. As such, they only include one structural feature at a time in their models and mix structural features and teachers' perceptions of their experiences. Using five years of data cross a state university system provides additional degrees of freedom and, as such, also permits controlling for structural features without decreasing the predictive power of the model.

Harris and Sass (2011) similarly investigate the effects of coursework preparation across an entire state, but use a series of fixed effects that dramatically reduce the variation they use to estimate teacher value-added. In their novel approach, in a first stage equation, they use a teacher-school spell fixed effect, only estimating value-added using within-teacher variation. They then recovered the predictive values from this first stage equation and use this value-added teacher effect as the outcome variable in a second stage equation where they estimate the effects of teacher preparation coursework. Given the small amount of variation they use to estimate the effects of structural features, it is unsurprising that they find no results. My analyses begin to address issues of bias, while preserving more of the variation used to estimate the effects of structural features.

Chapter 4

MODEL RESULTS

In chapter 4, I present the results from models designed to estimate the relationships between the structural features of teacher preparation programs and beginning teacher value-added for four tested subjects: middle school Mathematics, middle school English/ Language Arts, high school Algebra I, and high school English I. I present results by subject matter, and organize results within each subject area around the three research questions presented in chapter 3. These questions are:

1. What are the program features of initial teacher preparation programs for middle and secondary teachers in North Carolina public universities?
2. What is the relationship between the structural features of these preparation programs and beginning teacher effectiveness as measured by student achievement?
3. Do these effects vary for English Language Learners and students with special needs?

I first examine middle school mathematics, then turn to high school Algebra I, followed by middle school English/Language Arts and high school English I. For each subject, I present HLM, school fixed effects, and university fixed effects models[4] for multiple samples of teachers: all teachers, first year teachers, second year teachers, and third through fifth year teachers. While

[4] These models do not include a covariate measuring teachers' academic ability. An SAT score is only available for a portion of the sample and including this covariate reduces sample sizes drastically. I estimate models for each tested subject that include SAT score as a regressor and then estimate the model on the same sample, excluding SAT as a covariate. In the models including SAT score, it is not a significant predictor of achievement and the change in R^2 between the two models is less than 0.001. Finally, the direction and significance of coefficients on structural features do not change when SAT score is omitted.

from a bias reduction standpoint, the university fixed effects specification might be the preferred specification for its ability to mitigate against selection bias into preparation programs. However, due to sample size and distribution limitations that accompany the estimation of within-university effects, the HLM specification controlling for covariates associated with sorting of teachers into schools and non-random assignment of students to teachers is the preferred specification. There is not sufficient within-university variation for all features in many samples in the university fixed effects model to reliably estimate coefficients, while the within and between variation is adequate for estimating parameters for all structural features in the HLM model and the well-developed set of covariates offers substantial reduction of bias from the three previously mentioned sources. The school fixed effects and university fixed effects provide robustness checks for the parameter estimates from the HLM specification.

Using the HLM model, I also investigate the possibility of non-linearities in the relationship between required subject matter, foundations, and pedagogy coursework and early field experience hours. In addition, I expand the variables of interest in the HLM model to include specific foundations and pedagogy courses in order to examine the relationship between the specific required courses and value-added for each sample of teachers. These courses are educational psychology, adolescent development, classroom management, teaching English Language Learners, and special education. This examination may yield greater insights about the nature of the foundations courses that are related to higher value-added scores for the graduates of programs in which these courses are required.

Mathematics Findings

Research Question 1: Structural Features of Teacher Preparation

I first provide the descriptive statistics of structural features of teacher preparation programs for all mathematics-certified teachers in the sample, before turning to middle grades mathematics specifically. Table 6 provides descriptive statistics for the structural features of teacher preparation for teacher candidates with any math certification. There are 986 teachers with fewer than five years of experience were certified to teach secondary mathematics in North Carolina between 2007 and 2011 by a UNC institution. Of these, 411 are certified in Middle Grades Mathematics (6-9) at the baccalaureate level, 530 are certified in Mathematics (9-12) at the baccalaureate level, 38 hold an MAT in Middle Grades mathematics (6-9), and 7 hold an MAT in Mathematics (9-12).

Coursework is described and referred to in terms of credit hour requirements, but in considering what these structural features look like for a teacher candidate, it can be helpful to think in terms of numbers of required courses. Most courses are worth three credit hours, however there are exceptions to this. Among other exceptions, mathematics courses often carry 4 or 5 credit hours and technology courses may only be one credit hour. On the whole, these teachers are required to take about 30 hours of mathematics coursework, about 9 hours of foundations coursework, which is typically the equivalent of 3 classes, and about 13 hours of pedagogy coursework, slightly more than 4 typical classes. They are required to take, on average, about 1.5 credit hours of technology coursework and 47% percent are required to take a course in education that does not fall into one of the domains I consider. Going forward, I refer to this as a required "other" course. About two-thirds of math certified teachers are required to take a course in educational psychology and two-thirds are required to take a course in adolescent development. None of these teachers are required to take a course in teaching English Language Learners and 64% are required to take a course in special education. Only 12% are required to take a specific course in classroom management.

In terms of fieldwork requirements, these math certified teachers are required, on average, to participate in about 135 hours of early fieldwork experiences, though there is large variation in this requirement (sd=111.98). Their average student teaching internship is almost 14 weeks, but, as most programs require a semester long student teaching experience, this number is largely reflective of the variation in length of a university semester. During the student teaching internship, they are required to spend almost 6 weeks on average with full time responsibility for teaching, but here again there is wide variation (sd=3.19). University supervisors are required to observe these student teachers an average of 4 times, with very little variation, and 59% are required to take a professional seminar to accompany student teaching.

At the baccalaureate level, middle grades certified teachers are required to take fewer hours of mathematics coursework than those certified for high school, an average difference of almost 20 credit hours, and about half the average high school requirement. Conversely, middle grades teachers are required to take, on average, about 3 credit hours more of foundations and pedagogy coursework. Middle grades certified teachers are also required to participate in twice as many early field hours as high school teachers, on average.

Master of Arts in Teaching candidates are required to take far fewer subject matter credit hours during their programs, but are required to have a subject matter major or its equivalent for admission to an MAT program. At the middle grades level, MAT teachers are required to participate in far fewer early field experience hours than baccalaureate-prepared teachers.

Table 6: Structural feature requirements for all math certification candidates

	All Math Teachers		MG Math (BA)		MG Math MAT		HS Math (BA)		HS Math MAT	
Feature	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range
Subject Matter (hours)	29.93 (11.28)	3, 45	20.28 (4.42)	15, 36	9.71 (3.27)	6, 15	39.39 (4.21)	27, 48	5.61 (5.81)	3, 18
Pedagogy (hours)	12.92 (4.35)	6, 24	14.59 (4.96)	6, 24	19.41 (1.87)	15, 21	11.57 (3.01)	6, 15	9.87 (4.49)	8, 21
Foundations (hours)	8.87 (2.35)	3, 15	10.55 (2.05)	6, 15	7.41 (1.87)	3, 9	7.60 (1.60)	6, 12	9.61 (3.10)	3, 11
Technology	1.54 (1.62)	0, 6	1.99 (1.21)	0, 3	0	0	1.31 (1.82)	0, 6	0	0
Other	0.47 (0.50)	0, 1	0.45 (0.50)	0, 1	0.59 (0.51)	0, 1	0.45 (0.50)	0, 1	1 (0)	1, 1
Early field hours	134.42 (111.98)	0, 410	203.52 (124.33)	20, 410	66 (28.46)	0, 96	85.96 (70.93)	20, 242	91.96 (29.99)	0, 105
Full time teaching (weeks)	5.97 (3.19)	3, 15	5.59 (2.97)	3, 15	3.71 (0.77)	3, 6	6.46 (3.33)	3, 15	3.26 (0.69)	3, 6
Internship length (weeks)	13.95 (2.02)	10, 16	14.57 (1.59)	10, 16	12.06 (2.54)	10, 15	13.64 (2.15)	10, 16	11.65 (0.78)	10, 12
Minimum observations	4.00 (0.55)	1, 6	3.94 (0.41)	3, 5	4 (0)	4	4.06 (0.65)	1, 6	4 (0)	4
Seminar	0.59 (0.49)	0, 1	0.67 (0.47)	0, 1	0.94 (0.24)	0, 1	0.50 (0.50)	0, 1	0.96 (0.21)	0, 1
Educational Psychology	0.68 (0.47)	0, 1	0.61 (0.49)	0, 1	0.47 (0.51)	0,1	0.74 (0.44)	0, 1	0.87 (0.34)	0, 1
Adolescent Develop.	0.68 (0.47)	0, 1	0.76 (0.43)	0, 1	0.53 (0.51)	0, 1	0.62 (0.49)	0, 1	0.83 (0.39)	0, 1
Teaching	0.64	0, 1	0.72	0, 1	0.47	0, 1	0.61	0, 1	0.04	0, 1

Teaching ELLs	0	0	0	0	0	0	0	0	0	0
Classroom Management	0.12 (0.33)	0, 1	0.15 (0.36)	0, 1	0.41 (0.51)	0	0.09 (0.29)	0, 1	0	0
N	986		411		38		530		7	

Baccalaureate-prepared teachers also spend more weeks of the student teaching internship with full time teaching responsibility than MAT teachers. Almost all MAT teachers are required to take a seminar accompanying student teaching, while only 2/3 of middle grades baccalaureate and 1/2 of high school baccalaureate certified teachers are. Next, I describe what these features are for teachers who are not only certified, but actually teaching middle grades mathematics in a North Carolina public school.

Middle School Math

There are 248 teachers with five or fewer years of experience, certified by a UNC institution between 2007 and 2011 who are teaching middle school mathematics in North Carolina between 2007-2008 and 2011-2012. Of these, 201 are certified in Middle Grades Mathematics (6-9) at the baccalaureate level, 34 in secondary Mathematics (9-12) at the baccalaureate level, 12 hold an MAT in Middle Grades Mathematics, and 1 holds an MAT in secondary Mathematics. All 15 UNC institutions trained teachers in this sample, but over half (137) were prepared in 3 universities. Table 7 provides the descriptive statistics for the structural features of these middle grades mathematics teachers. Middle grades math teachers are required to take, on average, almost 10 hours of foundations coursework, slightly more than 3 courses. Within the foundations domain, 58% are required to take a course in Educational Psychology and 72% to take a course in Adolescent Development. Pedagogical requirements are 13.90 credit hours on average, almost 5 courses. Within the domain of pedagogy, 70% are required to take a special education course, only 16% are required to take a separate course on classroom management, and none of these teachers are required to take a course on teaching English Language Learners. These teachers are required to take an average of 23.77 credit hours of mathematics courses, 6 credit hours short of what is often the minimum requirement for a major in mathematics. They are required to take only 1.87 hours of technology coursework, and 52% are required to take an education course that does not fall into one of these four domains.

Turning to features of fieldwork, this subgroup of teachers is required to participate in 174 hours of early fieldwork experiences on average, but there is a wide range in this requirement (sd=124.95). Most MAT programs do not require any early field hours. The average student teaching internship is 14.11 weeks long, but as most internships last the university semester, this number is largely a reflection of the length of that semester. As such, it is not included in analytic models. Students are required to spend, on average, 5.33 weeks of their internship assuming full time responsibility for the classroom, and receive almost 4 minimum required observations from their university supervisor. Finally, 62% of these students are required to take a seminar accompanying their student teaching internship.

Table 7: Structural feature requirements for middle grades mathematics teachers

Structural Feature	Mean	Standard Deviation	Range
Foundations	9.93	2.50	3, 15
Subject Matter	23.77	8.69	15, 58
Pedagogy	13.90	4.97	6, 24
Technology	1.87	1.34	0, 6
Other	0.52	0.50	0, 1
Early field experience (hours)	174.01	124.94	0, 394
Full time teaching (weeks)	5.33	2.79	3, 15
Internship Length (weeks)	14.11	2.02	10, 16
Minimum observations	3.93	0.40	1, 5
Seminar	0.65	0.48	0, 1
Ed Psych	0.58	0.49	0, 1
Adolescent Development	0.72	0.45	0, 1
Classroom Management	0.16	0.36	0, 1
Special Education	0.70	0.46	0, 1
English Language Learners	0	0	n/a

Research Question 2: Structural features and student achievement

I now turn to answering my second research question, What are the relationships between the structural features of teacher preparation programs and student achievement in middle grades mathematics for beginning teachers? Table 8 provides results from 3 basic models. Model 1, a 3-level HLM model where students are nested in classrooms, and classrooms are nested within schools, shows that some structural features are related to middle grades math achievement gains of the teachers' students. These are subject matter coursework, early field hours, and full time responsibility for student teaching, all of which are negatively related to student achievement, while a required seminar has a positive relationship to math achievement[5]. A one credit hour increase in subject matter coursework is associated with a 0.0041 (p=0.083) standard deviation decrease in math achievement, or when considering adding a three credit hour course, a 0.0123 standard deviation decrease. Similarly, a ten-hour increase in the required number of early field hours is associated with a 0.0025 (p=0.0011) standard deviation decrease in math achievement, while an additional week of full time student teaching responsibility predicts a 0.0103 (p=0.014) standard deviation decrease, on average. Conversely, a required seminar during the student teaching semester is associated with 0.0491 (p=0.098) standard deviations higher math achievement, on average.

In the school fixed effects specification (model 3), teachers are compared to other teachers teaching in the same school. As such, the sample is reduced from 248 teachers to 191 because there are a number of schools where there is only one teacher in the analytical sample teaching in them. In this model, coefficients for subject matter coursework, early field experience hours, and weeks of full time teaching are of similar magnitude as in the HLM model, but none

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[5] These findings hold when omitting MAT teachers from the sample.

are statistically significant. In the university fixed effects specification, where teachers are compared to other teachers prepared in the same university (model 4), subject matter is the only of the three features where there is a significant association with student achievement: like the HLM model, subject matter requirements are negatively associated with math achievement: a credit increase is associated with a 0.0045 (p=0.008) standard deviation decrease in math achievement, or a 0.0135 standard deviation decrease for an additional 3 hour course. As such, subject matter is the only structure feature where there is robust evidence of a relationship to student achievement.

Because of evidence from prior research that there may be diminishing returns to subject matter coursework (Allen, 2003; Monk, 1994), I estimate an HLM model, including squared terms for subject matter, foundations, and pedagogical coursework, as well as early fieldwork hours. Allowing for non-linearities, there is a non-linear relationship between early field hours and math achievement (χ^2=14.72, p=0.0006). There is a negative relationship to achievement until a minimum threshold of 253 hours is required, after which increases in required early field hours have positive returns for math achievement. However, the average required number of early field experience hours is 174, well below this threshold.

Table 8: Structural features and Middle Grades Mathematics achievement

	HLM	School FE	University FE	HLM w/ classes
Foundations	-0.0045	-0.0307	0.0011	-0.0242***
	(0.0069)	(0.0315)	(0.0074)	(0.0084)
Subject Matter	-0.0041*	-0.0031	-0.0045***	-0.0069***
	(0.0023)	(0.0074)	(0.0014)	(0.0024)
Pedagogy	0.0007	-0.0040	-0.0168**	0.0050
	(0.0025)	(0.0097)	(0.0069)	(0.0042)
Technology	0.0040	0.0261	-0.0033	-0.0229
	(0.0118)	(0.0523)	(0.0049)	(0.0141)
Other	0.0255	0.0001	-0.0075	0.0758*

	(0.0258)	(0.1033)	(0.0461)	(0.0460)
Early Field Hours	-0.0025**	-0.0018	0.0066	-0.0020
	(0.0010)	(0.0030)	(0.0041)	(0.0021)
Weeks Full time Teaching	-0.0103**	-0.0121	-0.0067	-0.0177***
	(0.0042)	(0.0096)	(0.0049)	(0.0043)
Minimum Observations	-0.0183	0.0472	-0.5722**	0.0314
	(0.0315)	(0.0809)	(0.2219)	(0.0292)
Seminar	0.0491*	-0.0210		0.1601***
	(0.0297)	(0.1557)		(0.0455)
Special Education				-0.0586
				(0.0480)
Education Psychology				0.1195***
				(0.0337)
Development				0.1397**
				(0.0712)
Classroom Management				0.0268
				(0.0590)
R-sq		0.6655	0.7177	
N	35180	15256	35180	35180

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

While it can be helpful to know the nature of the relationship between these broad categories of coursework and beginning teacher value-added, knowing the influence of specific required foundations courses may be more helpful, since many different types of courses fall into that category and some may have effects, while others may not. For example, as chapter 3 notes, there is more theoretical justification for requiring foundations courses like adolescent development for teacher preparation, and for hypothesizing a relationship to achievement, as compared to a course on the history of education. As such, I investigate the relationship between specific coursework requirements and math achievement. I consider five specific courses, two foundations courses and three pedagogy courses: Educational Psychology, Adolescent Development, teaching special education, teaching English Language Learners, and a course in classroom management. However, there are no teachers in this sample of middle school math teachers who were required to take a course in teaching ELLs, so this course is omitted. In the HLM specification examining these relationships (model 4), both foundations courses are associated with middle grades math achievement. A required course in Educational Psychology is associated with 0.095 standard deviations higher math achievement, while a course in Adolescent Development has a stronger influence, and is associated with 0.129 standard deviations higher math achievement. Neither a course in special education nor in classroom management is related to math achievement, consistent with the non-significant coefficient on pedagogy coursework.

First Year Teachers

Because there are returns to experience in terms of improved student achievement and prior work has shown differences between the relationships of structural features to student achievement for first and second year teachers (Boyd, et al., 2009; Clotfelter, Ladd, & Vigdor, 2007, 2010), I conduct analyses that examine the relationship between the structural features of teacher preparation programs for teachers in their first year of teaching, in their second year of teaching, and teachers in their third to fifth years of teaching (combined because of reduced sample sizes). For each group of teachers, I estimate the same HLM models as were estimated on the full sample of teachers.

There are 211 teachers in the sample of first year teachers (Table 9, model 1). Here, there is no significant relationship between any structural feature and first year teacher value-added in middle grades math. Addressing the influence of specific pedagogical and foundations courses on middle grades math student achievement for first year teachers, a course in educational psychology is the only course that is significantly related to math achievement, where this requirement is associated with 0.1081 (p=0.0387) standard deviations higher math achievement gains.

Table 9: Teachers at various levels of experience and middle grades math achievement

	First year	First year w/ classes	2nd year	2nd year w/ classes	3rd year	3rd year w/ classes
Foundations	-0.0017	-0.0075	0.0048	-0.0318*	0.0180	0.0045
	(0.0096)	(0.0126)	(0.0137)	(0.0168)	(0.0128)	(0.0910)
Subject Matter	-0.0002	-0.0010	-0.0150***	-0.0093	0.0134*	0.0271
	(0.0033)	(0.0036)	(0.0053)	(0.0075)	(0.0078)	(0.0283)
Pedagogy	0.0016	0.0074	0.0039	-0.0034	-0.0017	0.0052
	(0.0026)	(0.0063)	(0.0043)	(0.0096)	(0.0064)	(0.0111)
Technology	-0.0020	-0.0169	-0.0328	-0.0237	0.0763***	0.0631
	(0.0151)	(0.0266)	(0.0270)	(0.0310)	(0.0257)	(0.0447)
Other	0.0400	0.0703	0.0824	-0.1256	-0.1590**	-0.1200
	(0.0296)	(0.0596)	(0.0595)	(0.1757)	(0.0792)	(0.5578)
Early Field hours	-0.0018	-0.0042	-0.0037**	0.0026	-0.0062**	0.0163
	(0.0012)	(0.0035)	(0.0017)	(0.0051)	(0.0025)	(0.0497)
Weeks full time teaching	0.0017	-0.0037	-0.0308**	-0.0786***	-0.0624***	-0.1433***
	(0.0060)	(0.0063)	(0.0132)	(0.0283)	(0.0208)	(0.0307)
Minimum Obs	0.0259	0.0576*	-0.1129	-0.3518*	-0.4668**	-1.7517
	(0.0357)	(0.0337)	(0.1103)	(0.1878)	(0.2192)	(1.3808)
Seminar	0.0406	0.1685***	0.1765**	0.1230	-0.2765***	-0.4997
	(0.0379)	(0.0600)	(0.0866)	(0.1439)	(0.0960)	(1.1050)
Special Ed class		-0.0740		-0.0818		-0.3806
		(0.0744)		(0.0850)		(0.4023)
Ed Psych		0.1119***		0.1132		-0.2145
		(0.0433)		(0.0861)		(1.3181)
Development		0.0746		0.4414**		0.2643
		(0.1141)		(0.1937)		(0.1613)

Classroom Mgmt		-0.0612		-0.0102		0.8686
		(0.0833)		(0.1318)		(1.5465)
N	16486	16486	9992	9992	8702	8702

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Second year teachers

Turning to second year teachers, there are 118 second year middle grades mathematics teachers in the sample (Table 9, model 3). Subject matter coursework, early field experience hours, and weeks of full time student teaching responsibility are the only significant predictors of middle grades math achievement for second year teachers, and all are negatively associated with math achievement. A credit hour increase in subject matter coursework is associated with a 0.0150 (p=0.004) standard deviation decrease in math achievement on average, or a -0.0451 standard deviation change for a typical 3 credit hour course increase. Every additional ten hours of required early field experiences are associated with a 0.0037 (p=0.034) standard deviation decrease in math achievement and each additional week of full time student teaching responsibility is associated with a 0.0308 (p=0.020) standard deviation decrease on average. There is no evidence of non-linear relationships between coursework and student achievement.

Of the courses I examine, educational psychology, adolescent development, special education, and classroom management, adolescent development is the only course that significantly predicts math achievement: this requirement is associated with 0.4413 (p=0.023) standard deviation higher achievement, on average. This is an unusually high coefficient for the effect of one course on achievement and is likely biased. However, while there is variation in which programs require this course, there is no correlation between teachers' academic ability as measured by SAT score and whether or not they are required to take this course, nor does it appear that only preparation programs with strong reputations require such a course. As such, it is unclear where this bias may arise from.

Third to fifth year teachers

Finally, I consider beginning teachers in their third to fifth years of teaching. There are even fewer teachers who persist to at least their third year of teaching and this sample is reduced even further to only 76 teachers. In this specification (Table 9, model 5), subject matter, technology and a required “other” course are all significantly associated with middle grades math achievement. A one credit hour increase in required subject matter coursework is associated with a 0.0133 (p=0.088) standard deviation increase in achievement, while for technology, a one credit hour increase in required technology coursework is associated with a 0.028 standard deviation increase in math achievement on average. A required “other” course is associated with 0.1590 (p=0.045) standard deviations lower achievement. All aspects of fieldwork are significantly associated with achievement for these more experienced teachers: early field experience hours (β=-0.0062, p=0.012), weeks of full time student teaching responsibility (β=-0.0624, p=0.033), required minimum observations (β=-0.4668, p=0.004), and a seminar (β=-0.2765, p=0.004) are all negatively related to achievement. There is evidence of a non-linear relationship to achievement for early field hours for third to fifth year middle grades math teachers. Increasing early field hours (χ^2=19.36, p=0.0001) has a negative relationship with math achievement until a threshold of 226 hours is met, at which point additional early field hours begin to have a positive influence on math achievement. Examining the influence of specific required courses on third to fifth year middle grades math achievement (Table 9, model 6), there is no evidence that any specific course is associated with student achievement.

In sum, for all teachers, subject matter coursework is the only structural feature of teacher preparation with a robust relationship to middle grades math achievement, where increased subject matter coursework requirements are associated with decreased student achievement. Considering teachers at varying levels of experience, this negative association disappears for teachers in their 3rd-5th year of teaching, where there is a positive relationship of required subject matter coursework to middle grades math achievement. For teachers with at least two years of experience, both weeks of full time student teaching responsibility and required early field experience hours are negatively related to student achievement. Finally, in the sample of all teachers and of first year teachers, there is a positive relationship between a required course in educational psychology and for second year teachers a positive relationship between a required course in adolescent development and middle grades math achievement, while increased coursework requirements appear to be negative related to achievement for more experienced teachers. Having examined the relationship of structural features of teacher preparation to student achievement for all students, on average, I now turn to research question three.

Research Question 3: Structural features of Teacher Preparation, English Language Learners, Special Education students, and middle grades mathematics achievement

Here I turn to my third research question and examine what the effects of the structural features of teacher preparation programs are for students who have a special education designation and students who are English Language Learners (ELLs). I examine English Language Learners first and then turn to special education students.

Effects for English Language Learners

Turning to the effects of the structural features of teacher preparation programs on ELL middle grades math achievement, there are 211 teachers teaching 2142 English Language Learners. For these students, no structural features are significant predictors of math achievement for ELL students (Table 10, model 1). Examining the relationship of specific courses to ELL achievement, there are significant relationships. A required course in development is associated with 0.4501 (p=0.004) standard deviations high achievement, on average, while a course in special education is associated with 0.2456 (p=0.008) standard deviations higher math achievement for ELLs, on average. The relationship of a special education course to ELL achievement is robust to the university fixed effects specification (B=0.2684, p=0.002), while a development course is not. Unfortunately, no middle grades math teachers are required to take a course in teaching ELLs, so the relationship of this course to ELL achievement cannot be estimated.

Table 10: Effects for English Language Learners and Special Education students

	(1)	(3)	(1)	(3)
	ELL	ELL w/ classes	Special Education	Special Education w/ classes
Foundations	0.0199	-0.0020	-0.0133	-0.0228**
	(0.0158)	(0.0206)	(0.0099)	(0.0114)
Subject Matter	0.0025	-0.0007	-0.0092**	-0.0072*
	(0.0051)	(0.0060)	(0.0039)	(0.0042)
Pedagogy	-0.0024	-0.0279***	-0.0021	-0.0059
	(0.0039)	(0.0102)	(0.0035)	(0.0069)
Technology	-0.0292	-0.0925***	0.0044	0.0009
	(0.0246)	(0.0290)	(0.0166)	(0.0235)
Other	-0.0400	-0.2114	0.0717**	-0.0061
	(0.0616)	(0.1342)	(0.0323)	(0.0763)
Early field hours	-0.0016	0.0059	-0.0020	0.0046
	(0.0016)	(0.0058)	(0.0015)	(0.0030)

Weeks full time teaching	-0.0100	-0.0290***	-0.0047	-0.0089
	(0.0115)	(0.0102)	(0.0058)	(0.0082)
Minimum Observations	-0.1059	-0.0375	-0.0312	-0.0553
	(0.1091)	(0.1182)	(0.0403)	(0.0439)
Seminar	-0.0028	0.0625	0.0355	-0.0485
	(0.0710)	(0.1363)	(0.0453)	(0.0755)
Ed Psych		0.1487		-0.0595
		(0.1117)		(0.0580)
Development		0.4501***		0.1401
		(0.1582)		(0.1053)
Special Ed class		0.2456***		-0.0163
		(0.0922)		(0.0697)
Classroom Management		-0.2172		0.1200
		(0.1418)		(0.0880)
N	2142	2142	3512	3512
Standard errors in parentheses				
* p<0.10, ** p<0.05, ** p<0.05				

Special Education Students

Examining the relationships between structural features and math achievement for special education students, there are 235 middle grades mathematics teachers teaching 3512 special education students. Here, subject matter coursework, and a required “other” course are the only significant predictors of achievement in the HLM specification (Table 10, model 3). A credit hour increase in subject matter coursework is associated with a 0.0092 (p=0.018) standard deviation decrease in middle grades math achievement for special education students, on average, while a required “other” course is associated with 0.0717 (p=0.026) standard deviations higher math achievement. The relationship of subject matter to special education student achievement is robust to the school fixed effects specification (β=-0.0458, p=0.000), but not the university fixed effects model, although the coefficient is of similar sign and magnitude (β=-

0.0012) though not significant. A required "other" course is not robust to either specification. No specific course, even a course in special education, is significantly associated with middle grades math achievement for special education students.

In sum, for English Language Learners, there is robust evidence a course in special education is positively related to mathematics achievement while for special education students, subject matter coursework has a negative relationship to special education student achievement, similar to its relationship to achievement for all students. Of note is that a required course in special education has no relationship to middle grades math achievement for special education students, the students whom such a course is ostensibly aimed at improving their learning. Having answered my three research questions for middle grades math teachers, I now turn to answering these questions for high school Algebra I teachers.

High School Algebra I

Research Question 1: Structural features of teacher preparation for High School Algebra I teachers

There are 258 teachers with complete data prepared by UNC institutions between 2007 and 2011 teaching Algebra I. Of these, 235 are certified at the baccalaureate level in secondary mathematics (9-12), 14 in Middle Grades mathematics (6-9), 7 hold an MAT in secondary mathematics, and 2 hold an MAT in Middle Grades mathematics. They are prepared in 13 of the 15 UNC institutions, and over half (144) are prepared at 3 institutions. These teachers are required to take greater hours of subject matter training than teachers teaching middle school mathematics, 38.58 credit hours on average, approximately 11 mathematics courses. They are required to take, on average, 11.95 hours of pedagogical training, 7.55 hours of foundations coursework, and 1.41 hours of technology coursework. Less than half (45.3%) are required to take another type of education course. Table 11 provides the descriptive statistics for the required structural features for these Algebra I teachers.

High school Algebra I teachers are required to participate in an average of about 102 early field experience hours, but there is wide variation in this requirement (sd=79.31). The average length of their student teaching internship is 13.41 and variation in this requirement largely reflects variation in the length of a university semester. They are required to spend just over 6 weeks during this internship with full time teaching responsibility and average 4 minimum required observations from their university supervisor. Just over half (53%) are required to take a professional seminar to accompany their internship.

Table 11: Structural features of teacher preparation for Algebra I teachers

Structural Feature	Mean	Standard Deviation	Range
Foundations	7.55	1.80	3, 13
Subject Matter	38.58	6.41	15, 58
Pedagogy	11.95	3.34	6, 24
Technology	1.41	1.86	0, 6
Other	0.45	0.50	0, 1
Early field experience (hours)	102.11	79.31	0, 394
Full time teaching (weeks)	6.13	3.20	3, 15
Internship Length (weeks)	13.41	2.29	10, 16
Minimum observations	4.02	0.58	1, 6
Seminar	0.53	0.50	0, 1
Ed Psych	0.67	0.47	0, 1
Adolescent Development	0.61	0.49	0, 1
Classroom Management	0.10	0.31	0, 1
Special Education	0.65	0.48	0, 1
English Language Learners	0	0	0

Research Question 2: Structural features and Algebra I teacher value-added

Table 12 presents results from the basic HLM, school fixed effects, and university fixed effects specifications. In the HLM specification (model 1) with a sample of 258 teachers, a required "other" course is all positively related to Algebra I achievement, while other types of coursework are unrelated. Requiring another education course that does not fit into one of the four specific categories listed here, such as teacher leadership or action research, is associated with a 0.1053 (p=0.010) standard deviation increase in Algebra I achievement. Of the field work features, only weeks of full time responsibility for student teaching is positively associated with Algebra I achievement. A week increase in full time teaching is associated with a 0.0185 (p=0.011) standard deviation increase in student achievement, a small, but again not inconsequential effect size[6]. No specific courses are associated with Algebra I achievement.

Table 12: Structural features and high school Algebra I achievement

	(1)	(2)	(3)	(4)
	HLM	School FE	University FE	HLM w/ classes
Foundations	0.0049	-0.0844	-0.0006	0.0058
	(0.0110)	(0.0535)	(0.0115)	(0.0119)
Subject Matter	-0.0033	0.0018	-0.0048	-0.0043
	(0.0045)	(0.0183)	(0.0033)	(0.0045)
Pedagogy	0.0062	-0.0418	0.0013	0.0037
	(0.0059)	(0.0354)	(0.0204)	(0.0066)
Technology	-0.0146	0.0119	-0.0307	-0.0173
	(0.0106)	(0.0437)	(0.0257)	(0.0124)
Other	0.1053**	0.0701	-0.0096	0.1410**
	(0.0410)	(0.1576)	(0.1555)	(0.0717)
Early Field Hours	0.0065**	0.0066	0.0103	0.0069**
	(0.0031)	(0.0088)	(0.0067)	(0.0033)
Weeks Full Time Teaching	0.0185**	0.0222	0.0167	0.0217***
	(0.0072)	(0.0167)	(0.0133)	(0.0079)

[6] These results are robust to a sample that excludes MAT teachers and full results can be found in Table A6 of the Appendix.

Minimum Observations	0.0251	-0.1544*	0.0123	0.0296
	(0.0256)	(0.0826)	(0.0755)	(0.0257)
Seminar	-0.0322	-0.1157	0.0971	-0.0522
	(0.0415)	(0.1620)	(0.0689)	(0.0518)
Special Education				0.0423
				(0.0552)
Educational Psychology				-0.0073
				(0.0470)
Development				-0.0408
				(0.0523)
Classroom Management				0.0413
				(0.0448)
R-sq		0.4594	0.5259	
N	25788	9736	25788	25788

The results from the HLM model are not supported by results from the fixed effects models. These models do not provide robust evidence as to the relationship of these features to Algebra I achievement.

First Year Teachers

Additionally, as there are both returns to experience and prior work has found differing relationships of features to achievement for teachers at varying levels of experience (Boyd et al., 2009; Clotfelter, Ladd, & Vigdor, 2007, 2010), I consider the relationship between these structural features and value-added for teachers in their first year of teaching, second year of teaching, and with three to five years of experience. There are 199 of the 258 teachers in the full sample teaching Algebra I in their first year of teaching, teaching 11,852 students. In the HLM (see Table 13, model 1), requiring another education course outside of the four domains I consider and early fieldwork hours are the only significant predictors of Algebra I achievement. Requiring an "other" course predicts approximately a one-tenth of standard deviation higher achievement, on average ($\beta=0.1097$, $p=0.027$), while requiring an additional ten hours of early field experiences is associated with a 0.0069 (p=0.034) standard deviation increase in achievement. However, fixed effects models do not provide support for these findings: in neither model are these features significantly associated with Algebra I achievement.

Examining the effects of specific classes on first year teacher value-added (model 2), requiring a course in development has a strong negatively relationship with value-added (β=-0.1368, p=0.025), while none of the others have a significant relationship.

Table 13: Structural features and Algebra I achievement for various years of experience

	(1)	(3)	(1)	(3)	(1)	(3)
	1st year	1st year w/ classes	2nd year	2nd year w/ classes	3rd-5th year	3rd-5th year w/ classes
Foundations	-0.0143	-0.0078	0.0339	0.0475	-0.0659	-0.0247
	(0.0127)	(0.0138)	(0.0226)	(0.0273)	(0.0502)	(0.0704)
Subject Matter	-0.0004	0.0038	-0.0009	0.0035	-0.0085	-0.0144
	(0.0056)	(0.0060)	(0.0070)	(0.0073)	(0.0104)	(0.0115)
Pedagogy	-0.0099	-0.0004	0.0245	0.0263	-0.0225	-0.0109
	(0.0065)	(0.0076)	(0.0135)	(0.0155)	(0.0252)	(0.0313)
Technology	-0.0049	-0.0046	-0.0280*	-0.0250	-0.0103	-0.0485
	(0.0155)	(0.0158)	(0.0135)	(0.0150)	(0.0277)	(0.0321)
Other	0.1097*	0.0277	0.0874	0.0963	0.3424*	0.2035
	(0.0496)	(0.0681)	(0.0880)	(0.1162)	(0.1450)	(0.2135)
Early Field Hours	0.0069*	0.0082*	0.0044	0.0036	0.0232*	0.0134
	(0.0033)	(0.0035)	(0.0067)	(0.0075)	(0.0106)	(0.0130)
Weeks Full Time Teaching	0.0111	0.0058	0.0198	0.0249	0.0697*	0.0294
	(0.0070)	(0.0072)	(0.0141)	(0.0147)	(0.0307)	(0.0407)
Minimum Obs	0.0436	0.0382	0.0222	0.0287	0.1163	0.0586
	(0.0337)	(0.0329)	(0.0446)	(0.0517)	(0.0974)	(0.1039)
Seminar	-0.0100	0.0499	0.0046	-0.0025	-0.2940*	-0.1234
	(0.0531)	(0.0608)	(0.0622)	(0.0893)	(0.1455)	(0.1762)
Education Psychology		-0.0701		-0.0917		0.0314
		(0.0507)		(0.0745)		(0.1179)
Development		-0.1368*		0.0244		0.1043
		(0.0612)		(0.0772)		(0.1361)
Special Education		0.0495		-0.1199		0.1064
		(0.0592)		(0.0775)		(0.1951)

Classroom Mgmt		0.0039		0.0406		0.1043
		(0.0544)		(0.0775)		(0.1401)
N	11852	11852	8033	8033	5903	5903

Second Year Teachers

The sample of second year teachers teaching Algebra I is even further reduced than the sample of first year teachers, to 134 teachers. For second year teachers, we see only one relationship between the coursework requirements of preparation programs and Algebra I achievement: required technology credit hours are negatively associated with Algebra I achievement, where an additional required credit hour is associated with a 0.0280 (p=0.037) standard deviation decrease in Algebra I achievement and robust to the university fixed effects model (β=-0969, p=0.000). There is no evidence that any specific course is significantly associated with Algebra I achievement.

Third to fifth year teachers

Considering teachers in their third to fifth years of experience teaching Algebra I (N=73), a required "other" course, early field hours, weeks of full time responsibility for student teaching, and a seminar are significantly associated with Algebra I achievement (Table 13, model 5). A required "other" course is associated with 0.3424 (p=0.018) standard deviations higher achievement. An additional week of full time student teaching is associated with a 0.0697 (p=0.023) standard deviation increase in achievement, on average, while an additional ten hours of early field experiences are associated with a 0.0232 (p=0.029) standard deviation increase. Conversely, a required seminar is associated with 0.2940 (p=0.043) standard deviations lower achievement, on average. Examining the effects of specific classes (model 6), there is no evidence that any specific course is a significant predictor of Algebra I achievement.

In sum, there is some evidence, though not robust to alternate specifications, that a required “other” course, early field experience hours, and weeks of full time responsibility for student teaching are positively related to Algebra I achievement. Both a required “other” course and early field experience hours are positively associated with achievement for teachers at various levels of experience as well, but weeks of full time teaching responsibility is only positively related to achievement for teachers with 3 or more years of experience. There is no evidence, across samples, that specific courses are related to Algebra I achievement. Next I turn to examining the relationships of features to achievement for specific subgroups of students.

Research Question 3: Structural features of teacher preparation, English Language Learners, Special Education students, and Algebra I achievement

English Language Learners

Research question three asks whether the effects of the structural features of teacher preparation programs on beginning teacher value-added vary for English Language learners? To answer this question, I estimate the same 3-level HLM model as for all students on Algebra I students who are designated English Language Learners, 1409 students, with 209 teachers. Results are presented in Table 14. In this model (model 1), there is evidence of effects of some features for ELL Algebra I achievement: pedagogy and “other” coursework, as well as weeks of full time student teaching responsibility. A credit hour increase in pedagogy requirements is associated with a 0.0207 (p=0.046) standard deviation increase in Algebra I achievement for ELLs, on average, while a required “other” course is associated with 0.1604 (p=0.050) standard deviations higher achievement, on average. For weeks of full time student teaching responsibility, an additional week is associated with a 0.0315 (p=0.034) standard deviation increase in Algebra I achievement for ELLs. No specific course is associated with Algebra I achievement for ELL students. Unfortunately, there are no high school Algebra I teachers who are required to take a course on teaching ELLs, so I cannot examine its relationship to their Algebra I achievement.

Table 14: Effects for English Language Learners and Special Education students

	(1)	(3)	(1)	(3)
	ELLs	ELLs w/ classes	Special Education students	Special Education w/ classes
Foundations	0.0216	0.0217	0.0131	0.0169
	(0.0165)	(0.0263)	(0.0179)	(0.0200)
Subject Matter	-0.0155	-0.0155	-0.0014	-0.0017
	(0.0101)	(0.0109)	(0.0063)	(0.0070)
Pedagogy	0.0207**	0.0182	0.0140	0.0126
	(0.0104)	(0.0148)	(0.0101)	(0.0121)
Technology	-0.0299	-0.0215	-0.0098	-0.0025
	(0.0207)	(0.0250)	(0.0160)	(0.0184)
Other	0.1604*	0.2099	0.1389*	0.1976
	(0.0819)	(0.1324)	(0.0725)	(0.1359)
Early Field Hours	0.0015	-0.0001	0.0113*	0.0088
	(0.0070)	(0.0075)	(0.0062)	(0.0071)
Weeks Full Time Teaching	0.0315**	0.0368**	0.0248**	0.0308*
	(0.0149)	(0.0155)	(0.0125)	(0.0158)
Minimum Observations	-0.0117	-0.0214	0.0658	0.0565
	(0.0558)	(0.0574)	(0.0443)	(0.0447)
Seminar	0.0048	-0.0198	-0.0907	-0.1129
	(0.0745)	(0.1179)	(0.0674)	(0.0980)
Educational Psychology		0.0203		0.0297
		(0.0895)		(0.0762)
Development		-0.0774		-0.0921
		(0.0891)		(0.0882)
Special Education		0.0514		0.0835
		(0.0966)		(0.0843)
Classroom Management		-0.0178		-0.0364
		(0.1353)		(0.0841)
N	1409	1409	3154	3154

Special Education students

The second part of research question three asks about differential effects of these structural features for special education student achievement. As such, I estimate the same models as for ELL students, 3154 special education students taught by 243 teachers. In the HLM model (Table 14, model 3), a required "other" course, early field experience hours and weeks of full time student teaching responsibility are related to Algebra I achievement for special education students. A required "other" course is associated with 0.1389 (p=0.055) standard deviations higher Algebra I achievement for special education students. An additional ten hours of early field experience hours are associated with a 0.0113 (p=0.066) standard deviation increase in special education student Algebra I achievement, on average, while an additional week of full time responsibility for teaching is associated with a 0.0248 (p=0.047) standard deviation increase. Only the relationship of early field hours is robust to other specifications: in the university fixed effects model, an additional ten hours of required early field hours is associated with a 0.0119 (p=0.091) standard deviation increase in achievement. Examining the effects of specific courses for special education students, there are no significant associations between these courses and Algebra I achievement for special education students (model 4), even for the relationship between a course in special education and special education student Algebra I achievement.

In summary, there are similar relationships to Algebra I achievement for ELL and special education students as for all students: a required "other" course and weeks of full time teaching responsibility are positively associated with achievement for both groups, and no specific courses are related to Algebra I achievement. Additionally, for ELLs, pedagogy coursework is positively related to achievement, as are early field hours to special education student achievement. Having considered the structural features of teacher preparation programs for math-certified teachers, I now turn to answering my 3 research questions for English/Language Arts certified teachers.

English/Language Arts Findings

Research Question 1: Structural features of preparation for English/Language Arts teachers

There were 822 teachers prepared in UNC institutions and certified to teach secondary English in North Carolina between 2007 and 2011 with complete data. Of these, 322 are certified in Middle Grades Language Arts (6-9) and 398 are certified in English (9-12) at the baccalaureate level. At the masters' level, 14 hold an MAT in Middle Grades Language Arts (6-9) and 88 hold an MAT in English (9-12).

Overall, on average, English/Language Arts teachers are required to take 26.4 credit hours of English coursework. Middle grades Language Arts certified teachers are required to take about 18 credit hours of subject matter coursework, or about 6 classes. High school English certified teachers are required to take almost twice as much subject matter coursework, just over 37 hours, more than 12 typical courses. At the MAT level, middle grades teachers are required to take about 7.5 credit hours of English coursework, between 2-3 courses, and high school teachers are required to take just over 9 hours, about 3 courses. However, MAT teachers must have a subject matter major or its equivalent for admission to an MAT program.

These teachers are required to take about 12 credit hours of pedagogy coursework, but these requirements vary across certification areas. Middle grades certified teachers are required to take 5-9 more credit hours than high school certified teachers, on average. As to the specific

Table 15: Structural features of preparation for all English/Language Arts teachers

	All teachers		MG Language Arts (BA)		MAT MG Language Arts		HS English (BA)		MAT HS English	
Feature	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range
Subject Matter (hours)	26.40 (12.37)	3, 48	18.14 (3.78)	15, 27	7.45 (5.76)	3, 18	37.39 (5.98)	27, 48	9.64 (3.37)	6, 15
Pedagogy (hours)	12.33 (5.01)	6, 24	15.44 (5.55)	6, 24	19.29 (1.94)	15, 21	9.98 (2.59)	6, 14	10.95 (4.81)	6, 21
Foundations (hours)	9.03 (2.97)	3, 15	10.91 (1.86)	6, 15	7.29 (1.94)	3, 9	7.94 (2.71)	3, 12	7.45 (3.84)	3, 11
Technology	0.93 (1.26)	0, 3	1.41 (1.33)	0, 3	0	0	0.75 (1.128)	0, 3	0.09 (0.52)	0, 3
Other	0.30 (0.46)	0, 1	0.34 (0.47)	0, 1	0.57 (0.51)	0, 1	0.16 (0.36)	0, 1	0.77 (0.42)	0, 1
Early field hours	115.98 (103.62)	0, 410	155.24 (129.95)	20, 410	0	0	93.06 (55.81)	20, 212	55.21 (52.70)	0, 105
Full time teaching (weeks)	6.35 (3.40)	3, 15	5.66 (2.80)	3, 15	3.71 (0.83)	3, 6	7.45 (3.58)	3, 15	4.03 (2.76)	3, 15
Internship length (weeks)	13.72 (1.96)	10, 16	13.95 (2.05)	10, 16	12.14 (2.57)	10, 15	13.77 (1.85)	10, 16	12.77 (1.65)	10, 15
Minimum observations	4.02 (0.53)	1, 6	3.98 (0.42)	3, 5	4	0	4.07 (0.69)	1, 6	3.88 (0.56)	1, 5
Seminar	0.63 (0.48)	0, 1	0.52 (0.50)	0, 1	0.93 (0.27)	0, 1	0.64 (0.48)	0, 1	0.93 (0.26)	0, 1
Educational Psychology	0.79 (0.40)	0, 1	0.75 (0.41)	0, 1	0.50 (0.52)	0,1	0.82 (0.38)	0, 1	0.85 (0.36)	0, 1
Adolescent Develop	0.59 [illegible]	0, 1	0.78 [illegible]	0, 1	0.36 [illegible]	0, 1	0.46 [illegible]	0, 1	0.53 [illegible]	0, 1

Special Education	(0.50)		(0.47)		(0.52)		(0.49)		(0.49)	
Teaching ELLs	0.02 (0.15)	0, 1	0	0	0	0	0.04 (0.21)	0, 1	0	0
Classroom Management	0.16 (0.37)	0, 1	0.12 (0.33)	0, 1	0.43 (0.51)	0, 1	0.15 (0.36)	0, 1	0.31 (0.46)	0, 1
N	822		322		14		398		88	

foundations courses I consider, 51% of these teachers are required to take a course in specia education, 16% to take a course in classroom management, and only 2% to take a course in teaching ELLs.

The average foundations coursework requirement is 9 credit hours, about 3 classes. Middle grades MAT, high school MAT, and high school baccalaureate programs all require average, just over 7 credit hours of foundations coursework, while middle grades baccalaureate programs require almost 11 hours. For the specific foundations courses I consider, 79% of these teachers are required to take a course in educational psychology, while 59% are required to take a course in adolescent development. On average, teachers are required to take less than a credit hour of technology coursework. It is primarily middle grades baccalaureate programs that require such a course and few MAT programs at either level require a technology course. Only 30% of ELA certified teachers are required to take an education course other than one in the 4 domains I consider. Most of these requirements come at the MAT level, where teacher candidates may be required to take a research course or a course on teacher leadership.

Turning to requirements for fieldwork, teachers are required to participate in about 116 hours of early field experiences, on average. Very few MAT programs require any early field experiences, and at the baccalaureate level, middle grades programs require more hours of early field experiences than high school English programs. The average length of the student teaching internship is 13.7 weeks. Most programs require a full semester of student teaching and much of the variation in this requirement comes from variation in the length of a semester. Of these 13.7 weeks, teachers are required to spend about 6.3 weeks with full time teaching responsibility in their student teaching classroom. This requirement is longer for baccalaureate teacher candidates than for MAT candidates, and longer for high school certification than for middle grades. A minimum of about 4 observations by a university supervisor is required, and there is very little variation in this number. Finally, 63% of teachers are required to take a seminar to accompany their internship. The vast majority of MAT (93%) teachers have this requirement.

Middle School English/Language Arts

Research Question 1: Structural features of teacher preparation for middle grades English/ Language Arts teachers

There are 175 teachers who are certified by UNC institutions in secondary English/Language Arts (ELA) with complete data, teaching ELA in middle grades in North Carolina public schools between 2007-2008 and 2011-2012. Of these, 120 are certified in Middle Grades Language Arts (6-9) at the baccalaureate level, 34 are certified in English (9-12) at the baccalaureate level, 14 hold an MAT in Middle Grades Language Arts, and 7 hold an MAT in English. Five of the UNC institutions produce 20 or more of these teachers, totaling 130.

These teachers are required to take, on average, about 24 hours of English coursework, less than is required for a subject area major. There is however, wide variation in this requirement. Additionally, they are required to take about 10 hours of foundations coursework, and almost 15 hours of pedagogy, about 5 classes. Of the specific foundations courses I consider, 81% are required to take a course in educational psychology, and 71% to take a course in adolescent development. For specific pedagogy courses, 66% are required to take a course in special education, 19% to take a course in classroom management, but only 2% to take a course in teaching English Language Learners. These middle grades ELA teachers are required to take an average of 1.3 hours of technology coursework and only 35% are required to take an education course outside of the 4 domains I consider.

For fieldwork requirements, they are required to participate in about 126 hours of early field experiences, but there is huge variation (sd=120.51) in this requirement. Their student teaching internships average about 13.5 weeks, and they are required to spend almost 6 weeks of this time with full time responsibility for teaching, on average. They receive a minimum of almost 4 observations from their university supervisor during the internship, with very little variation. Finally, 59% are required to take a seminar to accompany their student teaching.

Table 16: Structural Features for Middle School ELA Teachers

Feature	Mean	Standard Deviation	Range
Subject Matter	23.78	10.01	15, 56
Foundations	10.01	2.41	3, 15
Pedagogy	14.49	5.63	6, 22
Technology	1.33	1.33	0, 3
Other	0.35	0.48	0, 1
Early field hours	126.37	120.51	0, 394
Weeks full time teaching	5.94	3.23	3, 15
Internship Length	13.46	2.20	10, 16
Minimum Observations	3.93	0.37	3, 5
Seminar	0.59	0.49	0, 1
Educational Psychology	0.81	0.39	0, 1
Adolescent Development	0.71	0.45	0, 1
Special Education	0.66	0.47	0, 1
ELLs	0.02	0.13	0, 1
Classroom Management	0.19	0.40	0, 1

Research Question 2: The Relationship of Structural Features of Preparation and Beginning Teacher Value-Added for middle grades English/ Language Arts

Research question two asks, what are the relationships between the structural features of teacher preparation programs and beginning teacher valued-added. For middle grades ELA teachers, the HLM specification (Table 17, model 1) shows that pedagogy and technology coursework are all positively associated with middle grades language arts achievement. For pedagogy, an additional credit hour predicts a 0.0022 (p=0.089) standard deviation increase in ELA achievement, while an additional credit hour of technology coursework is associated with a

0.0174 (0.002) standard deviation increase. No features of fieldwork are significantly associated with middle grades ELA achievement[7].

Table 17: Structural Features Middle Grades English Language Arts achievement

	(1)	(2)	(3)	(4)
	HLM	School FE	University FE	HLM with classes
Foundations	-0.0026	0.0008	-0.0074	-0.0108**
	(0.0032)	(0.0096)	(0.0044)	(0.0044)
Subject Matter	0.0010	0.0052*	0.0012	0.0030
	(0.0016)	(0.0027)	(0.0011)	(0.0021)
Pedagogy	0.0022*	-0.0091	0.0044	-0.0007
	(0.0013)	(0.0120)	(0.0030)	(0.0018)
Technology	0.0185***	-0.0098	-0.0116**	-0.0107
	(0.0061)	(0.0331)	(0.0047)	(0.0102)
Other	-0.0025	0.0179	0.0918**	0.0279
	(0.0203)	(0.2540)	(0.0325)	(0.0240)
Early Field Hours	-0.0003	0.0013	-0.0007	0.0025**
	(0.0006)	(0.0015)	(0.0009)	(0.0011)
Weeks Full Time Teaching	-0.0007	-0.0151***	0.0014	-0.0001
	(0.0027)	(0.0036)	(0.0064)	(0.0030)
Minimum Observations	0.0035			0.0391
	(0.0216)			(0.0251)
Seminar	-0.0228	-0.0185		-0.0409*
	(0.0152)	(0.2651)		(0.0231)
Educational Psychology				0.0110
				(0.0303)
Development				0.0603**
				(0.0290)
Special Education				0.0513**
				(0.0204)
Teaching ELLs				0.0231
				(0.0313)
R-sq		0.6625	0.6974	
N	24269	11433	24269	24269

[7] These results are robust to a sample that excludes MAT teachers.

These significant relationships are not robust to other specifications. In fact, in the university fixed effects model, the direction of the relationship of technology requirements to achievement changes and this requirement is negatively associated with ELA achievement (β=-0.0116, p=0.031). Pedagogy requirements are not significantly associated with middle grades ELA achievement in either fixed effects specification and the direction of the relationship changes in the school fixed effects model.

Additionally, I examine the effects of requiring five specific foundations and pedagogy courses of interest: educational psychology, adolescent development, special education, teaching English Language Learners, and classroom management. In an HLM model including a binary indicator for each course (model 3), three of these classes are positively associated with ELA achievement: development, special education and classroom management. Requiring a course in development is associated with a 0.0603 (p=0.037) standard deviations higher achievement, a course in special education course predicts 0.0513 (p=0.012) standard deviations higher ELA achievement, on average, and classroom management predicts 0.0568 (p=0.034) standard deviations higher middle grades ELA achievement, on average.

First Year Teachers

Because there are returns to experience for teacher effectiveness (Clotfelter, Ladd, & Vigdor, 2007, 2010) and school context influences teachers over time, I estimate models that show the associations between the structural features of teacher preparation programs and beginning teacher value-added for first year middle grades ELA teachers only, 151 teachers. In the HLM model (Table 18, model 1), technology coursework is significantly associated with middle grades ELA achievement. For technology, a one credit hour increase in requirements is associated with a 0.0155 (p=0.054) in middle grades ELA achievement, on average. This estimate is not, however, robust to the university fixed effects specification[8].

Additionally, I examine the effects of specific courses on middle grades ELA achievement for first year teachers. In the HLM model (model 2), controlling for a rich set of covariates, each course, save classroom management, is a significant predictor of middle grades ELA achievement. A course in special education is associated with 0.0873 (p=0.005) standard deviations ELA higher achievement, on average, compared to those students whose teachers did not have such a course, a course in development is associated with 0.0778 (p=0.021) standard deviations higher achievement and a course in educational psychology is associated with 0.0557 (p=0.047) standard deviations higher achievement. Conversely, a course in teaching ELLs predicts 0.0889 (p=0.017) standard deviations lower achievement on average.

Table 18: Relationships of structural features to middle grades ELA for teachers at varying levels of experience

	(1)	(2)	(3)	(4)	(5)	(6)
	1st year	1st year w/ classes	2nd year	2nd year w/ classes	3rd-5th year	3rd-5th years w/ classes
Foundations	-0.0002	-0.0105**	-0.0027	-0.0219**	-0.0078	-0.0531*
	(0.0040)	(0.0051)	(0.0045)	(0.0095)	(0.0088)	(0.0300)
Subject Matter	0.0030	0.0057**	0.0019	0.0030	-0.0008	-0.0063
	(0.0024)	(0.0026)	(0.0027)	(0.0029)	(0.0032)	(0.0199)
Pedagogy	0.0008	-0.0066**	0.0035**	0.0025	0.0004	-0.0125
	(0.0019)	(0.0027)	(0.0015)	(0.0024)	(0.0065)	(0.0392)
Technology	0.0155*	-0.0223	0.0142	-0.0091	0.0386	0.0200
	(0.0081)	(0.0140)	(0.0096)	(0.0171)	(0.0445)	(0.0247)
Other	0.0038	0.0315	-0.0181	-0.0378	-0.0741*	-0.2106
	(0.0279)	(0.0306)	(0.0279)	(0.0337)	(0.0433)	(0.5145)
Early Field Hours	-0.0006	0.0015	0.0012	0.0066***	0.0001	0.0041
	(0.0008)	(0.0012)	(0.0010)	(0.0021)	(0.0027)	(0.0057)

[8] I do not estimate a coefficient for technology coursework in the school fixed effects model because of a lack of within-school variation in the requirement.

Weeks Full Time Teaching	0.0015	0.0021	-0.0076	-0.0077	-0.0017	-0.0220
	(0.0034)	(0.0035)	(0.0046)	(0.0066)	(0.0188)	(0.0722)
Minimum Obs	-0.0049	0.0422	0.0103	0.0376	-0.0475	-0.1347
	(0.0272)	(0.0279)	(0.0448)	(0.0425)	(0.2052)	(1.0737)
Seminar	-0.0132	0.0039	-0.0324	-0.1018**	-0.0917	-0.1491
	(0.0220)	(0.0223)	(0.0226)	(0.0415)	(0.0778)	(0.2803)
Ed Psych		0.0557**		-0.0263		-0.1352
		(0.0281)		(0.0544)		(0.1772)
		0.0778**		0.1336*		0.2165***
Development		(0.0338)		(0.0701)		(0.0517)
Special Education		0.0873***		0.0009		-0.0418
		(0.0309)		(0.0299)		(0.0581)
Teaching ELLs		-0.0889**		0.0538		
		(0.0373)		(0.0471)		
Classroom Mgmt		-0.0060		0.1174***		0.0059
		(0.0318)		(0.0446)		(0.6538)
N	12115	12115	7502	7502	4652	4652

Second year teachers

Next, I turn to considering the effects of the structural features of teacher preparation programs for second year teachers. There are only 85 second year middle grades ELA teachers in this sample. In the HLM model (Table 18, model 3), pedagogy coursework is the only feature that is significantly associated with ELA achievement. A credit hour increase in the pedagogy requirement is associated with a 0.0035 (p=0.025) standard deviation increase in middle grades ELA achievement, on average, about a 0.01 standard deviation increase for an additional 3-hour course. The university fixed effects model supports this[9]: pedagogy (β=0.0144, p=0.052) is positively associated with achievement.

[9] There are only 29 second year teachers teaching in the same school as another second year teacher. As such, school fixed effects models lack sufficient within-school variation to estimate this model.

In the HLM model (model 4) that examines the effects of specific classes on student achievement for second year teachers, courses in development and classroom management are positively associated with student achievement. Having a required course in development is associated with 0.1336 (p=0.057) standard deviations higher achievement in middle grades ELA, on average, and classroom management predicts 0.1174 (p=0.008) standard deviations higher achievement, on average.

Third to fifth year teachers

There are only 51 teachers in this sample teaching middle grades ELA in their third to fifth years of experience. In the HLM model (Table 18, model 5), a required other course is the only feature with a significant relationship to achievement, where requiring such a course is associated with 0.0741 (p=0.087) standard deviations lower achievement, on average. Examining the effects of specific classes, due to multicollinearity, I do not estimate a coefficient for teaching ELLs. The only other course that is significantly associated with ELA achievement is development, where such a course predicts 0.2165 (p=0.000) standard deviations higher achievement, on average.

In summary, while pedagogy and technology coursework are positively associated with middle grades ELA achievement in the HLM model, these results are not robust to other specifications. There is evidence from other samples of teachers at differing years of experiences that these findings hold: technology is positively associated with achievement for first year teachers, while pedagogy is positively associated with achievement for second year teachers. Additionally, a course in adolescent development has a strong positive relationship to ELA achievement for all teachers, as well as in each subsample. A course in special education also has a positive relationship to achievement for all teachers and the sample of first year teachers. The relationships of other features to achievement differ across years of experience. I now turn to answering my third research question for middle grades English/Language Arts.

Research Question 3: Relationships of structural features to middle grades ELA achievement for English Language Learners and special education students

Here, I turn to answering research question 3, which asks, do the effects of the structural features of teacher preparation programs on beginning teacher value-added in middle grade English/ Language Arts vary for English Language Learners (ELLs) and special education students? For both groups, I estimate the same models I estimated for all students, but on the relevant subsample of students.

English Language Learners

In the HLM specification, there are 147 teacher teaching 1006 English Language Learners (Table 19, model 1). Here, the only feature that is significantly associated with ELL achievement are required minimum observations. An additional required observation is associated with a 0.1071 (p=0.076) standard deviation increase in middle grades ELA achievement for ELLs. As to the relationships of specific required classes to ELL achievement: educational psychology, adolescent development, special education, classroom management, and importantly, teaching English Language Learners. Here, (Table 19, model 2), no specific course is significantly associated with ELL achievement in middle grades ELA. Of particular note, is that a course on teaching ELLs is not related to ELL achievement. These results are not robust to school or university fixed effects specifications. I now turn to examining relationships of these features for special education students.

Table 19: Effects of structural features on middle grades ELA achievement for English Language Learners and special education students

	(1)	(3)	(1)	(3)
	ELLs	ELLs with classes	Special Education	Special Education w/ classes
Foundations	0.0190	0.0227	0.0124	0.0042
	(0.0144)	(0.0215)	(0.0096)	(0.0149)
Subject Matter	0.0016	-0.0009	0.0151**	0.0155**
	(0.0050)	(0.0063)	(0.0061)	(0.0064)
Pedagogy	0.0003	-0.0003	0.0036	0.0038
	(0.0046)	(0.0072)	(0.0039)	(0.0049)
Technology	0.0166	-0.0059	0.0199	-0.0167
	(0.0234)	(0.0458)	(0.0161)	(0.0299)
Other	-0.0823	-0.0517	-0.0587	-0.0572
	(0.0541)	(0.0871)	(0.0620)	(0.0642)
Early Field Hours	-0.0002	0.0032	-0.0021	0.0046
	(0.0024)	(0.0036)	(0.0018)	(0.0031)
Weeks Full Time Teaching	-0.0117	-0.0084	-0.0122*	-0.0096
	(0.0088)	(0.0130)	(0.0073)	(0.0078)
Minimum Observations	0.1071*	0.1363	0.0378	0.0448
	(0.0604)	(0.0939)	(0.0465)	(0.0579)
Seminar	-0.0570	-0.1529**	0.0227	-0.0828
	(0.0490)	(0.0718)	(0.0496)	(0.0630)
Educational Psychology		-0.1171		-0.0901
		(0.0995)		(0.0598)
Development		-0.0162		0.0963
		(0.1300)		(0.0934)
Special Education		0.0510		0.0182
		(0.0794)		(0.0567)
Teaching ELLs		0.5337		0.1491
		(0.3284)		(0.1203)
Management		0.1491		0.1892***
		(0.1003)		(0.0716)
N	1006	1006	2193	2193

Special education students

In the HLM specification (Table 19, model 3), subject matter is the only feature of teacher preparation with a significant relationship to middle grades ELA achievement for special education students. A one credit hour increase in subject matter requirements is associated with a 0.0151 (p=0.013) standard deviation increase in achievement, on average. Additionally, a course in classroom management is related to ELA achievement for special education students: requiring such a course is associated with 0.1892 (p=0.008) standard deviations higher achievement.

Relationships of structural features to middle grades ELA achievement vary between ELL students and special education students, and differ from results for all students. Required minimum observations during student teaching is the only significant predictor of achievement for ELLs, and no specific course is associated. For special education students, subject matter is positively related to achievement, while weeks of full time teaching and course in classroom management are positively related. None of these features are related to achievement for the full sample of students. Similar to results for English Language Learners, these results are not robust to school or university fixed effects specifications. Having answered my research questions for middle grades English/ Language Arts, I turn to high school English I.

High School English I

Research Question 1: Structural features of high school English I preparation

There are 209 teachers prepared in a UNC institution between 2007 and 2011 with complete data who are teaching English I between 2007-2008 and 2011-2012 in an NC public school. Table 20 provides descriptive statistics of the structural features these teachers have as requirements of their teacher preparation programs. Of these teachers, at the baccalaureate level, 172 are certified in English (9-12), 7 are certified in Middle Grades Language Arts (6-9), and 30 hold an MAT in English. There are 5 universities that prepared 20 or more of these teachers, 140 in total, and 13 universities contribute teachers to this sample.

On average, these teachers are required to take almost 33 hours of subject matter coursework, about 11 courses and similar to the typical requirements for a major in English. They are required to take just over 8 hours of foundations coursework, slightly less than 3 typical courses. As to specific foundations course requirements, 81% take a course in educational psychology, while only 50% take a course in adolescent development. They are required to take about ten credit hours of pedagogy coursework, just over 3 typical courses. Only 19% of these teachers are required to take a specific course in classroom management. Further, 43% are required to take a course in special education, but only 2% to take a course in teaching English Language Learners. They are required to take less than one credit hour of technology coursework, on average and only 27% are required to take an education course in a domain outside of the four I consider.

Turning to requirements for field experiences, these teachers are required to participate in about 96 hours of early fieldwork, but there is wide variation here (sd=69.62). The length of their average student teaching internship is 13.65 weeks, and they spend 6.48 weeks of this time with full time classroom teaching responsibility. They receive just shy of a minimum of 4 observations during student teaching, and 68% are required to take a professional seminar accompanying student teaching.

Table 20: Structural features of English I teachers

Feature	Mean	Standard Deviation	Range
Foundations	8.23	3.02	3, 13
Subject Matter	32.90	12.39	3, 48
Pedagogy	10.11	3.20	6, 21
Technology	0.80	1.19	0, 3

Other course	0.27	0.44	0, 1
Early field experience hours	96.28	69.62	0, 394
Weeks full time teaching experience	6.48	3.51	3, 15
Minimum observations	3.96	0.60	1, 6
Seminar	0.68	0.47	0, 1
Internship length	13.65	1.90	10, 16
Educational Psychology	0.81	0.39	0, 1
Adolescent development	0.50	0.50	0, 1
Special education	0.43	0.50	0, 1
Teaching ELLs	0.02	0.15	0, 1
Classroom management	0.19	0.39	0, 1

Research Question 2: Relationships of structural features of teacher preparation to beginning teacher English I value-added

Research question two asks how the structural features of teacher preparation are related to high school English I achievement. I estimate models using a 3-level HLM model where students are nested in classrooms, which are nested in schools, and a university fixed effects model where teachers are compared to other teachers prepared in the same university. I also estimate the HLM model on a number of samples: first, I consider all teachers teaching English I, then turn to teachers with varying years of experience. Additionally, for each sample, I estimate HLM models that allow for non-linearities in specific features and examine the effects of specific courses. There are not enough teachers teaching in the same school with other English I teachers to estimate school fixed effects models, as features lack sufficient within-school variation.

In the linear HLM specification examining the effects of structural features for all teachers teaching English I (Table 21, model 1), foundations coursework requirements and weeks of full time students teaching responsibility are the only features that significantly predict English I achievement[10]. A credit hour increase in the required amount of foundations coursework is associated with a 0.0065 (p=0.096) standard deviation decrease in achievement, on average, or a 0.0202 standard deviation decrease for a typical 3 credit hour course, while an additional week of full time student teaching responsibility is associated with a 0.0055 (p=0.084) standard deviation increase in English I achievement, on average. There is no evidence of non-linear relationships between foundations coursework and English I achievement, and the relationship neither feature to achievement is robust to fixed effects specifications.

Next I turn to examining the relationship between specific foundations and pedagogy coursework and English I achievement: educational psychology, adolescent development, special education, teaching English Language Learners, and classroom management. In the HLM specification that looks at how these courses are associated with English I achievement (Table 21, model 3), courses in special education, educational psychology, and classroom management are all associated with achievement: on average, the English I achievement of students whose teachers were required to take a course in special education is 0.0714 (p=0.026) standard deviations below the achievement of those whose teachers were not, while for educational psychology, requiring such a course is associated with 0.0798 (p=0.023) standard deviations lower achievement. Conversely, a required course in classroom management is associated with 0.0701 (p=0.046) standard deviations higher English I achievement, on average.

[10] These results are robust to a sample that excludes MAT teachers.

Table 21: Relationships of structural features of teacher preparation to English I achievement for all teachers

	(1)	(2)	(3)
	HLM	University FE	HLM with classes
Foundations	-0.0065*	-0.0084	0.0047
	(0.0039)	(0.0160)	(0.0080)
Subject Matter	0.0013	0.0134**	-0.0003
	(0.0019)	(0.0046)	(0.0022)
Pedagogy	-0.0020	0.0125	0.0002
	(0.0030)	(0.0083)	(0.0031)
Technology	-0.0046	0.0399	0.0093
	(0.0107)	(0.0384)	(0.0157)
Other	0.0089	0.2676	-0.0442
	(0.0264)	(0.1733)	(0.0332)
Early Field Hours	0.0030	0.0018	0.0042
	(0.0023)	(0.0057)	(0.0027)
Weeks Full Time Teaching	0.0055*	-0.0093	0.0090***
	(0.0032)	(0.0334)	(0.0032)
Minimum Observations	-0.0188	-0.0630	-0.0297*
	(0.0137)	(0.0413)	(0.0171)
Seminar	0.0080	-0.0084	-0.0084
	(0.0340)	(0.0160)	(0.0393)
Educational Psychology			-0.0798**
			(0.0351)
Development			-0.0091
			(0.0292)
Special Education			-0.0714**
			(0.0320)
Teaching ELLs			0.0535
			(0.0605)
Classroom Management			0.0701**
			(0.0352)
R-sq		0.6712	
N	22329	22329	22329

First year teachers

There are 155 English I teachers in their first year of teaching. In the HLM model examining the relationship of structural features of teacher preparation to value-added for these teachers (Table 22, model 1), weeks of full time teaching experience is the only structural feature that is significantly associated with English I achievement. An additional week of full time student teaching responsibility predicts a 0.0096 (p=0.083) standard deviation increase in English I achievement, on average[11]. I also investigate the relationship of specific courses to English I achievement. In the HLM model examining the effects of these courses for first year teachers (model 2), there is no evidence that any specific course is associated with achievement.

Table 22: Effects of structural features for English I teachers at varying levels of experience

	(1)	(2)	(3)	(4)	(5)	(6)
	1st year	1st year w/ classes	2nd year	2nd year w/ classes	3rd-5th year	3rd-5th year w/ classes
Foundations	-0.0010	-0.0029	-0.0153***	-0.0120	-0.0090	0.0244
	(0.0063)	(0.0130)	(0.0049)	(0.0109)	(0.0107)	(0.0177)
Subject Matter	0.0028	0.0009	0.0024	0.0036	0.0036	0.0032
	(0.0039)	(0.0038)	(0.0023)	(0.0027)	(0.0042)	(0.0074)
Pedagogy	0.0015	0.0017	-0.0074*	-0.0071	-0.0120	-0.0122
	(0.0054)	(0.0092)	(0.0039)	(0.0044)	(0.0081)	(0.0137)
Technology	-0.0228	-0.0166	-0.0223	0.0023	0.0321*	0.0636**
	(0.0172)	(0.0282)	(0.0145)	(0.0289)	(0.0173)	(0.0270)
Other	0.0671	0.0475	0.0410	-0.0094	-0.0783	-0.1594**
	(0.0461)	(0.0621)	(0.0374)	(0.0516)	(0.0635)	(0.0659)
Early Field Hours	0.0054	0.0098**	0.0089***	0.0080**	-0.0007	-0.0036
	(0.0038)	(0.0042)	(0.0031)	(0.0037)	(0.0062)	(0.0074)
Weeks Full Time Teaching	0.0096*	0.0102*	0.0122***	0.0137***	-0.0031	0.0073
	(0.0055)	(0.0062)	(0.0045)	(0.0046)	(0.0063)	(0.0101)
Minimum Observations	-0.0172	-0.0227	-0.0138	-0.0243	-0.0219	-0.0019
	(0.0249)	(0.0381)	(0.0309)	(0.0292)	(0.0206)	(0.0346)
Seminar	-0.0011	-0.0238	-0.0171	0.0182	0.1118*	0.1054
	(0.0605)	(0.0618)	(0.0412)	(0.0509)	(0.0641)	(0.1055)
Ed Psych		-0.0146		-0.0307		-0.1946**
		(0.0595)		(0.0489)		(0.0858)
Development		0.0192		0.0010		-0.0713
		(0.0773)		(0.0410)		(0.1305)

[11] There is insufficient within-university variation in this requirement to estimate its relationship to achievement in the university fixed effects model.

Special Education		-0.0828		-0.0744		-0.0588
		(0.0717)		(0.0466)		(0.1055)
Teaching ELLs		0.0798		-0.0044		
		(0.1038)		(0.0478)		
Classroom Mgmt		0.0843		-0.0171		0.1002
		(0.0761)		(0.0521)		(0.1101)
N	9512	9512	6841	6841	5976	5648

Second year teachers

Next I turn to examining the relationships of the structural features of teacher preparation to English I value-added for second year teachers. This is a sample of 99 teachers in the HLM model (Table 22, model 3). Here, a number of features are predictors of English I achievement. Increases in requirements for foundations and pedagogy coursework are negatively associated with achievement: a credit hour increase in required foundations coursework predicts a 0.0153 (p=0.002) standard deviation decrease in achievement, on average, while the same increase in pedagogy coursework requirements predicts a 0.0074 (p=0.058) standard deviation decrease. There is evidence that increases in pedagogy requirements are initially associated with decreased student achievement coursework (χ^2=5.94, p=0.0513), until 14.0 hours are reached, after which, additional credit hours predict increased achievement, on average.

As to fieldwork, early fieldwork hours and weeks of full time student teaching responsibility are both positive predictors as well: an additional ten hours of early fieldwork requirements is associated with a 0.0089 (p=0.004) standard deviation increase in English I achievement, while an additional week of full time teaching responsibility predicts a 0.0122 (p=0.007) standard deviation increase on average. For early field hours, the relationship to English I achievement is non-linear (χ^2=17.62, p=0.0001): it is positive until a maximum amount of hours is reached, after which diminishing returns set in. This inflection point is 175.7 hours.

Only some of these results are robust to other specifications: In the university fixed effects model[12], there is evidence that increased foundations coursework is negatively associated with student achievement. A credit hour increase in required foundations coursework predicts a 0.0309 (p=0.024) standard deviation decrease in achievement, on average, a larger estimate than its HLM counterparts. Additionally, consistent with the HLM model, an additional week of full time student teaching responsibility predicts a 0.0820 (p=0.010) standard deviation increase in English I achievement on average, here a smaller effect size. Finally, none of the specific courses that I examine has a significant relationship to English I achievement (model 4).

Third to fifth year teachers

Finally, I examine the relationship of structural features of teacher preparation to English I achievement for more experienced beginning teachers, 71 teachers teaching in their third to fifth years of experience. In the HLM model examining the effects of structural features for these English I teachers (Table 22, model 5), technology coursework requirements are significantly associated with English I achievement. A credit hour increase in technology requirements predicts a 0.0321 (p=0.064) standard deviation decrease in English I achievement. The only other significant predictor of achievement in this model is a professional seminar, where having a teacher with this requirement is associated with 0.1118 (p=0.081) standard deviations higher achievement on average, compared to students whose teachers did not have this requirement[13].

In the HLM model estimating the effect of specific courses on English I achievement (model 3), a course in teaching English Language Learners is omitted due to multicollinearity. Of the other courses, special education is the only significant predictor of English I achievement,

[12] I omit a professional seminar due to lack of within-university variation.
[13] I do not estimate a coefficient for a professional seminar in the university fixed effects model because of lack of within-university variation.

where having a required special education course is associated with 0.1946 (p=0.023) standard deviations lower achievement than those who do not have this course.

In summary, foundations coursework has a negative relationship to English I achievement, while weeks of full time student teaching responsibility has a positive relationship. Additionally, a course in educational psychology is negatively related to achievement, while a course in classroom management is positively related. However, none of these findings is robust to alternative specifications. The positive relationship of weeks of full time teaching responsibility is present in both first and second year teacher samples, while the negative relationship of foundations coursework to achievement is only present in the 2nd year teacher sample. Additionally, a course in educational psychology also has a negative relationship to achievement for 3rd to 5th year teachers. I now turn to estimating the relationships of structural features to English I achievement for specific subgroups of students.

Research Question 3: Relationships of Structural features of teacher preparation to English Language Learner and Special Education student English I achievement

Here I turn to answering my third research question, what are the relationships between the structural features of teacher preparation programs and achievement for English Language Learners (ELLs) and special education students? To answer this question, I estimate the same models as for research question two, but on the relevant subsamples of students. In HLM model, I investigate the effects of specific courses, as I did for all students in research question two. First, I consider the effects of structural features for English Language Learners, and then turn to special education students.

English Language Learners

In the HLM model that examines the relationships of structural features to English I achievement for English Language Learners (Table 23, model 1), 1321 students taught by 142 teachers, foundations coursework is the only feature that is related to ELL achievement: a credit hour increase in foundations requirements is associated with a 0.0347 (p=0.003) standard deviation decrease in achievement. Further, a non-linear HLM model shows that foundations coursework does have a non-linear relationship to English I achievement for ELL students (X^2=6.82, p=0.0330): foundations coursework has a negative relationship to achievement for ELLs until a minimum of 14.8 hours are required, after which point, additional requirements are associated with increased achievement.

In the HLM model estimating the effects of specific courses on ELL achievement (model 2), a course in educational psychology is the only specific course that is a significant predictor of English I achievement for ELL students. A required course in educational psychology is associated with 0.3780 (p=0.031) standard deviations lower achievement compared to ELL students whose teachers have not had this course. Of note, a course in teaching ELLs is not a significant predictor of ELL achievement.

Table 23: Structural features of teacher preparation and ELL English I achievement

	(1)	(2)	(3)	(4)
	ELLs	ELLs w/ classes	Special Education	Special Education w/ classes
Foundations	-0.0347***	0.0246	0.0081	-0.0093
	(0.0117)	(0.0318)	(0.0085)	(0.0157)
Subject Matter	-0.0013	-0.0073	-0.0001	-0.0017
	(0.0055)	(0.0068)	(0.0047)	(0.0049)
Pedagogy	-0.0017	0.0095	-0.0136*	-0.0007
	(0.0117)	(0.0135)	(0.0074)	(0.0068)

Technology	-0.0361	-0.0546	0.0303	-0.0088
	(0.0227)	(0.0336)	(0.0228)	(0.0298)
Other	0.0194	-0.0807	0.0261	0.0521
	(0.0774)	(0.1106)	(0.0539)	(0.0691)
Early Field Hours	0.0094	0.0005	-0.0024	0.0032
	(0.0067)	(0.0087)	(0.0043)	(0.0049)
Weeks Full Time Teaching	0.0050	0.0172	0.0124*	0.0085
	(0.0094)	(0.0121)	(0.0073)	(0.0076)
Minimum Observations	-0.0367	0.0045	0.0541	0.0096
	(0.0354)	(0.0561)	(0.0360)	(0.0427)
Seminar	0.0577	-0.0502	-0.0956	-0.1775*
	(0.1146)	(0.1506)	(0.0856)	(0.0945)
Educational Psychology		-0.3780**		0.0010
		(0.1580)		(0.0756)
Development		0.0422		0.2057***
		(0.1025)		(0.0704)
Special Education		0.0150		-0.0957
		(0.0839)		(0.0743)
Teaching ELLs		0.0576		-0.0039
		(0.1444)		(0.1792)
Management		0.1437		0.0317
		(0.1104)		(0.0751)
N	1321	1321	2110	2110

Special education students

Here I turn to examining the effects of the structural features of teacher preparation programs for special education students, 2110 students taught by 180 teachers. In the basic HLM model for special education students (Table 23, model 3), pedagogy coursework and weeks of full time student teaching responsibility are the only features that predict English I achievement for special education students. An additional required credit hour of pedagogy coursework is associated with 0.0136 (p=0.065) standard deviations lower achievement in English I for special education students, on average. Conversely, an additional week of full time student teaching responsibility is associated with a 0.0124 (p=0.088) standard deviation increase in achievement.

Examining the effects of specific courses in the HLM specification (model 3), a course in adolescent development is the only specific course that is significantly associated with English I achievement for special education students. For special education students, this course is associated with 0.2057 (p=0.003) standard deviations higher achievement, on average. Of importance, a course in special education is not associated with English I achievement for special education students.

In sum, few features of teacher preparation are associated with English I achievement for English Language Learners and special education students. Foundations coursework is negatively associated with achievement for ELLs, while pedagogy coursework is negatively associated with achievement for special education students. Like the full sample of students, a course in educational psychology is negatively associated with achievement for ELLs. Additionally, a course in development is positively associated with special education student English I achievement.

Summary

Research question one described the structural features of teacher preparation programs for mathematics and English/Language Arts at the middle and high school levels in North Carolina. Data demonstrate that requirements differ between baccalaureate and MAT programs, as well as between middle grades (6-9) and secondary (9-12) programs. Middle grades programs have greater requirements for foundations and pedagogy coursework, as well as early field experience hours, while secondary programs have greater requirements for subject matter coursework. For other features, patterns are less clear. I discuss these findings and their implications further in chapter 5.

Research question two examined the relationship between the structural features of teacher preparation programs and student achievement in middle grades mathematics, high school Algebra I, middle grades English/Language Arts, and high school English I, testing for non-linear relationships and examining the relationships of specific foundations and pedagogy courses to achievement. These results do not present an immediately clear picture of these relationships. Relationships of structural features to achievement vary between middle and high school and between subject areas and differ for teachers of different levels of experience. Again, I discuss these findings in greater detail in Chapter 5.

Finally, research question three asked about varying relationships of these structural features to achievement for two specific groups of students: English Language Learners and special education students. There is evidence of varying relationships for both groups of students, and some evidence that the features of teacher preparation have similar relationships to achievement for these students as for all students, particularly in high school subjects. Chapter 5 provides more detailed discussion of these findings, as well as implications of this study for teacher preparation programs and school leaders.

Chapter 5

DISCUSSION AND CONCLUSION

The purpose of this dissertation is to describe the structural features of teacher preparation programs for middle and high school teachers teaching math and English and to examine the relationship of these features to student achievement. Additionally, it seeks to understand the relationships of these features to achievement for two traditionally underserved groups of students: English Language Learners and special education students. As no state-level database exists documenting the requirements of these structural features, I add to the scant knowledge base detailing the relationship between teacher preparation programs and teacher effectiveness. In this chapter, I first summarize results for my three research questions, organized by subject area within each question. I then provide implications of these findings for teacher preparation programs and school leaders, and conclude with directions for future research.

Research Question 1

Requirements for features of Coursework

Research question one examines the structural features of teacher preparation programs for teachers recently certified in middle grades (6-9) and secondary (9-12) mathematics and English/Language Arts. In both subject areas at the baccalaureate level, secondary certified teachers have greater requirements for subject matter coursework than middle grades, about twice as many credit hours, on average. Similarly, math teachers teaching middle grades mathematics are required to take about 15 fewer credit hours of mathematics coursework than those teaching high school Algebra I. Those teaching middle grades English are required to take about 10 credit hours fewer English credit hours than those teaching high school English I.

As to pedagogy requirements, middle grades teachers are required to take more credit hours than secondary teachers at the baccalaureate level, about a 3 credit hour difference in math and 5 in ELA. At the high school level, baccalaureate and MAT teachers are required to take a similar number of pedagogy credit hours, but middle grades MAT students are required to take 4 more hours of pedagogy than middle grades baccalaureate teachers. No math teachers are required to take a course in teaching English Language Learners, and only 2% of ELA teachers have this requirement. In English, more middle grades teachers are required to take a course in special education than high school teachers, at both levels. However, in math, more baccalaureate teachers have this requirement than MAT teachers. In fact, only 4% of high school math MAT teachers are required to take such a course, while for no other type of certification do less than 40% have this requirement. For classroom management, it is middle grades MAT teachers who most often have this requirement, 41% of math teachers and 43% of English teachers. Interestingly, no MAT math program at the high school level requires such a course, while 31% of high school English MAT teachers have this requirement.

Middle grades MAT math teachers and all high school teachers are required to take about 7 credit hours of foundations coursework, while middle grades math teachers at the baccalaureate level take about 10 hours, essentially the addition of one extra foundations course. Overall, more math teachers than English teachers are required to take a course in adolescent development (68% vs. 59%). In both subjects, 76% of baccalaureate middle grades certified teachers have this requirement, while 62% of high school math teachers have it but only 46% of high school English teachers do. At the MAT level, only 36% of middle grades ELA teachers have this requirement, while 53% of middle grades math teachers do. Similarly, at the MAT level for high school certification, 83% of math teachers have an adolescent development requirement, but only 53% of English teachers do. Requirements across subjects and program levels for an educational psychology course similarly lack a pattern. At least 75% of teachers for each type of English certification have this requirement except for middle grades MAT teachers (50%). For math, 74% (baccalaureate) and 87% (MAT) of high school teachers have this requirement, while only 61% (baccalaureate) and 47% (MAT) of middle grades teachers do.

For technology requirements, very few MAT teachers are required to take a specific course in technology, and more middle grades teachers have a technology requirement than high school teachers, in math and English. More MAT teachers have a required "other" course than baccalaureate teachers. At the high school level, all MAT math teachers have such a course and 77% of MAT English teachers do. These "other" courses include action research, research methods, and teacher leadership courses, primarily. At the baccalaureate level, they may include a course to prepare students to take the Praxis I or on health and safety in schools.

Requirements for features of Fieldwork

Here I turn to features of fieldwork across types of certification and subjects. Middle grades baccalaureate teachers, in both math and ELA are required to participate in far more hours of early field experiences than any other type of certification, an average of about 200 hours for math and 155 for ELA. High school teachers at the baccalaureate level are required to participate in an average of 85 hours for math and 93 hours for English. Requirements are much lower in MAT programs. In fact, no middle grades ELA MAT students are required to participate in any early field experience hours. Middle grades math MAT teachers are required to participate in about 66 hours. At the high school level, math MAT teachers are required to participate in an average of 92 hours early field experience hours, 6 more hours than the average for high school math teachers at the baccalaureate level, while English MAT teachers are only required to participate in an average of 55 hours. There is wide variation in these requirements for every time of certification however, save the MAT in middle grades ELA.

While there are a few programs that require only 10 weeks of a student teaching internship, most internships are the length of the university semester between 14 and 16 weeks. For all types of certification, the average length of the internship is between 12 and 14.6 weeks, with middle grades mathematics teachers at the baccalaureate level having the longest average internship (14.57 weeks) and high school math MAT teachers having the shortest average internship (11.65 weeks). There is less variation in this duration across types of certification for ELA, where all averages fall between 12 and 14 weeks. There is greater variation in the length that full time student teacher responsibility for classroom teaching is required. In math, baccalaureate programs require, on average, about 6 weeks, while MAT programs require only 3-4 weeks. The same is true for English programs, except for high school baccalaureate teachers, where the average length of full time responsibility for student teaching is 7.5 weeks.

Required minimum observations by a university supervisor during the student teaching internship, together with cooperating teacher requirements, how field placements are determined for student teachers, who serves as university faculty (faculty, retired teachers and principals, or graduate students), and the number of student teachers supervisors are responsible for, were initially included as proxies for oversight of the student teaching experience. However, there is no variation in how programs place students in internships, or in requirements for cooperating teachers. Student teachers are allowed to rank districts in order of preference for their placement, but ultimately, program faculty and staff make these placements. Similarly, cooperating teachers are required to have a minimum of 3 years of teaching experience, the recommendation of their principal, be certified in the same subject and grade level area as a student teacher, and participate in a brief orientation. Additionally, university programs employ faculty, graduate students, and retired school leaders as supervisors of student teaching, and were unable to provide historical details for how many of each type were utilized. Similarly, some of these supervisors work part time, while others work full time. As such, programs had no set number of students assigned to a university supervisor. At best, university contacts were able to provide ranges of student interns that supervisors were responsible for. In light of this, minimum required observations by a university supervisor during student teaching is the only characteristic of oversight of student teaching I am able to provide descriptive statistics for and include in analytic models. Further, there is little variation in this requirement, as most programs require between 3 and 5 observations per student teacher and, across types of certification and subjects, teachers average about 4 observations.

The final feature of fieldwork is a seminar during the student teaching internship, meant to link theory from coursework to practice during student teaching. For both English and math, almost all of these teachers at the MAT level, both middle grades and high school, have a requirement for a seminar, between 93 and 96%. At the baccalaureate level, these percentages range from about 50% to 67%, with differences between subjects and high school and middle grades certification. In sum, looking across programs for different subjects, grade levels, and at different degree levels, there is little evidence of clear patterns in which requirements for coursework and fieldwork features of teacher preparation programs have developed in UNC system institutions.

Again, the Appendix provides sample programs of study for both subjects, at the middle and high school levels, for both MAT and baccalaureate programs. Having discussed the requirements of teacher preparation programs, I now focus on research question two, which examines how these structural features are associated with student achievement in middle and high school math and English tested subjects.

Research Question 2

Middle Grades mathematics

Evidence for the relationships of the structural features of teacher preparation programs to middle grades mathematics achievement for the full sample of teachers in their first five years of experience is mixed. Subject matter has a negative relationship to middle grades mathematics, with an effect size between -0.0041 and -0.0045 standard deviations for a credit hour increase in requirements. It is the only feature of coursework for which there is strong, consistent support for a relationship to middle grades mathematics achievement. While foundations coursework in the aggregate is unrelated to achievement, both foundations courses for which I examine specific relationships, educational psychology and adolescent development, are positively associated with math achievement.

Additionally, there is evidence of negative relationships between features of fieldwork and achievement. In the HLM model, early field experience hours are negatively related to math achievement, while the non-linear model shows that this negative relationship persists only until 253 hours are required. Above 253 required hours, early field experience hours are positively related to achievement. However, the mean early field hours requirement for middle grades math teachers is only 174 hours, so most teachers are not required to participate in enough hours for this requirement to be positively associated with achievement.

Required weeks of full time student teaching responsibility are also negatively associated with middle grades mathematics achievement, with an effect size of -0.0103 standard deviations for an additional week requirement. However, there are differences among universities in the prior achievement of students, even when controlling for the covariates I include in the HLM model. There are 2 universities whose teachers have students with higher middle grades prior achievement, compared to all other universities, and 2 universities whose teachers teach students with lower prior achievement in math. Compared to all other teachers, teachers from universities where students have lower prior achievement, on average, are required to assume full time responsibility for the classroom during student teaching for a longer period of time. This provides evidence of non-random assignment of students to teachers prepared in different universities, and evidence that bias arising from this sorting has not been sufficiently mitigated against, even with the inclusion of the covariates included in my models. As such, the negative relationship of weeks of full time student teaching responsibility to student achievement is likely biased and reflects an association between required weeks of full time responsibility for student teaching and student academic ability.

This evidence for the relationships between these structural features and achievement comes from the HLM specifications. In examining the school fixed effects and university fixed effects specifications, where teachers are compared to other teachers within the same school or to other teachers prepared in the same university, these relationships are not present. The exception is subject matter coursework, which has a negative relationship to achievement in the university fixed effects specification. This is the specification that should best reduce bias, as it eliminates much of the bias arising from the sorting of teachers into universities, while also controlling for aspects of school context and student characteristics that may also be associated with student achievement.

Varying years of experience

For teachers in their first year of experience, none of these relationships of coursework features to math achievement are apparent. Table 24 presents the significant relationships of features to student achievement for middle grades mathematics, across samples. The one exception is a course in educational psychology, which continues to have a positive relationship to achievement in this sample. However, for second year teachers, there is, again, evidence of the same relationships of features to middle grades math achievement. Subject matter is negatively associated with achievement but here, only human development is related to achievement, again, a strong positive relationship. As is the case in the full sample of teachers, both early field experience hours and weeks of full time student teaching responsibility are negatively associated with math achievement. Also similar to the full sample of teachers, while these relationships are apparent in the HLM models, there is no evidence of them in the university fixed effects model where teachers are compared to other teachers prepared in the same university.

Table 24: Significant relationships of structural features to student achievement for Middle Grades Mathematics

	All	1st year	2nd year	3rd-5th yr	ELL	Special Ed
Subject Matter	–		–	+		–
Technology				+		
Other				–		+
Early Field Hours	–		–	–		
Full Time Teaching	–		–	–		

Min Obs				–		
Seminar	+		+	–		
Ed Psych	+	+				
Development	+		+		+	
Special Ed					+	

For third to fifth year teachers, as Table 24 shows, the relationship of subject matter to achievement changes direction, and increased subject matter requirements are associated with increased achievement. Human development no longer has a significant relationship to achievement. For these teachers, the evidence of negative associations between features of fieldwork and achievement persist. Early field experience hours are negatively associated with achievement until 226 hours are required and a weeks of full time student teaching responsibility has an effect size of -0.0624 and -0.0780 standard deviations for an additional week of responsibility, a relationship that is present in both the HLM model and the university fixed effects model.

However, similar to the case of the full sample of teachers, students of third to fifth year teachers have lower prior achievement, on average, than students of first and second year teachers[14]. More of these more experienced teachers are required to take an "other" course and the relationship of such a course to middle grades mathematics achievement may indicate, again, that bias arising from the non-random assignment of students to teachers has not been mitigated against. That is, the negative relationship of a required "other" course to achievement reflects that more teachers who are required to take such a course have students with lower prior achievement, inducing the negative relationship of a required "other" course to achievement. The same story is true for a student teaching seminar: as more 3rd to 5th year teachers are required to

[14] When controlling for covariates included in the HLM model, being a 3rd to 5th year teacher is a significant predictor of prior achievement (β=-0.025) at the p=0.109 level.

take such a course, the negative relationship of such a seminar to achievement for 3rd to 5th year teachers is likely negatively biased from the non-random assignment of students to teachers and does not reflect the true relationship of a seminar to achievement.

Algebra I

Here, I turn to considering results across models for Algebra I. Unlike the sample of middle grades math teachers, in the full sample of high school Algebra I teachers, there are positive relationships of early field experience hours and weeks of full time responsibility for student teaching to Algebra I achievement, but like the middle school math sample, these are not apparent in either fixed effects models, though coefficients are in the same direction, of similar magnitude, and for early field experience hours, the university fixed effects coefficient approaches significance (p=0.149). Specific foundations courses, educational psychology and development, do not have a relationship to Algebra I achievement as they did to middle grades math achievement, nor do specific pedagogy courses. Additionally, a required "other" course has a positive association to Algebra I achievement, with a moderate effect size, 0.1053 standard deviations. This relationship is not consistent in fixed effects models, however.

Varying years of experience

For first year Algebra I teachers, the only consistent evidence of relationships of structural features to achievement are for a required "other" course and early field experience hours, where both are positively associated with achievement, as is the case for the full sample of teachers. Table 25 presents significant relationships of structural features to Algebra I student achievement across samples. Requiring an "other" course is associated with 0.1007 standard deviations higher achievement, an effect size similar to that for the full sample of teachers. For early field experience hours, the effect size is 0.0069 standard deviations for a ten-hour increase, slightly higher than the effect size in the full sample of teachers.

Table 25: significant relationships of structural features to Algebra I student achievement

	All	1st year	2nd year	3rd-5th yr	ELL	Special Ed
Pedagogy					+	
Technology			–			
Other	+	+		+	+	+
Early Field Hours	+	+		+		+
Full Time Teaching	+			+	+	+
Seminar				–		

In the sample of second year teachers, technology coursework is the only feature with evidence of a relationship to Algebra I achievement and none of the relationships that are evident in the full sample of teachers or for 1st and 3rd-5th year teachers are evident. Technology is negatively associated with achievement in basic HLM and university fixed effects models. Here, there is no evidence of effects of specific classes. For 3rd to 5th year teachers, the same positive relationships to achievement of a required "other" course, early field experience hours, and weeks of full time student teaching responsibility as in the full sample of Algebra I teachers are evident, but of stronger magnitude. However, for these more experienced teachers, there is no evidence of a relationship of any specific course to Algebra I achievement.

Results for teachers in their first and third to fifth years of experience are similar to each other and consistent with results for the full sample of Algebra I teachers as Table 25 displays, while results for second year teachers are quite different. These second year teachers have students with lower prior achievement than all other teachers. If the students of second year teachers have lower prior achievement than all other students and greater requirements for these features, the positive relationships of a required “other” course, early field experience hours, and weeks of full time teaching may not be sufficient to produce the same positive relationship to achievement for teachers of lower achieving Algebra I students. This is in fact the case for a required “other” course and early field experience hours. Further, these second year teachers are required to take more credit hours of technology coursework than teachers at other levels of experience, which may explain the negative relationship between technology coursework and middle grades math achievement for second year teachers that is not present for any other sample. The differences in relationships of structural features to achievement for second year teachers may be attributed to differences in achievement not appropriately controlled for by the covariates included in my model: second year teachers teach lower-achieving students and the relationships of structural features to achievement for these students may vary from relationships for other students.

Mathematics Summary

Based on these findings, relationships to achievement for mathematics vary across school level. For middle school mathematics teachers, courses in educational psychology and adolescent development are important for increased student achievement, while increased subject matter coursework requirements have are negatively associated with achievement. For high school Algebra I teachers, both a required “other” course, early field experience hours, and weeks of full time student teaching responsibility are positively associated with student achievement, across levels of experience. Pedagogy and foundations coursework in the aggregate do not appear to be related to math achievement at either level.

There are at least two possible explanations for why these two features of fieldwork have negative relationships to achievement for middle grades math, but positive relationships to achievement for high school Algebra I. Middle grades teachers are required to participate in almost twice as many early field experience hours as high school Algebra I teachers (174 vs. 102), and, in programs where teachers teach students with lower prior achievement, teachers are required to participate in more early field hours. As mentioned earlier, the coefficient on early field hours for middle grades math may be biased and not account for the non-random assignment of students to teachers. Further, because high school Algebra I teachers take fewer pedagogy courses than middle grades math teachers (13.90 vs. 11.95), it may be that these early field experiences are more important for high school teachers, possibly by providing pedagogical skills, in effect compensating for the differences in required pedagogy coursework.

High school Algebra I teachers are required to assume full time classroom responsibility during student teaching for about a week longer than middle grades math teachers. Like early field hours, it is possible that because high school teachers take fewer hours of pedagogy coursework than middle grades teachers, this full time teaching responsibility is more important for them. It is also possible that for middle grades math teachers, weeks of full time student teaching responsibility is endogenous- that programs have realized their teachers were struggling when they become teacher of record and to address this, programs have increased the required time student teachers must assume full time responsibility for the classroom, but have not increased the requirement sufficiently to have a positive effect on student achievement. If this is the case, it suggests that middle grades programs should increase weeks their teacher candidates are required to assume full time responsibility for the classroom during student teaching. However, I do not have sufficient longitudinal data to investigate this possibility.

Counter to previous work (Boyd et al., 2009), there is some evidence of similar relationships of features to achievement across years of experience. The exception to this is subject matter coursework for middle grades math teachers, which has no relationship to achievement for first year teachers, a negative relationship for second year teachers, and a positive relationship for 3^{rd} to 5^{th} year teachers, suggesting that it takes time and experience for the importance of subject matter coursework to manifest itself in student outcomes.

For features not mentioned here, pedagogy and minimum observations, together with courses in special education, and classroom management, there is little to no evidence of a relationship between each feature and mathematics achievement at any level.

From here, I turn to discussing findings from middle grades English/Language Arts and high school English I models.

Middle Grades ELA

Relationships of structural features to English/Language Arts achievement differ from relationships of structural features to mathematics achievement. In the sample of all middle grades English/Language Arts teachers, there are positive relationships of pedagogy and technology coursework to achievement. However, these relationships are not robust to fixed effects specifications. For the full sample of middle grades ELA teachers, courses in development and special education are also positively related to achievement, with effect sizes of 0.0603 and 0.0513, respectively. There is no evidence for significant relationships of other features to middle grades ELA achievement.

Varying years of experience

First year teachers are the only subsample of teachers for whom the positive relationship of technology coursework to achievement for all teachers persists. Table 26 presents significant relationships of structural features to Middle Grades ELA achievement for all samples. There is a positive relationship of a course in development to achievement for teachers at all years of experience, but the positive relationship of special education to achievement is again, only present for first year teachers. For these first year teachers, courses in educational psychology, special education, and adolescent development are positively associated with achievement, while teaching English Language Learners has a negative relationship. First year teachers are the only subsample of teachers where there is a negative relationship of a course in teaching ELLs to achievement. This suggests at least two possibilities: either that teachers for whom such a course is negatively related to achievement leave the sample or that there is reverse causation: programs realized teachers needed a course in teaching ELLs an added such a requirement, but this requirement is not sufficient to overcome the deficit for first year teachers. However as there is no evidence of this relationship for teachers with more experience, it may be that with time and experience as the teacher of record, teachers do learn enough overcome the deficit. If this is the case, the coefficient is endogenous and the data are not sufficient to determine the true relationship.

Table 26: Significant relationships of features to Middle Grades ELA achievement

	All	1st year	2nd year	3rd-5th yr	ELL	Special Ed
Subject Matter						+
Pedagogy	+		+			
Technology	+	+				
Other				–		

Full Time Teaching						–
Min Obs					+	
Ed Psych		+				
Development	+	+	+	+		
Special Ed	+					
Teaching ELLs		–				
Classroom Mgmt			+			+

In the sample of second year teachers, there is the only evidence of a relationship between classroom management and achievement. There are no differences between the prior achievement of students of second year teachers and students of teachers with other levels of achievement, nor are there differences between the number of second year teachers and teachers at other levels of experience who are required to take a course in classroom management. However, second year teachers do teach fewer black and Hispanic students, who, even controlling for prior achievement, have lower achievement than other students, on average. As such, the positive relationship of a course in management to middle grades ELA achievement could be another case of bias arising from the non-random assignment of students to teachers.

Additionally, where either foundations course, that is, educational psychology or development, has a significant positive relationship to student achievement, across years of experience as Table 26 illustrates, foundations courses in the aggregate have a negative relationship to achievement. This suggests that the negative relationship of other foundations courses in the aggregate, combined with the positive relationships of specific courses to achievement drown out an overall relationship of foundations courses to achievement when foundations coursework is only considered in the aggregate, without addressing the relationships of these specific courses.

English I

Unlike findings for middle grades ELA, foundations coursework has a negative relationship to achievement and weeks of full time student teaching responsibility has a positive relationship to English I achievement, but neither estimate is robust to the university fixed effects model. In the HLM model that includes specific foundations courses (adolescent development and educational psychology), there is no longer a significant relationship between foundations courses in the aggregate and English I achievement, but there is a negative relationship of a course in educational psychology to achievement. This indicates that the negative relationship of foundations coursework to English I achievement may be driven by the negative relationship of educational psychology to achievement. However, there is no clear explanation for a negative relationship of educational psychology to achievement: while there are differences among universities in the prior achievement of students assigned to teachers, all teachers from universities with students with higher prior achievement are required to take such a course, while only 71% of other teachers are. There are no universities where teachers have students with lower prior achievement, on average. Further, more high school teachers have such a requirement than middle grades teachers, reverse causation, where an educational psychology course was added to overcome perceived program shortfalls is not a plausible explanation.

Additionally, a course in special education has a negative relationship to English I achievement, while classroom management has a positive relationship. However, for neither course does this relationship exist at any traditional level of significance in any subsample of teachers at varying levels of experience. There is no evidence of a relationship of pedagogy coursework to achievement in the aggregate, nor is there in the model including specific pedagogy courses. However, as the coefficients on special education and classroom management are of similar magnitude, but in opposite directions, it is not clear how their inclusion impacts the relationship of other pedagogy coursework in the aggregate[15]. No other feature has a clear relationship to English I achievement.

Table 27: Significant relationships of structural features to high school English I achievement

	All	1st year	2nd year	3rd-5th yr	ELL	Special Ed
Foundations	–		–		–	
Pedagogy			–			–
Technology				+		
Early Field Hours			+			
Full Time Teaching	+	+	+			+
Seminar				+		
Ed Psych	–			–	–	
Development						+
Special Ed	–					
Classroom Mgmt	+					

Varying years of experience

In the sample of all first year teachers, the evidence of a negative relationship of foundations coursework to English I achievement is gone, and is evident only for second year teachers. Table 27 presents significant relationships of structural features to high school English I achievement for all samples. For both first and second teachers, as in the full sample of teachers, there is a positive relationship of weeks of full time student teaching to achievement and a stronger relationship for second year teachers, but this relationship disappears for 3rd to 5th year teachers. For 3rd to 5th year teachers, with the exception of special education, relationships diverge from first and second year teachers and from the full sample of teachers, which Table 27

[15] In addition I estimate models that include either a special education course OR a classroom management course, and find no relationship of pedagogy coursework in the aggregate to student achievement.

demonstrates. There is a strong negative relationship of a required course in educational psychology to English I achievement for these teachers, consistent with and stronger than the negative relationship in the full sample of teachers. However, for these teachers, positive relationships between technology coursework and a required seminar emerge that are not evident in any other sample of English I teachers. Teachers in their 3^{rd} to 5^{th} years of experience teach students with higher prior achievement than teachers in their first or second years of teaching[16] and teach fewer African-American students and more Hispanic and male students than other teachers. As both prior achievement and race/ethnicity are significant predictors of English I achievement, these differences in student sample composition may explain different results for 3^{rd} to 5^{th} year teachers, in that there may be differential relationships of structural features to student achievement at different levels of prior achievement, for different races/ethnicities, or for male students. Additionally, teachers for whom the relationships of structural features to achievement for all teachers hold may leave the sample by their 3^{rd} year or the experience teachers gain may change the relationships of features to achievement for more experienced teachers.

Summarizing English/ Language Arts

For English/ Language Arts, similar to math, relationships of features to achievement vary between middle grades and high school. For middle grades ELA, a course in special education is also positively associated with student achievement, while for high school English I teachers a course in special education has a negative relationship to achievement. This relationship at the high school level is not driven by differential assignment of special education

[16] Controlling for the covariates included in the HLM model, being a 3^{rd} to 5^{th} year approaches a statistically significant relationship to prior achievement, p=0.137.

students to teachers at the high school level; in fact, teachers who are required to take a special education course teach significantly fewer special education students than those not required to take such a course. At neither level does this relationship persist in subsamples of teachers with varying years of experience at any traditional level of significance. However, it is possible that the negative relationship for English I represents an endogenous additional course requirement: high school programs not requiring such a course may have recognized that their teachers had a deficit in this area and added a course in special education to their program of study. However, the addition of only one course may not have been sufficient to overcome the initial deficit, which may be what the negative coefficient on special education reflects. These data are not sufficient to eliminate this potential endogeneity.

Additionally, for high school English I teachers, similar to high school Algebra I teachers, weeks of full time student teaching responsibility are positively associated with achievement, while there is no relationship of features of fieldwork to achievement for middle grades teachers. For high school English I teachers, foundations coursework is negatively related to achievement, although, as discussed earlier, this relationship may be driven by the negative relationship of a course in educational psychology to English I achievement. As to middle grades ELA teachers, technology and a course in human development are positively associated with student achievement. These are the only features with clear relationships to ELA achievement for all teachers. Similar to mathematics teachers, the relationships of features to achievement change with teachers' levels of experience. For features not mentioned above, there is little to no evidence of a relationship between any of these features and ELA achievement.

Cross-subject comparisons

Comparing and contrasting English/Language Arts findings with mathematics findings, there is more common ground in the features of teacher preparation for which there is little evidence of a relationship to achievement across subjects than for features that have the same relationship for both subjects: the evidence does not support a relationship in either subject of minimum observations during student teaching or a student teaching seminar to mathematics or English Language Arts achievement. The intention of university supervisor observations of student teaching is to provide oversight of student teaching, through observation of and feedback on teaching practice, but research has long suggested that supervisors may not be adequately prepared for such roles (Borko & Mayfield, 1995, Smith, 1990). A lack of evidence for a relationship between increased observations and student achievement suggests that this may still be the case, that programs may need to provide more training to university supervisors in providing specific feedback and coaching for student teachers. Similarly, as there is no evidence of a relationship between a student teaching seminar and student achievement, programs should reconsider the content of this seminar. While they do accompany student teaching, many seminars also include opportunities for student teachers to prepare portfolios for use during interviews and practice interviewing skills. Instead, it may be more beneficial for programs to amend this curriculum to include more opportunities for student teachers to address problems arising during their internships or to explicitly connect theory from classwork to experiences in the classroom.

As to features for which there is evidence of a relationship, subject matter has a negative relationship to middle grades mathematics achievement but no relationship to student achievement for any other subject. There is evidence that this relationship becomes positive for middle grades math achievement as teacher experience increases, but middle grades math is the only subject for which there is evidence of a relationship of required subject matter coursework to achievement.

Foundations courses in educational psychology and human development are positively associated with achievement at the middle grades level, but not in high school, suggesting that these courses are more important for early adolescent, middle grades students than for high school students. Why there is a negative relationship of educational psychology to English I achievement, when there are positive relationships for both middle school subjects and no relationship for Algebra I is difficult to explain. While there are differences in the prior achievement of students of teachers prepared in different universities, all programs where teachers have students with *higher* achievement require a course in educational psychology, while only 71% of teachers whose students have lower achievement are required to take such a course, suggesting this is not a case of unmitigated bias. As the majority of high school programs require a course in educational psychology, there is nothing to suggest that programs have added a this course to overcome a perceived deficit, but that one course is insufficient to do that. As such, it appears that the content of a course in educational psychology is harmful for student achievement.

Weeks of full time student teaching responsibility are positively associated with achievement at the high school level, but at the middle grades level there is a negative relationship for mathematics and no relationship for ELA. The negative relationship for middle grades math may negatively biased and driven by an negative association between required weeks of full time student teaching and prior academic achievement of students assigned to teachers. Further, as discussed earlier, because high school programs, in both math and ELA, require fewer early field experience hours and pedagogy coursework hours than middle grades programs, weeks of full time teaching experience may be more important for achievement at the high school level. Similarly, there is evidence of relationships of early fieldwork hours to mathematics achievement, but not to ELA achievement. For mathematics, this relationship is negative for middle grades math teachers, but positive for Algebra I, and the same possible explanations for these relationships apply as for weeks of full time student teaching responsibility. As such, there is evidence that field experiences are more important for student achievement at the high school level where there are fewer requirements for pedagogy coursework and opportunities for "on the job" learning may be more important.

Similar to the findings of Boyd et al., 2009, the relationships of structural features to student achievement vary across subject matters and years of teacher experience, with no clear patterns cutting across them. I now turn to discussing findings for my final research question, question three.

Research Question 3

Research question 3 asks about the relationships of structural features of teacher preparation programs to achievement for English Language Learners and special education students. I first address English Language Learners.

English Language Learners

For English Language Learners in middle school mathematics, there is evidence for positive relationships of courses in human development and special education to ELL achievement, but for no other features. The relationship of development to achievement is present in the full sample of middle grades mathematics students, but a course in special education is only associated with middle grades math achievement for ELL students. For high school Algebra I, a required “other” course and weeks of full time student teaching are positively associated with achievement for ELLs, but no specific courses are. These findings are consistent with findings for the full sample of Algebra I students.

For middle grades ELA, the only feature, including specific courses, that is related to achievement for ELL students is required minimum observations during student teaching, a feature that is unrelated to achievement in the full sample of students for any subject. Foundations coursework is negatively related to ELL achievement in English I, which may be driven by the strong negative relationship of a course in educational psychology to ELL achievement. These are the same relationships of features to achievement for all English I students.

No clear pattern emerges across school levels and subjects about the relationships of structural features of teacher preparation programs to achievement for English Language Learners. For high school subjects, relationships of features to achievement for ELL students are similar to relationships of features to achievement for all students. At the middle school level, few features of teacher preparation appear to be related to achievement for English Language Learners, even where there is a relationship for all students. Of particular interest is that there no relationship between a course in teaching ELLs and ELL achievement in middle or high school English/Language Arts, while no math teachers are required to take such a course.

Special Education Students

For special education students, subject matter coursework has a negative relationship to middle grades mathematics achievement, as it does for the full sample of students. For special education students, there is a positive relationship between a required “other” course and achievement that does not exist for all students. There are no associations between specific foundations courses and special education student achievement, however, as there are for all students. For Algebra I, the same positive relationships of a required “other” course, early field hours, and weeks of full time student teaching responsibility to achievement that are evident for all students emerge for special education students as well, at stronger magnitude.

For middle school ELA, relationships of features to achievement are different for special education students than for all students. Pedagogy and technology coursework are positively associated with ELA achievement for all students, but have no relationship to achievement for special education students. Instead, subject matter requirements have a positive relationship to middle grades ELA achievement for special education students, while weeks of full time student teaching have a negative relationship. There are some similar relationships of features to high school English I achievement for special education students as for all students: foundations coursework is negatively associated with achievement for both samples. While educational psychology had a negative relationship to achievement for all students, for special education students, there is a strong positive relationship of a course in human development to achievement. Additionally, there is a negative relationship of a course in special education for all students, but no relationship at all to achievement for special education students.

Similar to the relationships of structural features to achievement for ELLs, there is no clear picture of relationships between these features and special education student achievement, across subject and school levels. There is evidence at the high school level that relationships of features to achievement for special education students are similar to what they are for all students. In particular, there is no evidence that a course in special education is important for special education student achievement in either subject at either school level.

Implications

Implications for teacher preparation programs

This dissertation has multiple implications for teacher preparation programs, school leaders making human capital decisions, and future research. The clearest are the importance of a course in human development for middle grades achievement, in both mathematics and English/Language Arts programs and the importance of weeks of full time student teaching responsibility for student achievement in both subjects at the high school level. Based on these findings, universities should consider requiring a course human development in any middle grades education preparation program and high school preparation programs should maximize the number of weeks in the student teaching semester they require teacher candidates to assume full time responsibility for the classroom during student teaching.

However, as there are few clear patterns across subjects and grade levels, specific implications for subject matter, foundations, or pedagogy coursework are less evident. That subject matter is not positively associated with achievement, and appears negatively related to middle grades math achievement is not wholly consistent with prior research, but teachers in this sample are required to take greater amounts of subject matter coursework than the point in prior research at which increased subject matter courses are associated with strong achievement gains (Monk, 1994). In fact, in this study, the minimum required number of subject matter credit hours (15) is equivalent to the point at which achievement gains begin to diminish (5 courses). Further, there is some evidence that as teachers gain experience in middle grades mathematics, subject matter does begin to have a positive relationship to achievement. This is consistent with the idea that beginning teachers must first learn to manage their classrooms and master the basics of pedagogy before subject matter knowledge can emerge as important to the achievement of their students.

That there is not clear evidence of a relationship of foundations and pedagogy coursework to achievement does not mean, however, that they are not important for teacher preparation: each program does require at least 3 hours of foundations coursework and at least 6 hours of pedagogy coursework. Thus, we cannot infer that foundations and pedagogy coursework do not matter for student achievement since it is possible that the variation in requirements for pedagogy and foundations coursework is not sufficient for a co-variation to register.

When allocating coursework across domains in a teacher preparation degree program, programs are faced with a zero sum game. Particularly at the baccalaureate level, most are constrained by university requirements in the number of credit hours they can require for an education major. Thus, to add a requirement for a particular course like human development, another course must be cut. If programs are requiring specific courses that are unrelated or negatively related to achievement, these courses may be crowding out other courses like educational psychology or additional courses in special education that may be positively associated with student achievement.

While these findings do not offer great insight into what areas might be cut, technology is one domain of coursework with little consistent evidence of a relationship to achievement. This, together with the ubiquity of technology in classrooms and students' lives suggests that a requirement for a specific course in technology could be eliminated and content pertaining to the use of technology in the classroom integrated throughout other coursework, consistent with the idea of technological pedagogical content knowledge (CAEP, 2013; Mishra & Koehler, 2006).

Further, with the exception of English I, when including specific foundations courses in these models, the relationship of other foundations coursework in the aggregate has a negative relationship to achievement. This suggests that foundations coursework, other than courses in educational psychology and adolescent development may be credit hours that could be re-allocated to other areas where there is a relationship to achievement. Before suggesting that particular courses should be cut from the professional education curriculum, however, the content and quality of those courses should be addressed. Cutting courses that are unrelated to achievement like the sociology of education or multicultural education may seem reasonable, but may also be related to other important outcomes. These courses are intended to provide prospective teachers with multiple conceptions of teaching, an understanding of the role of schooling in education, help them develop cultural sensitivity, and understand their students' backgrounds (Dotts, 2013; Milner, 2010; Tozer & McAninch, 1986). While they may not be directly related to student achievement, such courses may be related to teachers' attitudes towards and treatment of their students or may be related to teacher retention, particularly in schools with students from a diversity of backgrounds. Additionally, there is some variation in the credit hours programs assign to the student teaching internship, between 6 and 15 credit hours. Yet, most student teaching is a semester long, regardless of the credit hours assigned. Programs could reduce the number of hours associated with student teaching and reassign these hours. However, other than the addition of an adolescent development course in middle grades programs, this analysis does not provide specific indications of where these credit hours should be reassigned.

The majority of these findings, particularly with regard to the relationships of specific classes to achievement for different groups of students, and inconsistent findings for domains of coursework like pedagogy and foundations coursework suggest that further research is necessary into what specific courses are offered and what the content and quality of these courses is. There is no evidence that courses in teaching ELLs and special education are related to the achievement of the particular groups of students for which they purpose to prepare teachers to teach. However, given two elements of the current school contexts, that special education policy favors inclusion of special education students in mainstream courses and most special education students spend over half of their school day in a mainstream classroom and that the number of English Language Learners is rapidly increasing, particularly in North Carolina, general classroom teachers at the secondary level will, most likely, be teaching special education and English Language Learner students and must have the skills and abilities necessary to effectively teach them.

As such, programs should investigate whether or not it is the case that teachers prepared in middle and high school English programs are, in fact, struggling with teaching special education student and English Language Learners and where the deficits in their training lie. If this is the case and English programs at the high school level have added special education courses or middle school ELA programs have added a course in teaching ELLs in response to deficits in their teacher candidates' training, but the addition of one course has not been sufficient to overcome these shortfalls, teacher preparation programs must investigate the quality of these courses and the content that they cover, to ensure that they are in fact aligned with the vast current research base on best practices for teaching these populations of students. Future research with additional longitudinal data as to the timing of changes in the requirements of teacher preparation programs should investigate whether this is in fact the case. However, if this is not the case, given the number of general education students who are performing below grade level, while there is no empirical evidence, it stands to reason that additional pedagogical coursework on teaching these two populations of students would benefit other students who are struggling learners, particularly in cases where general education high school students may be performing far below grade level. As such, programs should consider integrating coursework on teaching special education students and ELLs into other pedagogy coursework.

The professional seminar is another area where its quality should be probed. In theory, such a link between theory and practice is key for beginning teacher learning and effectiveness in the classroom. However, there is little evidence that such a seminar is related to student achievement. While these seminars are meant to be a setting where students can discuss problems of practice that arise during student teaching, getting advice from supervisors and peers, and make important links between the theory they have learned during coursework and their actual teaching practice, they may instead be used to create portfolios for use in seeking a job, or to practice interviewing skills, neither of which would we expect to be related to student achievement.

As there is evidence of the importance of early field experience hours and weeks of full time student teaching responsibility for student achievement, programs should consider increasing these requirements, particularly for MAT programs, where weeks of full time student teaching responsibility, on average, is half the length it is for baccalaureate programs, and far fewer early field experience hours are required. Unfortunately, because of data constraints I have not been able to establish the relationship of the length of student teaching to student achievement. However, while prior research has not examined the relationship between the length of student teaching and achievement, it does suggest that the quality, rather than the quantity, of student teaching is important for student teachers' feelings of preparedness, efficacy, and plans to remain in teaching (Ronfeldt, Reininger, & Kwok, 2013; Ronfeldt & Reininger, 2012)

Minimum observations, for which there is no evidence of a relationship to achievement, is a proxy for university supervision of student teaching, albeit a weak proxy. Unfortunately, as there was no variation in the other variables through which I intended to measure university supervision, but for which there is theoretical support as to their importance for the student teaching experience, it is both difficult to conclude that university supervision of student teaching is not important for student achievement and to determine what attributes of student teaching are most beneficial to student achievement. Teacher preparation programs use faculty, graduate students who may be former teachers, and retired teachers and principals as supervisors for student teaching. These university supervisors may lack training and experience in observing student teachers and providing meaningful feedback to help them improve their practice. Thus, programs should consider training university supervisors as coaches, to enable them to provide actionable feedback to student teachers, in order to improve their classroom practice. Additionally, the mean number of university supervisor observations student teachers receive is less than 4. Over the course of a semester, this is less than one observation a month. As such, student teachers may benefit from more frequent observations and subsequent feedback in order for observations to impact their classroom practice, and ultimately, student achievement gains.

Alternative Drivers of Program Effectiveness

Based on my findings, I have provided some implications for teacher preparation programs, as they consider how to most effectively prepare new teachers. However, it is also possible that variation in structural features is not the source of variation in student achievement gains between teacher preparation programs. Instead, program success may be driven by the quality of program faculty, unmeasured selection effects, peer effects, or specific structural features that schools/colleges of education have combined in their preparation programs, among others. Just as there is variation in the quality of teachers within and across schools, there is variation in the quality of faculty within and across universities. Such variation in faculty quality could impact program effectiveness in multiple ways including the quality of courses that are taught, supervision of student teaching, the culture of the program as a whole, faculty willingness to innovate and experiment with ways of improving a program.

Additionally, teacher characteristics such as unmeasured selection effects or peer effects may be drivers of program effectiveness. While SAT score is not a significant predictor of student achievement gains in this study, other measures of teachers' cognitive ability such as GPA may be. Similarly, there may be non-cognitive traits that are related to teacher effectiveness, but such traits are rarely captured for a broad sample of teachers. However, there is growing empirical evidence that teacher characteristics such as conscientiousness, efficacy, perseverance, and organizational ability are positively associated with student achievement gains (Dobbie, 2011; Rockoff, et al, 2011; Bastian, 2013). These characteristics are among those that highly selective teacher preparation programs such as TFA include in their selection decisions and, theoretically, upon which the effectiveness of their teachers rests. Peer effects in teacher preparation programs are unstudied, but may contribute to the overall effectiveness of preparation programs if teacher candidates are particularly academically driven, or passionate about teaching a particular grade level of students, such traits may affect other students in the program, creating a culture of academic press or passion for middle school students, and thereby increase overall program effectiveness.

Finally, while marginal changes to the structural features of teacher preparation programs may have little relationship to student achievement gains, there may be specific structural features or preparation program practices, that, when bundled together, lead to more effective preparation programs. For instance, some programs require separate, stand-alone courses for their early field experience hours, while others integrate these early field experience requirements into foundations and pedagogy coursework. Program success may be driven in part not by the number of required early field experience hours, but by whether these early field experiences are integrated into coursework and connected to theory and how many courses require field experiences, or whether they stand alone and have little explicit connection to the theory of effective teaching.

Similarly, while there are not clear types of preparation programs in this study, there are multiple programs that require at least 9 foundations hours, including courses in educational psychology and adolescent development, at least 12 pedagogy hours, over 200 hours of early fieldwork experiences, and a student teaching seminar, while other programs require only 6 foundations hours, which do not necessarily include development and educational psychology, 6 pedagogy hours, fewer than 50 early field experience hours, and no student teaching seminar. If the first type of program is more effective than the second, it may be the combination, depth of, and interactions between experiences driving teacher effectiveness rather than variation in requirements for the discrete structural features. Thus, if the effects of teacher preparation programs are more than a simple sum of parts, rather than looking to make a single change in requirements for structural features that will have large impact on student achievement gains, it may be more useful for teacher preparation programs to consider implementing a series of changes including training university supervisors to provide coaching and feedback to student teachers, integrating field experiences into multiple foundations and pedagogy courses, and requiring a student teaching seminar that actually links theory from coursework to the practice of teaching. Such changes in programs of study must then be evaluated for their effects on both proximal outcomes like the EdTPA and distal outcomes like student achievement gains.

North Carolina is different from many states in that, instead of setting specific requirements in domains of coursework for teacher certification, it approves teacher preparation programs that then certify teachers in turn, giving teacher preparation programs more flexibility in program design than they may have in other states. As such, North Carolina schools and colleges of education have more room to innovate with their preparation programs and experiment with requirements for certification.

Implications for School Leaders and Human Capital Decisions

Given high rates of attrition, particularly among early career teachers (Ingersoll & Merrill, 2010; Henry, Bastian, & Smith, 2012), school leaders are increasingly less often able to hire new teachers and use their experience as a proxy for teacher quality. In North Carolina, in state, university-prepared teachers are significantly more likely to remain in teaching for five years, than teachers prepared through any other route, but less than 70% of these teachers remain for five years (Henry, Bastian, & Smith, 2012). For teachers prepared through any other route, fewer than 50% remain for five years. Extant research is largely silent on the role, if any, information about teacher preparation programs plays in human capital decisions. Principals serve as the “primary gatekeepers” (Rutledge, Harris, Thompson, & Ingle, 2008, p. 243) for hiring teachers and often view hiring as an important mechanism through which they can influence teacher effectiveness, but whether principals can identify effective teachers at the outset is unclear (Donaldson, 2013). Research suggests that principals rely on interviews, experience, credentials, recommendations, and teacher screening instruments such as the Haberman Prescreener to make human capital decisions (Engel, 2013; Rutledge, Harris, Thompson, & Ingele, 2008; Liu & Johnson, 2006). There is some weak support that teachers’ personalities and attitudes (e.g., conscientiousness and efficacy), measured by screening tests, predict teacher effectiveness, but little evidence that other information principals rely on such as certification and education does (Engel, 2013; Clotfelter, Ladd, & Vigdor, 2007; Kane, Rockoff, & Staiger, 2007; Goldhaber & Brewer, 2000; Rockoff, Jacob, Kane, & Staiger, 2011). College coursework, which includes teachers’ subject matter training, is not a tool principals use in making teachers hiring decisions, despite evidence that teachers with more subject matter training are on average more effective (Monk, 1994). While there may be some evidence that principals have begun to incorporate teacher effectiveness data into their hiring decisions, such data does not exist for new teachers (Baker & Cooper, 2005).

This dissertation provides little guidance for principals as to what features of teacher preparation programs for the brand new teachers they consider hiring they should pay attention to. Teachers from programs that require coursework in educational psychology and human development, particularly for middle school principals, and programs that require more early field experience hours and greater duration of full time teaching responsibility during student teaching at the high school level should be given preference, all things being equal.

Principals tend to hire teachers from universities they are familiar with, from universities that are similar to their own alma maters in terms of academic caliber, and from local universities (Baker & Cooper, 2005). Additionally, particularly in low-achieving schools, principals rely on district resources such as hiring fairs to find their teachers, rather than networking or looking externally for new teachers (Engel, Finch, & Huff, 2012). However, further research into what other aspects of teacher preparation programs such a faculty quality and peer effects, may be driving program effectiveness is necessary to better inform how principals make hiring decisions for beginning teachers so that principals are drawing their pool of new teacher candidates from the pool of most effective teachers, rather than the pool of low hanging fruit or the pool with which they are most familiar.

Implications for Future Research

Because it appears that relationships of structural features to achievement change over time as teachers gain experience and are influenced by the context of the schools where they work, examining the relationships between structural features and beginning teacher retention is an important next step for research into teacher preparation program effectiveness. Similarly, as only 58% of teacher education students become a teacher of record within 5 years of graduation (NCES, 2000, 2007), the relationship of the structural features of teacher preparation programs to employment as a teacher is another important next step. Further, as has been recommended for the last two decades, researchers must continue to dig deeper in understanding teacher preparation programs, including developing measures of faculty quality, broader measures of teachers' cognitive and non-cognitive characteristics, and evaluating the effectiveness of program innovations on both proximal and distal outcomes, including, but not limited to EdTPA and student achievement gains. As, to my knowledge, this is the only data that catalogs the structural features of teacher preparation programs at the state level, researchers must continue to gather this data, as well as other characteristics of teacher preparation programs and increase its scope beyond only public universities.

Transcript studies (e.g., Harris and Sass, 2011) provide another source of data to provide a deeper understanding of teacher preparation, with its own strengths and weaknesses. Transcript data provide information on the specific coursework teacher candidates take as part of teacher preparation and can provide greater depth of insight into their coursework preparation, but do not provide insight into the features of field experiences. For example, teacher candidates may take more credit hours in a particular domain than are required by their program of study or may request to opt out of a particular course requirement, which may in turn affect student achievement. If this is the case, linking transcript data to student achievement may present more valid associations between features of coursework and achievement and these deviations may provide more variation to exploit in estimating relationships.

At the same time, however, teacher candidates who deviate from the prescribed program of study may differ systematically from teachers who do not, and their students may as well. That is to say, using transcript data may induce bias into estimates of the relationships between coursework and student achievement if the characteristic that compels teacher candidates to deviate from the prescribed course of study is also correlated with student achievement, but not included as a covariate. Thus, analyses using programs of study are, in a loose sense, an instrumental variable approach, where the program requirement of credit hours in a specific domain of coursework serves as the instrument for the actual credit hours taken that transcript data provide.

Both are important lines of study. Analyses using programs of study are important because they provide information on features of fieldwork that transcripts studies do not include and because they may address bias arising from differences between students who do and do not deviate from the prescribed program of study. Comparing transcript studies and the coursework teacher candidates actually engage in to programs of study may also be informative, as patterns may emerge where the majority of students opt out of a particular course or take more hours than are required in a particular domain. If this is the case, transcript studies may provide more accurate relationships of the features of coursework to student achievement. Because of additional variation they may provide in how much coursework teacher candidates take, transcript studies may also be better suited for estimating the relationships of specific courses to student achievement than an analysis of programs of study are.

They must, as well, continue working to measure the quality of these structural features and assess how program features interact with each other to produce effective teachers. Given the variation in these 15 universities in terms of teacher candidate academic ability, demographic characteristics, and eventual school placement sites, it is a reasonable expectation that there is just as much variation in the quality of these programs and their structural features, both within and between universities as there is in teacher quality, both within and between schools. Other sources of data including syllabus review to determine the content of courses at greater depth than what is provided in course descriptions, university classroom observations, and interviews with both faculty and teacher candidates, all linked to student and teacher outcomes are key pieces of this work, with the goal of program improvement to better foster effective teachers.

APPENDIX A

Table A1: Sample courses and descriptions

Domain of coursework	Sample Course(s)	Course description(s)
Pedagogy	Principles and Methods of Teaching	Methods, strategies, materials, and techniques of clinical and classroom teaching.
	Teaching English/Language Arts in the Middle Grades	Curriculum design and methods of teaching language arts in grades 6-9.
Special Education	Exceptional Students in the Regular Classroom	Methods and strategies for the design and delivery of instructional programs for students with disabilities in the general curriculum
Classroom Management	Classroom Management	Roles and responsibilities of teacher in organizing and managing classroom setting. Approaches to handling discipline problems.
Teaching English Language Learners	Teaching English as a Second Language	Current trends/strategies in teaching English to nonnative speakers. Aspects of American culture that affect language learning.
Foundations	Introduction to American Education	Historical, philosophical, and sociological foundations of American education, including multiculturalism. Organizational, financial, and legal bases of education at federal, state, and local levels. Curricular purposes in American ladder of educational institutions. Teaching as profession. Current issues and trends.
	Historical, Social, and Philosophical Foundations of Education	Survey of historical, sociological, and philosophical aspects of education and current influences, including diversity and technology. Introduction to teacher education conceptual framework.
Educational Psychology	Educational Psychology	Psychological principles applied to educational settings, including learning, motivation, classroom management, and psychological assessment
Development	Adolescent Development: Problems and Achievements	Theories and principles of development and problems specific to adolescents from diverse backgrounds.

Technology	Technology in Education	Use of technology for professional and instructional use. Instructional design, video applications, and basic and expanded computer applications.
Other	The Teacher Leader	Students explore the changing roles that teachers have played in American schools, focusing on current formal and informal opportunities for leadership.
	Health and Safety Issues in Middle and Secondary Schools	Provides the pre-service teacher with the curricular content of health and safety in grades 6-12. Focuses on knowledge and behaviors conducive to health and safety.
Seminar	Seminar	Theory related to practice during student teaching or internship.

Table A2: T-tests of differences in sample characteristics between middle and high school licensure

	Middle grades license	High School license
Middle Grades Mathematics		
SAT	1108.14 (0.82)***	1139.75 (1.79)
Female teacher	0.793 (0.002)***	0.819 (0.005)
Prior teaching experience	0.856 (0.006) ***	1.039 (0.013)
Bachelors degree	0.920 (0.002)***	0.987 (0.002)
Remedial curriculum	0.006 (0.000)***	0.029 (0.002)
Advanced curriculum	0.219 (0.002)***	0.301 (0.006)
Class size	23.936 (0.028)***	22.719 (0.075)
Black (teacher)	0.142 (0.002)***	0.063 (0.003)
Asian (teacher)	0.011 (0.001)***	0
Hispanic (teacher)	0.023 (0.001)***	0
American Indian (teacher)	0.008 (0.001)***	0
Other race (teacher)	0.019 (0.001)***	0
School level % Asian	2.796 (0.025)***	3.109 (0.058)
School level % Black	25.125 (0.114)***	29.918 (0.264)
School level % Hispanic	11.221 (0.056)***	11.753 (0.119)
School level % multiracial	3.354 (0.010)***	3.948 (0.028)
School level % Am Indian	1.428 (0.040)***	0.358 (0.005)
School level % FRL	52.483 (0.117)***	51.380 (0.270)
Per pupil expenditure (/100)	79.01 (0.09)***	82.90 (0.25)
Male	0.496 (0.003)	0.505 (0.007)
Black	0.257 (0.003)***	0.314 (0.006)
Hispanic	0.116 (0.002)	0.117 (0.004)
Asian	0.026 (0.001)	0.025 (0.002)
Multiracial	0.033 (0.001)***	0.042 (0.003)
American Indian	0.014 (0.001)***	0.004 (0.001)

Free lunch	0.429 (0.003)***	0.400 (0.007)
Reduced lunch	0.073 (0.002)***	0.084 (0.004)
Was LEP	0.036 (0.001)	0.035 (0.002)
Is LEP	0.060 (0.001)*	0.066 (0.003)
Gifted	0.137 (0.002)***	0.151 (0.005)
Special Education	0.095 (0.002)***	0.125 (0.004)
Underage	0.011 (0.001)***	0.017 (0.002)
Overage	0.230 (0.002)***	0.259 (0.006)
Days absent	7.52 (0.04)**	7.75 (0.10)
Moved in year	0.049 (0.001)	0.053 (0.003)
Peer achievement	-0.047 (0.004)***	-0.088 (0.009)
Variation in peer ach.	0.614 (0.001)	0.616 (0.002)
Middle Grades ELA		
SAT	1087.72 (1.34)	1076.90 (2.93)
Female teacher	0.828 (0.033)	0.756 (0.068)
Prior teaching experience	0.522 (0.071)	0.512 (0.116)
Bachelor’s degree	0.896 (0.027)	0.829 (0.059)
Remedial curriculum	0.029 (0.001)***	0
Advanced curriculum	0.058 (0.002)***	0.046 (0.003)
Class size	23.86 (0.04)***	22.84 (0.06)
Black (teacher)	0.104 (0.027)	0.195 (0.063)
Asian (teacher)	0.007 (0.007)	0
Hispanic (teacher)	0.015 (0.011)	0
American Indian (teacher)	0	0
Other race (teacher)	0.030 (0.015)	0.024 (0.024)
School level % Asian	2.40 (0.02)***	2.85 (0.06)
School level % Black	26.84 (0.16)**	26.09 (0.29)
School level % Hispanic	10.40 (0.06)**	10.12 (0.10)
School level % multiracial	3.43 (0.01)***	3.87 (0.03)
School level % Am Indian	1.79 (0.06)***	4.69 (0.12)
School level % FRL	51.29 (0.15)***	58.86 (0.29)
Per pupil expenditure (/100)	80.14 (0.11)***	87.66 (0.22)
Male	0.498 (0.004)	0.491 (0.006)
Black	0.271 (0.003)	0.264 (0.006)
Hispanic	0.099 (0.002)	0.101 (0.004)
Asian	0.022 (0.001)	0.023 (0.002)
Multiracial	0.033 (0.001)***	0.040 (0.003)
American Indian	0.019 (0.001)***	0.047 (0.003)
Free lunch	0.395 (0.004)***	0.464 (0.006)
Reduced lunch	0.069 (0.002)**	0.076 (0.003)
Was LEP	0.033 (0.001)	0.030 (0.002)
Is LEP	0.041 (0.001)	0.044 (0.003)
Gifted	0.176 (0.003)***	0.149 (0.005)
Special Education	0.096 (0.002)***	0.072 (0.003)
Underage	0.010 (0.001)	0.008 (0.001)

Overage	0.218 (0.003)***	0.238 (0.005)
Days absent	7.40 (0.06)***	7.80 (0.11)
Moved in year	0.044 (0.002)***	0.053 (0.003)
Peer achievement	0.017 (0.005)***	-0.056 (0.008)
Variation in peer ach.	0.720 (0.001)***	0.736 (0.003)
High school Algebra I		
SAT	1140.0 (5.0)	1146.4 (0.9)
Female teacher	0.795 (0.010)***	0.719 (0.003)
Prior teaching experience	1.008 (0.025)***	0.850 (0.006)
Bachelors degree	0.822 (0.009)***	0.960 (0.001)
Remedial curriculum	0.011 (0.003)***	0.0246 (0.001)
Advanced curriculum	0.026 (0.004)***	0.008 (0.001)
Class size	19.55 (0.13)***	21.58 (0.04)
Black (teacher)	0.027 (0.004)***	0.096 (0.002)
Asian (teacher)	0	0.001 (0.000)
Hispanic (teacher)	0.085 (0.007)***	0.013 (0.001)
American Indian (teacher)	0***	0.006 (0.001)
Other race (teacher)	0***	0.018 (0.001)
School level % Asian	1.68 (0.04)***	2.58 (0.02)
School level % Black	31.56 (0.45)***	25.43 (0.11)
School level % Hispanic	9.43 (0.21)***	8.61 (0.04)
School level % multiracial	2.38 (0.03)***	2.86 (0.01)
School level % Am Indian	1.17 (0.05)	1.33 (0.04)
School level % FRL	54.54 (0.48)***	40.99 (0.12)
Per pupil expenditure (/100)	83.19 (0.30)***	81.31 (0.11)
Male	0.510 (0.012)	0.517 (0.003)
Black	0.333 (0.011)**	0.305 (0.003)
Hispanic	0.105 (0.007)	0.105 (0.002)
Asian	0.012 (0.003)	0.016 (0.001)
Multiracial	0.032 (0.004)	0.033 (0.001)
American Indian	0.011 (0.002)	0.013 (0.001)
Free lunch	0.534 (0.012)***	0.408 (0.003)
Reduced lunch	0.081 (0.007)	0.077 (0.002)
Was LEP	0.054 (0.005)***	0.036 (0.001)
Is LEP	0.070 (0.006)***	0.054 (0.001)
Gifted	0.044 (0.005)*	0.054 (0.001)
Special Education	0.100 (0.007)***	0.124 (0.002)
Underage	0.005 (0.002)**	0.010 (0.001)
Overage	0.342 (0.011)***	0.309 (0.003)
Days absent	9.03 (0.21)	8.88 (0.06)
Moved in year	0.052 (0.005)**	0.042 (0.001)
Peer achievement	-0.400 (0.010)***	-0.266 (0.003)
Variation in peer ach.	0.574 (0.003)***	0.629 (0.001)
High school English I		
SAT	1278.5 (0.5)***	1137.3 (0.1)

Female teacher	0.534 (0.014)***	0.838 (0.003)
Prior teaching experience	1.279 (0.033)***	0.925 (0.007)
Bachelors degree	1.0 (0.0)***	0.879 (0.002)
Remedial curriculum	0.085 (0.008)***	0.042 (0.001)
Advanced curriculum	0.316 (0.013)*	0.291 (0.003)
Class size	21.27 (0.13)	21.38 (0.04)
Black (teacher)	0.203 (0.012)***	0.102 (0.002)
Asian (teacher)	0***	0.025 (0.001)
Hispanic (teacher)	0.034 (0.005)***	0
American Indian (teacher)	0***	0.008 (0.001)
Other race (teacher)	0***	0.023 (0.001)
School level % Asian	5.56 (0.15)***	2.08 (0.02)
School level % Black	27.17 (1.00)	27.90 (0.14)
School level % Hispanic	6.23 (0.11)***	10.10 (0.05)
School level % multiracial	1.79 (0.04)***	2.87 (0.01)
School level % Am Indian	2.02 (0.09)***	1.02 (0.03)
School level % FRL	48.45 (0.38)***	41.42 (0.13)
Per pupil expenditure (/100)	79.13 (0.45)***	83.12 (0.14)
Male	0.524 (0.014)	0.516 (0.003)
Black	0.275 (0.013)	0.285 (0.003)
Hispanic	0.062 (0.007)***	0.120 (0.002)
Asian	0.046 (0.006)***	0.019 (0.001)
Multiracial	0.021 (0.004)**	0.031 (0.001)
American Indian	0.019 (0.003)**	0.012 (0.001)
Free lunch	0.458 (0.014)***	0.379 (0.003)
Reduced lunch	0.093 (0.008)***	0.069 (0.002)
Was LEP	0.035 (0.005)	0.041 (0.001)
Is LEP	0.053 (0.007)	0.060 (0.002)
Gifted	0.109 (0.009)***	0.143 (0.002)
Special Education	0.085 (0.008)	0.095 (0.002)
Underage	0.007 (0.002)	0.012 (0.001)
Overage	0.229 (0.012)***	0.276 (0.003)
Days absent	8.37 (0.29)	8.29 (0.06)
Moved in year	0.028 (0.005)***	0.047 (0.001)
Peer achievement	-0.141 (0.020)***	-0.074 (0.004)
Variation in peer ach.	0.592 (0.004)***	0.643 (0.001)

Table A3: Middle Grades mathematics, all teachers

	HLM	School FE	University FE	HLM w/ classes
Prior Achievement	0.6580***	0.6733***	0.6601***	0.6580***
	(0.0066)	(0.0117)	(0.0058)	(0.0066)
Foundations	-0.0045	-0.0307	0.0011	-0.0242***
	(0.0069)	(0.0315)	(0.0074)	(0.0084)

Subject Matter	-0.0041*	-0.0031	-0.0045***	-0.0069***
	(0.0023)	(0.0074)	(0.0014)	(0.0024)
Pedagogy	0.0007	-0.0040	-0.0168**	0.0050
	(0.0025)	(0.0097)	(0.0069)	(0.0042)
Technology	0.0040	0.0261	-0.0033	-0.0229
	(0.0118)	(0.0523)	(0.0049)	(0.0141)
Other course	0.0255	0.0001	-0.0075	0.0758*
	(0.0258)	(0.1033)	(0.0461)	(0.0460)
Early Field Hours	-0.0025**	-0.0018	0.0066	-0.0020
	(0.0010)	(0.0030)	(0.0041)	(0.0021)
Weeks Full Time Teaching	-0.0103**	-0.0121	-0.0067	-0.0177***
	(0.0042)	(0.0096)	(0.0049)	(0.0043)
Minimum Observations	-0.0183	0.0472	-0.5722**	0.0314
	(0.0315)	(0.0809)	(0.2219)	(0.0292)
Seminar	0.0491*	-0.0210		0.1601***
	(0.0297)	(0.1557)		(0.0455)
Male	-0.0139**	-0.0129	-0.0169***	-0.0139**
	(0.0058)	(0.0094)	(0.0040)	(0.0058)
Black	-0.0860***	-0.0694***	-0.0870***	-0.0861***
	(0.0091)	(0.0152)	(0.0103)	(0.0091)
Hispanic	-0.0182	-0.0343	-0.0131	-0.0183
	(0.0136)	(0.0222)	(0.0085)	(0.0137)
Asian	0.1006***	0.1395***	0.1015***	0.1007***
	(0.0216)	(0.0320)	(0.0200)	(0.0216)
Multiracial	-0.0400**	-0.0357	-0.0359*	-0.0401**
	(0.0163)	(0.0243)	(0.0179)	(0.0163)
American Indian	-0.0136	-0.0030	-0.0046	-0.0135
	(0.0280)	(0.0391)	(0.0206)	(0.0280)
Free Lunch	-0.0433***	-0.0456***	-0.0407***	-0.0432***
	(0.0074)	(0.0126)	(0.0099)	(0.0074)
Reduced Lunch	-0.0376***	-0.0363*	-0.0393**	-0.0381***
	(0.0102)	(0.0192)	(0.0164)	(0.0102)
Was LEP	0.0291*	0.0211	0.0349	0.0295*
	(0.0168)	(0.0241)	(0.0219)	(0.0168)
Is LEP	-0.0343**	-0.0447	-0.0370**	-0.0342**
	(0.0171)	(0.0314)	(0.0133)	(0.0171)
Gifted	0.1852***	0.1985***	0.1921***	0.1853***
	(0.0125)	(0.0235)	(0.0250)	(0.0125)
Special Education	-0.0889***	-0.1005***	-0.1008***	-0.0891***
	(0.0106)	(0.0169)	(0.0168)	(0.0106)
Grade	0.0181	0.0120	0.0251	0.0177

	(0.0130)	(0.0287)	(0.0160)	(0.0126)
Underage	0.0736***	0.0340	0.0788**	0.0729***
	(0.0234)	(0.0335)	(0.0271)	(0.0234)
Overage	-0.0795***	-0.0755***	-0.0855***	-0.0797***
	(0.0082)	(0.0149)	(0.0072)	(0.0082)
Days Absent	-0.0076***	-0.0069***	-0.0079***	-0.0076***
	(0.0005)	(0.0007)	(0.0006)	(0.0005)
Moved in year	-0.0832***	-0.0935***	-0.0887***	-0.0827***
	(0.0156)	(0.0239)	(0.0190)	(0.0156)
Variation in Peer Achievement	-0.0174	0.0552	-0.0291	-0.0171
	(0.0287)	(0.0504)	(0.0456)	(0.0285)
Peer Achievement	0.1313***	0.1198***	0.1346***	0.1313***
	(0.0109)	(0.0178)	(0.0156)	(0.0109)
School level % Asian	0.0015		-0.0011	0.0013
	(0.0024)		(0.0030)	(0.0024)
School level % black	-0.0001		-0.0000	-0.0003
	(0.0006)		(0.0011)	(0.0006)
School level % Hispanic	-0.0003		-0.0006	-0.0005
	(0.0010)		(0.0011)	(0.0010)
School level % multiracial	0.0012		0.0004	-0.0015
	(0.0048)		(0.0033)	(0.0047)
School level % American Indian	0.0019*		0.0026	0.0020*
	(0.0010)		(0.0028)	(0.0011)
School level % FRL	-0.0006		-0.0006	-0.0005
	(0.0006)		(0.0008)	(0.0006)
Per Pupil Expenditure	-0.0017***		-0.0010*	-0.0016***
	(0.0006)		(0.0005)	(0.0006)
Female teacher	0.0134	-0.0303	0.0199	0.0159
	(0.0240)	(0.0649)	(0.0154)	(0.0223)
Teaching experience	0.0451***	0.0385	0.0437***	0.0398***
	(0.0095)	(0.0245)	(0.0067)	(0.0094)
Bachelors degree	0.0515	0.1081	-0.2720*	0.1698**
	(0.0443)	(0.1517)	(0.1266)	(0.0661)
Remedial curriculum	-0.0148	0.0131	0.0203	-0.0176
	(0.0778)	(0.0472)	(0.0423)	(0.0769)
Advanced curriculum	0.0178	-0.0038	0.0130	0.0179
	(0.0158)	(0.0253)	(0.0108)	(0.0157)
Class size	-0.0022**	-0.0015	-0.0016	-0.0022*
	(0.0011)	(0.0020)	(0.0011)	(0.0011)
Black teacher	-0.0004	0.0645	-0.0445	-0.0025
	(0.0245)	(0.0632)	(0.0457)	(0.0244)

Asian teacher	-0.1539**	-0.3076*	-0.0624	-0.1487***
	(0.0605)	(0.1718)	(0.0701)	(0.0551)
Hispanic teacher	-0.0868	-0.3642**	0.1130***	-0.0969
	(0.1332)	(0.1652)	(0.0265)	(0.1306)
American Indian teacher	-0.2175***	-0.2596***	-0.5315**	-0.1640***
	(0.0436)	(0.0734)	(0.2176)	(0.0437)
Other race teacher	0.1435***	0.2298***	0.0595	0.1540***
	(0.0427)	(0.0606)	(0.0764)	(0.0460)
HS license	0.0345	-0.0039		0.0825*
	(0.0429)	(0.1381)		(0.0440)
Special Ed class				-0.0586
				(0.0480)
Educational psychology				0.1195***
				(0.0337)
Development				0.1397**
				(0.0712)
Classroom management				0.0268
				(0.0590)
Constant	0.3377*	0.2128	2.8286**	0.0825
	(0.2017)	(0.4902)	(1.0451)	(0.2011)
R-sq		0.6655	0.7177	
N	35180	15256	35180	35180
Standard errors in parentheses				
* p<0.10, ** p<0.05, *** p<0.01				

Table A4: Middle grades mathematics by level of experience

	(1)	(2)	(3)	(4)	(5)	(6)
	1st year teachers	1st year teachers w/ classes	2nd year teachers	2nd year teachers w/ classes	3rd-5th year teachers	3rd-5th year teachers w/ classes
Prior Ach	0.6559***	0.6558***	0.6822***	0.6822***	0.6360***	0.6358***
	(0.0090)	(0.0090)	(0.0124)	(0.0124)	(0.0131)	(0.0131)
Foundations	-0.0017	-0.0075	0.0048	-0.0318*	0.0180	0.0045
	(0.0096)	(0.0126)	(0.0137)	(0.0168)	(0.0128)	(0.0910)
Subject Matter	-0.0002	-0.0010	-0.0150***	-0.0093	0.0134*	0.0271
	(0.0033)	(0.0036)	(0.0053)	(0.0075)	(0.0078)	(0.0283)
Pedagogy	0.0016	0.0074	0.0039	-0.0034	-0.0017	0.0052
	(0.0026)	(0.0063)	(0.0043)	(0.0096)	(0.0064)	(0.0111)
Technology	-0.0020	-0.0169	-0.0328	-0.0237	0.0763***	0.0631
	(0.0151)	(0.0266)	(0.0270)	(0.0310)	(0.0257)	(0.0447)
Other course	0.0400	0.0703	0.0824	-0.1256	-0.1590**	-0.1200
	(0.0296)	(0.0596)	(0.0595)	(0.1757)	(0.0792)	(0.5578)

Early field hours	-0.0018	-0.0042	-0.0037**	0.0026	-0.0062**	0.0163
	(0.0012)	(0.0035)	(0.0017)	(0.0051)	(0.0025)	(0.0497)
Wks full time teaching	0.0017	-0.0037	-0.0308**	-0.0786***	-0.0624***	-0.1433***
	(0.0060)	(0.0063)	(0.0132)	(0.0283)	(0.0208)	(0.0307)
Minimum Obs	0.0259	0.0576*	-0.1129	-0.3518*	-0.4668**	-1.7517
	(0.0357)	(0.0337)	(0.1103)	(0.1878)	(0.2192)	(1.3808)
Seminar	0.0406	0.1685***	0.1765**	0.1230	-0.2765***	-0.4997
	(0.0379)	(0.0600)	(0.0866)	(0.1439)	(0.0960)	(1.1050)
Male	-0.0219***	-0.0219***	-0.0061	-0.0061	-0.0078	-0.0076
	(0.0084)	(0.0084)	(0.0107)	(0.0107)	(0.0109)	(0.0110)
Black	-0.0897***	-0.0897***	-0.0838***	-0.0839***	-0.0781***	-0.0782***
	(0.0120)	(0.0120)	(0.0187)	(0.0187)	(0.0203)	(0.0203)
Hispanic	-0.0316*	-0.0315*	0.0211	0.0214	-0.0310	-0.0314
	(0.0190)	(0.0191)	(0.0247)	(0.0247)	(0.0246)	(0.0247)
Asian	0.0837***	0.0841***	0.1659***	0.1670***	0.0683	0.0678
	(0.0231)	(0.0231)	(0.0406)	(0.0405)	(0.0471)	(0.0471)
Multiracial	-0.0215	-0.0216	-0.0490*	-0.0490*	-0.0709**	-0.0712**
	(0.0253)	(0.0254)	(0.0285)	(0.0285)	(0.0300)	(0.0299)
American Indian	-0.0226	-0.0225	-0.0156	-0.0154	0.0048	0.0049
	(0.0484)	(0.0484)	(0.0369)	(0.0370)	(0.0679)	(0.0679)
Free Lunch	-0.0483***	-0.0484***	-0.0390***	-0.0392***	-0.0377***	-0.0372**
	(0.0105)	(0.0105)	(0.0129)	(0.0129)	(0.0145)	(0.0145)
Reduced Lunch	-0.0366**	-0.0376***	-0.0127	-0.0130	-0.0696***	-0.0695***
	(0.0146)	(0.0145)	(0.0207)	(0.0207)	(0.0228)	(0.0229)
Was LEP	0.0597**	0.0601**	0.0019	0.0012	0.0002	0.0008
	(0.0251)	(0.0251)	(0.0338)	(0.0339)	(0.0292)	(0.0292)
Is LEP	0.0016	0.0016	-0.1045***	-0.1056***	-0.0170	-0.0175
	(0.0243)	(0.0243)	(0.0281)	(0.0281)	(0.0313)	(0.0312)
Gifted	0.1700***	0.1702***	0.1810***	0.1814***	0.2091***	0.2096***
	(0.0181)	(0.0181)	(0.0205)	(0.0207)	(0.0247)	(0.0246)
Special Education	-0.0980***	-0.0980***	-0.0739***	-0.0736***	-0.0873***	-0.0874***
	(0.0153)	(0.0153)	(0.0190)	(0.0191)	(0.0230)	(0.0230)
Grade	0.0211*	0.0225*	0.0177	0.0179	0.0260	0.0230
	(0.0128)	(0.0126)	(0.0225)	(0.0228)	(0.0281)	(0.0303)
Underage	0.0677**	0.0676**	0.1025**	0.1015**	0.0446	0.0444
	(0.0333)	(0.0333)	(0.0428)	(0.0429)	(0.0473)	(0.0472)
Overage	-0.0657***	-0.0657***	-0.0882***	-0.0880***	-0.0954***	-0.0955***
	(0.0118)	(0.0118)	(0.0145)	(0.0145)	(0.0167)	(0.0167)
Days Absent	-0.0076***	-0.0076***	-0.0070***	-0.0070***	-0.0080***	-0.0080***
	(0.0006)	(0.0006)	(0.0009)	(0.0009)	(0.0010)	(0.0010)
Moved in	-0.0725***	-0.0726***	-0.1097***	-0.1093***	-0.0784**	-0.0782**

year	(0.0219)	(0.0219)	(0.0294)	(0.0293)	(0.0328)	(0.0328)
Variation in Peer Ach	-0.0292	-0.0316	0.0051	0.0073	0.0250	0.0240
	(0.0408)	(0.0410)	(0.0549)	(0.0548)	(0.0587)	(0.0589)
Peer Ach	0.1263***	0.1260***	0.1184***	0.1189***	0.1593***	0.1581***
	(0.0150)	(0.0150)	(0.0203)	(0.0204)	(0.0215)	(0.0214)
School level % Asian	0.0038	0.0036	0.0056	0.0054	-0.0012	-0.0020
	(0.0027)	(0.0027)	(0.0050)	(0.0050)	(0.0034)	(0.0036)
School level % black	0.0002	0.0003	-0.0001	-0.0006	-0.0000	0.0001
	(0.0007)	(0.0007)	(0.0009)	(0.0009)	(0.0015)	(0.0015)
School level % Hispanic	0.0012	0.0011	-0.0019	-0.0024	-0.0042	-0.0054
	(0.0014)	(0.0014)	(0.0019)	(0.0018)	(0.0027)	(0.0033)
School level % multiracial	-0.0036	-0.0042	0.0076	0.0046	0.0075	0.0072
	(0.0067)	(0.0067)	(0.0095)	(0.0087)	(0.0074)	(0.0073)
School level % Am Indian	0.0011	0.0016	-0.0025	-0.0051	-0.0041	-0.0053
	(0.0022)	(0.0022)	(0.0034)	(0.0031)	(0.0034)	(0.0035)
School level % FRL	-0.0015*	-0.0017**	0.0002	0.0006	0.0012	0.0012
	(0.0008)	(0.0008)	(0.0012)	(0.0012)	(0.0016)	(0.0016)
Per Pupil Expenditure	-0.0015**	-0.0015**	-0.0031***	-0.0033***	-0.0010	-0.0011
	(0.0008)	(0.0008)	(0.0012)	(0.0011)	(0.0007)	(0.0008)
Female teacher	0.0154	0.0174	0.0558	0.0379	0.0654	0.0692
	(0.0285)	(0.0293)	(0.0370)	(0.0363)	(0.0418)	(0.0436)
Teaching experience					-0.0019	-0.0068
					(0.0289)	(0.0291)
Bachelors degree	0.0566	0.1742*	0.0626	-0.0451	0.0067	0.1280
	(0.0564)	(0.1025)	(0.0813)	(0.1604)	(0.0811)	(0.6717)
Remedial curriculum	-0.0896	-0.0874	0.1383**	0.1444**	-0.0818	-0.0562
	(0.1030)	(0.1096)	(0.0626)	(0.0699)	(0.0657)	(0.0698)
Advanced curriculum	0.0062	0.0067	0.0415	0.0432	-0.0084	-0.0083
	(0.0208)	(0.0208)	(0.0275)	(0.0277)	(0.0339)	(0.0338)
Class size	-0.0024	-0.0024	-0.0034	-0.0036	-0.0002	-0.0005
	(0.0015)	(0.0015)	(0.0029)	(0.0028)	(0.0023)	(0.0023)
Black teacher	-0.0055	-0.0020	-0.0197	-0.0165	-0.1202**	-0.1207*
	(0.0308)	(0.0316)	(0.0432)	(0.0438)	(0.0550)	(0.0657)
Asian teacher	-0.1585***	-0.1634***	0.1354**	0.1313**	0.0014	-0.0051
	(0.0168)	(0.0169)	(0.0640)	(0.0641)	(0.1078)	(0.1114)
Hispanic teacher	0.0490	0.0340	0.0294	0.0331	0.0825	0.0489
	(0.1790)	(0.1780)	(0.1117)	(0.1077)	(0.1480)	(0.1657)
Am Indian teacher	-0.0840	-0.0396	0.3729	0.6862**		
	(0.1139)	(0.1073)	(0.3367)	(0.3343)		

Other race teacher	0.1339***	0.1383***	0.1153	0.1225	0.1294**	0.1566**
	(0.0493)	(0.0525)	(0.0975)	(0.1143)	(0.0624)	(0.0693)
HS license	-0.0152	0.0157	0.2427*	0.1587	-0.2802**	-0.3579
	(0.0761)	(0.0833)	(0.1372)	(0.1470)	(0.1400)	(0.2317)
Special Ed class		-0.0740		-0.0818		-0.3806
		(0.0744)		(0.0850)		(0.4023)
Educational psychology		0.1119***		0.1132		-0.2145
		(0.0433)		(0.0861)		(1.3181)
Developme nt		0.0746		0.4414**		0.2643
		(0.1141)		(0.1937)		(0.1613)
Classroom Mgmt		-0.0612		-0.0102		0.8686
		(0.0833)		(0.1318)		(1.5465)
_cons	-0.0364	-0.3326	0.9698*	2.3277**	1.9456**	6.9106
	(0.2096)	(0.2386)	(0.5870)	(1.0500)	(0.8819)	(5.4526)
R-sq						
N	16486	16486	9992	9992	8702	8702
Standard errors in parentheses						
* p<0.10, ** p<0.05, *** p<0.01						

Table A5: Middle Grades math, Special Education students and English Language Learners

	ELLs	ELLs w/ classes	Special Education	Special Ed w/ classes
Prior Achievement	0.6482***	0.6508***	0.6522***	0.6521***
	(0.0188)	(0.0188)	(0.0156)	(0.0155)
Foundations	0.0199	-0.0020	-0.0133	-0.0228**
	(0.0158)	(0.0206)	(0.0099)	(0.0114)
Subject Matter	0.0025	-0.0007	-0.0092**	-0.0072*
	(0.0051)	(0.0060)	(0.0039)	(0.0042)
Pedagogy	-0.0024	-0.0279***	-0.0021	-0.0059
	(0.0039)	(0.0102)	(0.0035)	(0.0069)
Technology	-0.0292	-0.0925***	0.0044	0.0009
	(0.0246)	(0.0290)	(0.0166)	(0.0235)
Other course	-0.0400	-0.2114	0.0717**	-0.0061
	(0.0616)	(0.1342)	(0.0323)	(0.0763)
Early Field Hours	-0.0016	0.0059	-0.0020	0.0046
	(0.0016)	(0.0058)	(0.0015)	(0.0030)
Wks Full time teaching	-0.0100	-0.0290***	-0.0047	-0.0089
	(0.0115)	(0.0102)	(0.0058)	(0.0082)
Minimum Observations	-0.1059	-0.0375	-0.0312	-0.0553
	(0.1091)	(0.1182)	(0.0403)	(0.0439)
Seminar	-0.0028	0.0625	0.0355	-0.0485
	(0.0710)	(0.1363)	(0.0453)	(0.0755)

Male	-0.0191	-0.0219	-0.0101	-0.0109
	(0.0256)	(0.0255)	(0.0198)	(0.0197)
Black	-0.1236	-0.1345	-0.1237***	-0.1235***
	(0.1191)	(0.1203)	(0.0264)	(0.0266)
Hispanic	-0.2436***	-0.2508***	-0.0075	-0.0054
	(0.0715)	(0.0728)	(0.0465)	(0.0464)
Asian	-0.0503	-0.0502	0.2119**	0.2123**
	(0.0854)	(0.0857)	(0.0899)	(0.0901)
Multiracial	-0.0433	-0.0407	-0.0712	-0.0691
	(0.1625)	(0.1608)	(0.0499)	(0.0495)
American Indian	-0.3314	-0.3516	0.0399	0.0439
	(0.2564)	(0.2505)	(0.0716)	(0.0720)
Free lunch	-0.0207	-0.0172	0.0147	0.0150
	(0.0400)	(0.0405)	(0.0245)	(0.0246)
Reduced lunch	-0.0856	-0.0831	-0.0121	-0.0130
	(0.0569)	(0.0571)	(0.0371)	(0.0372)
Was LEP			-0.0251	-0.0267
			(0.0941)	(0.0943)
Is LEP			-0.1223**	-0.1260**
			(0.0515)	(0.0517)
Gifted	0.1522	0.1469	0.2165***	0.2180***
	(0.0955)	(0.0980)	(0.0593)	(0.0596)
Special Ed	-0.1031**	-0.1011**		
	(0.0413)	(0.0416)		
Underage	0.1035	0.0922	0.0750	0.0693
	(0.0725)	(0.0733)	(0.1228)	(0.1219)
Overage	-0.0378	-0.0443*	-0.0461**	-0.0475**
	(0.0261)	(0.0264)	(0.0201)	(0.0201)
Days absent	-0.0097***	-0.0100***	-0.0068***	-0.0067***
	(0.0016)	(0.0016)	(0.0012)	(0.0012)
Moved in year	-0.0708	-0.0717	-0.1096**	-0.1095**
	(0.0506)	(0.0502)	(0.0434)	(0.0435)
Peer achievement	0.1450***	0.1461***	0.1359***	0.1357***
	(0.0374)	(0.0377)	(0.0284)	(0.0285)
Variation in Peer Ach	-0.1505*	-0.1320	-0.1278*	-0.1214
	(0.0842)	(0.0839)	(0.0777)	(0.0778)
Female teacher	-0.0001	-0.0234	0.0173	0.0120
	(0.0462)	(0.0452)	(0.0315)	(0.0312)
Teaching experience	0.0140	0.0161	0.0437***	0.0425***
	(0.0173)	(0.0169)	(0.0156)	(0.0158)

Bachelors degree	0.0703	-0.2682	-0.0543	-0.1572
	(0.0940)	(0.2039)	(0.0691)	(0.1178)
Remedial curriculum	0.0870	0.0477	-0.1677	-0.1656
	(0.1047)	(0.1146)	(0.1122)	(0.1116)
Advanced curriculum	-0.0018	-0.0052	0.0962**	0.0961**
	(0.0497)	(0.0520)	(0.0404)	(0.0404)
Class size	0.0008	0.0022	-0.0063**	-0.0061**
	(0.0034)	(0.0035)	(0.0028)	(0.0028)
Black teacher	-0.0289	0.0116	-0.0436	-0.0197
	(0.0486)	(0.0534)	(0.0365)	(0.0382)
Asian teacher	-0.0677	-0.0402	-0.2678**	-0.2517**
	(0.0885)	(0.0902)	(0.1150)	(0.1126)
Hispanic teacher	-0.0637	-0.0871	0.1427	0.1330
	(0.1148)	(0.1164)	(0.1034)	(0.1014)
American Indian teacher	-0.2212	-0.1964	0.1248	0.1477
	(0.2301)	(0.2286)	(0.2459)	(0.2290)
Other race teacher	0.1609**	0.1222	0.0196	0.0244
	(0.0739)	(0.0819)	(0.0728)	(0.0752)
HS License	-0.0191	0.0121	0.1231	0.0984
	(0.1161)	(0.1196)	(0.0811)	(0.0860)
School level % Asian	0.0035	0.0028	0.0006	0.0004
	(0.0033)	(0.0034)	(0.0038)	(0.0038)
School level % black	0.0004	0.0009	0.0002	-0.0001
	(0.0013)	(0.0013)	(0.0009)	(0.0010)
School level % Hispanic	-0.0017	-0.0011	0.0018	0.0015
	(0.0019)	(0.0019)	(0.0015)	(0.0015)
School level % multiracial	-0.0019	-0.0049	0.0038	0.0036
	(0.0109)	(0.0107)	(0.0069)	(0.0070)
School level % Am Indian	0.0075*	0.0066	-0.0051	-0.0051
	(0.0042)	(0.0043)	(0.0032)	(0.0031)
School level % FRL	-0.0001	-0.0003	-0.0007	-0.0003
	(0.0015)	(0.0016)	(0.0010)	(0.0011)
Per pupil expenditure	0.0026**	0.0030**	-0.0012*	-0.0013*
	(0.0012)	(0.0012)	(0.0007)	(0.0007)
Educational psychology		0.1487		-0.0595
		(0.1117)		(0.0580)
Development		0.4501***		0.1401
		(0.1582)		(0.1053)
Special Ed class		0.2456***		-0.0163
		(0.0922)		(0.0697)
Classroom		-0.2172		0.1200

management		(0.1418)		(0.0880)
_cons	0.0659	-0.1688	0.1862	0.3010
	(0.2187)	(0.3448)	(0.1466)	(0.1861)
N	2142	2142	3512	3512
Standard errors in parentheses				
* p<0.10, ** p<0.05, *** p< 0.01				

Table A6: Algebra I, all teachers

	HLM	School FE	University FE	HLM w/ classes
Prior Achievement	0.5556***	0.5368***	0.5598***	0.5556***
	(0.0091)	(0.0151)	(0.0032)	(0.0092)
Foundations	0.0049	-0.0844	0.0066	0.0058
	(0.0110)	(0.0535)	(0.0262)	(0.0119)
Subject Matter	-0.0033	0.0018	0.0163	-0.0043
	(0.0045)	(0.0183)	(0.0115)	(0.0045)
Pedagogy	0.0062	-0.0418	0.0037	0.0037
	(0.0059)	(0.0354)	(0.0219)	(0.0066)
Technology	-0.0146	0.0119	0.0805**	-0.0173
	(0.0106)	(0.0437)	(0.0305)	(0.0124)
Other course	0.1053**	0.0701	-0.1512	0.1410**
	(0.0410)	(0.1576)	(0.1240)	(0.0717)
Early field hours	0.0065**	0.0066	0.0158**	0.0069**
	(0.0031)	(0.0088)	(0.0055)	(0.0033)
Weeks full time teaching	0.0185**	0.0222	-0.0285	0.0217***
	(0.0072)	(0.0167)	(0.0269)	(0.0079)
Minimum Observations	0.0251	-0.1544*	-0.2981**	0.0296
	(0.0256)	(0.0826)	(0.1152)	(0.0257)
Seminar	-0.0322	-0.1157	0.2378	-0.0522
	(0.0415)	(0.1620)	(0.1625)	(0.0518)
Male	-0.0157*	-0.0427***	-0.0168	-0.0157*
	(0.0083)	(0.0125)	(0.0123)	(0.0083)
Black	-0.1256***	-0.1076***	-0.1182***	-0.1255***
	(0.0122)	(0.0194)	(0.0089)	(0.0122)
Hispanic	0.0186	0.0303	0.0082	0.0184
	(0.0199)	(0.0274)	(0.0095)	(0.0198)
Asian	0.1243***	0.1474***	0.1430***	0.1240***
	(0.0332)	(0.0554)	(0.0306)	(0.0332)
Multiracial	-0.0580***	-0.0436	-0.0529*	-0.0582***
	(0.0222)	(0.0334)	(0.0269)	(0.0222)
American Indian	-0.0465	-0.0516	-0.0852**	-0.0458
	(0.0465)	(0.0486)	(0.0350)	(0.0465)

Free lunch	-0.0162	-0.0021	-0.0093	-0.0159
	(0.0099)	(0.0148)	(0.0083)	(0.0099)
Reduced lunch	-0.0050	-0.0090	0.0001	-0.0048
	(0.0154)	(0.0233)	(0.0083)	(0.0154)
Was LEP	0.0145	0.0141	0.0205	0.0145
	(0.0248)	(0.0423)	(0.0359)	(0.0249)
Is LEP	-0.1118***	-0.1557***	-0.1033***	-0.1119***
	(0.0240)	(0.0313)	(0.0107)	(0.0240)
Gifted	0.2609***	0.2300***	0.2879***	0.2604***
	(0.0189)	(0.0334)	(0.0080)	(0.0189)
Special Education	-0.1518***	-0.1648***	-0.1491***	-0.1516***
	(0.0156)	(0.0224)	(0.0136)	(0.0156)
Underage	0.0818*	0.1259**	0.1240***	0.0811*
	(0.0433)	(0.0503)	(0.0284)	(0.0432)
Overage	-0.1608***	-0.1505***	-0.1647***	-0.1608***
	(0.0098)	(0.0144)	(0.0111)	(0.0098)
Days absent	-0.0098***	-0.0114***	-0.0101***	-0.0098***
	(0.0006)	(0.0008)	(0.0005)	(0.0006)
Moved in year	-0.1308***	-0.1484***	-0.1259***	-0.1311***
	(0.0229)	(0.0339)	(0.0287)	(0.0230)
Variation in peer achievement	-0.1053**	-0.0665	-0.0863	-0.1073**
	(0.0424)	(0.0632)	(0.0798)	(0.0426)
Peer achievement	0.1267***	0.1322***	0.1305***	0.1260***
	(0.0194)	(0.0371)	(0.0279)	(0.0194)
School level % Asian	0.0065*		0.0111**	0.0065
	(0.0039)		(0.0046)	(0.0039)
School level % black	0.0014*		0.0018**	0.0013
	(0.0008)		(0.0007)	(0.0009)
School level % Hispanic	0.0120***		0.0112***	0.0121***
	(0.0020)		(0.0017)	(0.0020)
School level % multiracial	-0.0034		0.0097	-0.0036
	(0.0057)		(0.0078)	(0.0058)
School level % American Indian	0.0042		0.0036	0.0046
	(0.0034)		(0.0049)	(0.0034)
School level % FRL	-0.0023**		-0.0029**	-0.0023**
	(0.0010)		(0.0010)	(0.0010)
Per pupil expenditure	-0.0004		0.0000	-0.0004
	(0.0006)		(0.0007)	(0.0006)
Female teacher	0.0714**	0.0453	0.0152	0.0721**
	(0.0278)	(0.0526)	(0.0425)	(0.0283)
Teaching experience	0.0381***	-0.0101	0.0972***	0.0365***

	(0.0138)	(0.0244)	(0.0143)	(0.0140)
Bachelors degree	0.0049			-0.0406
	(0.0768)			(0.0883)
Remedial curriculum	0.0292	0.0934	0.0619	0.0287
	(0.0437)	(0.0739)	(0.0537)	(0.0438)
Advanced curriculum	0.0807	0.1810***	0.2307**	0.0803
	(0.0802)	(0.0280)	(0.0911)	(0.0793)
Class size	-0.0021	0.0008	-0.0029	-0.0021
	(0.0013)	(0.0021)	(0.0028)	(0.0013)
Black teacher	0.0280	0.5360**	0.0370	0.0282
	(0.0486)	(0.2297)	(0.0723)	(0.0462)
Asian teacher	-0.1357***			-0.1348***
	(0.0317)			(0.0317)
Hispanic teacher	-0.0329	-0.0462	-0.0755	-0.0330
	(0.0648)	(0.0929)	(0.1301)	(0.0667)
American Indian teacher	-0.1753		-0.1661	-0.1752
	(0.2953)		(0.3736)	(0.3030)
Other race teacher	-0.0175	-0.1088*	0.0010	-0.0166
	(0.0576)	(0.0655)	(0.0234)	(0.0592)
HS License	-0.0502	-0.1225	-0.2599	-0.0445
	(0.1135)	(0.6407)	(0.2758)	(0.1110)
Special Ed class				0.0423
				(0.0552)
Educational Psychology				-0.0073
				(0.0470)
Development				-0.0408
				(0.0523)
Classroom management				0.0413
				(0.0448)
_cons	-0.0309	1.8332***	0.5777	0.0255
	(0.2827)	(0.5829)	(0.8816)	(0.2956)
R-sq		0.4594	0.5367	
N	25788	9736	25788	25788
Standard errors in parentheses				
* p<0.10, ** p<0.05, *** p<0.01				

Table A7: Algebra I, Varying levels of teacher experience

	1st year teachers	1st year w/ classes	2nd year teachers	2nd year w/ classes	3rd-5th year teachers	3rd-5th year w/ classes
Prior Ach	0.5630***	0.5629***	0.5550***	0.5550***	0.5449***	0.5451***
	(0.0137)	(0.0137)	(0.0153)	(0.0153)	(0.0182)	(0.0182)
Foundations	-0.0143	-0.0078	0.0339	0.0475	-0.0659	-0.0247

	(0.0127)	(0.0138)	(0.0226)	(0.0273)	(0.0502)	(0.0704)
Subject Matter	-0.0004	0.0038	-0.0009	0.0035	-0.0085	-0.0144
	(0.0056)	(0.0060)	(0.0070)	(0.0073)	(0.0104)	(0.0115)
Pedagogy	-0.0099	-0.0004	0.0245	0.0263	-0.0225	-0.0109
	(0.0065)	(0.0076)	(0.0135)	(0.0155)	(0.0252)	(0.0313)
Technology	-0.0049	-0.0046	-0.0280*	-0.0250	-0.0103	-0.0485
	(0.0155)	(0.0158)	(0.0135)	(0.0150)	(0.0277)	(0.0321)
Other	0.1097*	0.0277	0.0874	0.0963	0.3424*	0.2035
	(0.0496)	(0.0681)	(0.0880)	(0.1162)	(0.1450)	(0.2135)
Early field hours	0.0069*	0.0082*	0.0044	0.0036	0.0232*	0.0134
	(0.0033)	(0.0035)	(0.0067)	(0.0075)	(0.0106)	(0.0130)
Wks full time teaching	0.0111	0.0058	0.0198	0.0249	0.0697*	0.0294
	(0.0070)	(0.0072)	(0.0141)	(0.0147)	(0.0307)	(0.0407)
Minimum Obs	0.0436	0.0382	0.0222	0.0287	0.1163	0.0586
	(0.0337)	(0.0329)	(0.0446)	(0.0517)	(0.0974)	(0.1039)
Seminar	-0.0100	0.0499	0.0046	-0.0025	-0.2940*	-0.1234
	(0.0531)	(0.0608)	(0.0622)	(0.0893)	(0.1455)	(0.1762)
Male	-0.0098	-0.0093	-0.0268	-0.0265	-0.0105	-0.0107
	(0.0122)	(0.0122)	(0.0154)	(0.0153)	(0.0157)	(0.0158)
Black	-0.1482***	-0.1476***	-0.1281***	-0.1278***	-0.0912***	-0.0912***
	(0.0176)	(0.0177)	(0.0213)	(0.0213)	(0.0261)	(0.0262)
Hispanic	-0.0110	-0.0100	0.0005	0.0007	0.0852*	0.0848*
	(0.0292)	(0.0293)	(0.0309)	(0.0308)	(0.0404)	(0.0403)
Asian	0.1257**	0.1249**	0.0972	0.0951	0.1315	0.1315
	(0.0466)	(0.0466)	(0.0557)	(0.0550)	(0.0755)	(0.0756)
Multiracial	-0.0463	-0.0461	-0.0752	-0.0756	-0.0520	-0.0521
	(0.0357)	(0.0358)	(0.0412)	(0.0406)	(0.0391)	(0.0392)
American Indian	-0.1300*	-0.1295*	-0.0334	-0.0343	0.0959	0.0953
	(0.0623)	(0.0622)	(0.0929)	(0.0926)	(0.0811)	(0.0812)
Free lunch	-0.0171	-0.0175	-0.0080	-0.0072	-0.0213	-0.0207
	(0.0154)	(0.0156)	(0.0154)	(0.0154)	(0.0204)	(0.0204)
Reduced lunch	0.0006	0.0011	0.0010	0.0007	-0.0275	-0.0263
	(0.0242)	(0.0243)	(0.0255)	(0.0255)	(0.0301)	(0.0301)
Was LEP	0.0261	0.0243	0.0497	0.0485	-0.0369	-0.0379
	(0.0384)	(0.0387)	(0.0421)	(0.0420)	(0.0482)	(0.0481)
Is LEP	-0.0838*	-0.0835*	-0.1450***	-0.1455***	-0.1260**	-0.1272**
	(0.0399)	(0.0399)	(0.0364)	(0.0364)	(0.0484)	(0.0481)
Gifted	0.2771***	0.2773***	0.2978***	0.2951***	0.1984***	0.1969***
	(0.0228)	(0.0226)	(0.0420)	(0.0423)	(0.0316)	(0.0315)
Special Education	-0.1633***	-0.1637***	-0.1460***	-0.1456***	-0.1542***	-0.1542***
	(0.0228)	(0.0228)	(0.0262)	(0.0262)	(0.0361)	(0.0362)

Underage	0.0943	0.0945	0.1132	0.1103	0.0185	0.0168
	(0.0685)	(0.0685)	(0.0658)	(0.0650)	(0.0912)	(0.0915)
Overage	-0.1579***	-0.1582***	-0.1530***	-0.1533***	-0.1728***	-0.1725***
	(0.0140)	(0.0139)	(0.0184)	(0.0183)	(0.0185)	(0.0185)
Days absent	-0.0080***	-0.0079***	-0.0116***	-0.0116***	-0.0109***	-0.0110***
	(0.0009)	(0.0009)	(0.0011)	(0.0011)	(0.0009)	(0.0009)
Moved in year	-0.1154**	-0.1156**	-0.1273**	-0.1294**	-0.1443**	-0.1454**
	(0.0372)	(0.0372)	(0.0432)	(0.0432)	(0.0443)	(0.0442)
Variation in peer ach	-0.0877	-0.0871	-0.0892	-0.0882	-0.0831	-0.0853
	(0.0671)	(0.0665)	(0.0737)	(0.0743)	(0.0851)	(0.0851)
Peer achievement	0.1638***	0.1626***	0.1182***	0.1127**	0.1113**	0.1117**
	(0.0302)	(0.0301)	(0.0347)	(0.0344)	(0.0376)	(0.0380)
School level % Asian	0.0052	0.0052	0.0080	0.0068	0.0206**	0.0215***
	(0.0053)	(0.0052)	(0.0053)	(0.0056)	(0.0063)	(0.0061)
School level % black	0.0008	0.0006	0.0024	0.0024	-0.0012	-0.0028
	(0.0010)	(0.0010)	(0.0016)	(0.0016)	(0.0024)	(0.0025)
School level % Hispanic	0.0089***	0.0081**	0.0133***	0.0139***	0.0132**	0.0204**
	(0.0027)	(0.0027)	(0.0028)	(0.0029)	(0.0051)	(0.0064)
School level % Multiracial	0.0154*	0.0163*	-0.0092	-0.0104	-0.0231	-0.0254*
	(0.0073)	(0.0072)	(0.0095)	(0.0091)	(0.0118)	(0.0114)
School level % Am Indian	0.0029	0.0022	-0.0016	-0.0003	0.0111***	0.0116***
	(0.0044)	(0.0043)	(0.0039)	(0.0036)	(0.0031)	(0.0033)
School level % FRL	-0.0012	-0.0011	-0.0043**	-0.0045**	-0.0021	-0.0018
	(0.0011)	(0.0011)	(0.0015)	(0.0014)	(0.0023)	(0.0019)
Per pupil expenditure	-0.0013	-0.0014*	0.0022*	0.0020	0.0008	0.0004
	(0.0007)	(0.0007)	(0.0011)	(0.0011)	(0.0016)	(0.0016)
Female teacher	0.0804*	0.0865*	0.0151	0.0240	0.1186	0.1007
	(0.0364)	(0.0355)	(0.0464)	(0.0477)	(0.0637)	(0.0658)
Teaching experience					-0.0054	0.0029
					(0.0376)	(0.0369)
Bachelors degree	-0.0377	0.0920	0.0751	0.1483	-0.2326	-0.0598
	(0.0999)	(0.1175)	(0.1320)	(0.1529)	(0.2415)	(0.2890)
Remedial curriculum	0.0588	0.0452	-0.0101	-0.0183	0.0380	0.0207
	(0.0688)	(0.0666)	(0.0229)	(0.0228)	(0.1353)	(0.1317)
Advanced curriculum	0.1229*	0.1258*	0.2477	0.2593	-0.0815	-0.1493
	(0.0541)	(0.0524)	(0.2029)	(0.2051)	(0.2429)	(0.2452)
Class size	-0.0052**	-0.0053**	0.0006	0.0006	-0.0002	-0.0006
	(0.0020)	(0.0020)	(0.0023)	(0.0023)	(0.0024)	(0.0024)
Black teacher	0.0126	0.0117	-0.0446	-0.0340	0.2679*	0.3280*
	(0.0450)	(0.0409)	(0.0608)	(0.0593)	(0.1279)	(0.1331)
Asian					-0.1132	-0.1229

teacher					(0.0663)	(0.0659)
Hispanic teacher	0.0085	0.0081			0.6128	0.2875
	(0.0796)	(0.0734)			(0.3293)	(0.4419)
Am Indian teacher	-0.0196	-0.0170	0.2838	0.1990		
	(0.3621)	(0.3569)	(0.3079)	(0.2950)		
Other race teacher	0.1003	0.1034	-0.0256	-0.0168	0.0540	-0.0327
	(0.0627)	(0.0647)	(0.0465)	(0.0466)	(0.0865)	(0.1030)
HS License	-0.0470	-0.0534	0.0069	-0.0427	-0.4360	-0.2239
	(0.1346)	(0.1305)	(0.2049)	(0.2031)	(0.2797)	(0.3124)
Educational Psychology		-0.0701		-0.0917		0.0314
		(0.0507)		(0.0745)		(0.1179)
Special ed class		-0.1368*		0.0244		0.1043
		(0.0612)		(0.0772)		(0.1361)
Development class		0.0495		-0.1199		0.1064
		(0.0592)		(0.0775)		(0.1951)
Classroom management		0.0039		0.0406		0.1043
		(0.0544)		(0.0775)		(0.1401)
Constant	0.2037	-0.0795	-0.7358	-0.9830	0.8303	0.6949
	(0.3629)	(0.3840)	(0.4735)	(0.5642)	(0.8442)	(1.1668)
R-sq						
N	11852	11852	8033	8033	5903	5903
Standard errors in parentheses						
* p<0.05, ** p<0.01, *** p<0.001						

Table A8: High School Algebra I, Special Education and ELL students

	ELLs	ELLs w/ classes	Special Education	Special Ed w/ classes
Prior achievement	0.5854***	0.5863***	0.4941***	0.4954***
	(0.0348)	(0.0351)	(0.0249)	(0.0250)
Foundations	0.0216	0.0217	0.0131	0.0169
	(0.0165)	(0.0263)	(0.0179)	(0.0200)
Subject Matter	-0.0155	-0.0155	-0.0014	-0.0017
	(0.0101)	(0.0109)	(0.0063)	(0.0070)
Pedagogy	0.0207**	0.0182	0.0140	0.0126
	(0.0104)	(0.0148)	(0.0101)	(0.0121)
Technology	-0.0299	-0.0215	-0.0098	-0.0025
	(0.0207)	(0.0250)	(0.0160)	(0.0184)
Other course	0.1604*	0.2099	0.1389*	0.1976
	(0.0819)	(0.1324)	(0.0725)	(0.1359)
Early field hours	0.0015	-0.0001	0.0113*	0.0088
	(0.0070)	(0.0075)	(0.0062)	(0.0071)
Weeks full time teaching	0.0315**	0.0368**	0.0248**	0.0308*

	(0.0149)	(0.0155)	(0.0125)	(0.0158)
Minimum Observations	-0.0117	-0.0214	0.0658	0.0565
	(0.0558)	(0.0574)	(0.0443)	(0.0447)
Seminar	0.0048	-0.0198	-0.0907	-0.1129
	(0.0745)	(0.1179)	(0.0674)	(0.0980)
Male	-0.0010	-0.0017	0.0167	0.0163
	(0.0424)	(0.0425)	(0.0266)	(0.0267)
Black	-0.0175	-0.0127	-0.2196***	-0.2192***
	(0.1385)	(0.1386)	(0.0349)	(0.0348)
Hispanic	-0.0754	-0.0714	0.0335	0.0287
	(0.0914)	(0.0925)	(0.0531)	(0.0532)
Asian	0.0478	0.0534	0.1543	0.1494
	(0.1087)	(0.1097)	(0.1647)	(0.1643)
Multiracial	-0.0778	-0.0652	-0.0433	-0.0469
	(0.1818)	(0.1796)	(0.0815)	(0.0808)
American Indian	-0.2862	-0.2982	-0.1030	-0.1001
	(0.2730)	(0.2683)	(0.0942)	(0.0932)
Free lunch	-0.0610	-0.0608	-0.0158	-0.0168
	(0.0524)	(0.0522)	(0.0317)	(0.0318)
Reduced lunch	-0.1324	-0.1357	0.0176	0.0175
	(0.0866)	(0.0864)	(0.0510)	(0.0510)
Was LEP			0.1369*	0.1390*
			(0.0787)	(0.0782)
Is LEP			-0.1478*	-0.1454*
			(0.0781)	(0.0781)
Gifted	0.2870	0.2849	0.3047***	0.3061***
	(0.1885)	(0.1853)	(0.0697)	(0.0693)
Special Education	-0.1040	-0.1054		
	(0.0674)	(0.0671)		
Underage	0.0433	0.0444	0.4118***	0.4094***
	(0.1375)	(0.1375)	(0.1565)	(0.1581)
Overage	-0.2039***	-0.2022***	-0.1288***	-0.1289***
	(0.0456)	(0.0456)	(0.0278)	(0.0280)
Days absent	-0.0099***	-0.0100***	-0.0096***	-0.0097***
	(0.0019)	(0.0019)	(0.0015)	(0.0015)
Moved in year	-0.1813*	-0.1844*	-0.1416**	-0.1412**
	(0.1019)	(0.1030)	(0.0607)	(0.0608)
Peer prior achievement	0.1501**	0.1497**	0.1813***	0.1784***
	(0.0601)	(0.0603)	(0.0426)	(0.0433)
Variation in peer prior achievement	-0.1748	-0.1686	-0.3586***	-0.3652***
	(0.1477)	(0.1500)	(0.0942)	(0.0942)

Female teacher	-0.0075	-0.0076	0.0478	0.0488
	(0.0467)	(0.0483)	(0.0400)	(0.0410)
Teaching experience	0.0629***	0.0620***	0.0627***	0.0617***
	(0.0221)	(0.0225)	(0.0159)	(0.0162)
Bachelors degree	-0.0013	-0.0320	-0.1075	-0.1627
	(0.1659)	(0.1976)	(0.1242)	(0.1520)
Remedial curriculum	-0.1147	-0.1050	0.1052	0.1102
	(0.1888)	(0.1909)	(0.0821)	(0.0857)
Advanced curriculum	0.0740	0.0696	-0.0420	-0.0570
	(0.3149)	(0.3141)	(0.1024)	(0.1052)
Class size	-0.0022	-0.0021	-0.0053**	-0.0053**
	(0.0045)	(0.0045)	(0.0025)	(0.0025)
Black teacher	0.0034	0.0073	0.0677	0.0705
	(0.0805)	(0.0841)	(0.0669)	(0.0653)
Asian teacher	-0.0272	-0.0234	-0.3468***	-0.3386***
	(0.0922)	(0.0936)	(0.0746)	(0.0764)
Hispanic teacher	-0.2781**	-0.2669*	0.0159	0.0339
	(0.1414)	(0.1466)	(0.1359)	(0.1324)
American Indian teacher	-1.0594*	-1.0568*	-0.5207	-0.5174
	(0.5497)	(0.5579)	(0.5227)	(0.5265)
Other race teacher	-0.1531	-0.1563	0.0152	0.0141
	(0.2598)	(0.2593)	(0.0825)	(0.0826)
HS License	0.0366	0.0018	0.0789	0.0675
	(0.1842)	(0.1964)	(0.1510)	(0.1619)
School level % Asian	-0.0047	-0.0051	0.0138***	0.0137**
	(0.0057)	(0.0059)	(0.0053)	(0.0055)
School level % black	0.0042***	0.0045***	0.0033**	0.0034**
	(0.0015)	(0.0017)	(0.0014)	(0.0014)
School level % Hispanic	0.0087**	0.0090**	0.0151***	0.0156***
	(0.0037)	(0.0039)	(0.0037)	(0.0038)
School level % multiracial	-0.0097	-0.0090	-0.0089	-0.0082
	(0.0112)	(0.0113)	(0.0092)	(0.0093)
School level % American Indian	0.0212***	0.0216***	0.0057	0.0058
	(0.0064)	(0.0066)	(0.0071)	(0.0071)
School level % FRL	-0.0055***	-0.0057***	-0.0048***	-0.0048***
	(0.0018)	(0.0018)	(0.0017)	(0.0018)
Per pupil expenditure	0.0012	0.0012	0.0005	0.0005
	(0.0012)	(0.0012)	(0.0009)	(0.0009)
Educational psychology		0.0203		0.0297
		(0.0895)		(0.0762)
Development		-0.0774		-0.0921

		(0.0891)		(0.0882)
Special Education class		0.0514		0.0835
		(0.0966)		(0.0843)
Classroom management		-0.0178		-0.0364
		(0.1353)		(0.0841)
Constant	0.2519	0.2976	0.1940	0.2343
	(0.2907)	(0.3053)	(0.2233)	(0.2371)
R-sq				
N	1409	1409	3154	3154
Standard errors in parentheses				
* p<0.10, ** p<0.05, ** p<0.05				

Table A9: Middle grades ELA, all teachers

	HLM	School FE	University FE	HLM w/ classes
Prior achievement	0.6868***	0.6764***	0.6878***	0.6867***
	(0.0067)	(0.0096)	(0.0101)	(0.0067)
Foundations	-0.0026	0.0008	-0.0074	-0.0108**
	(0.0032)	(0.0096)	(0.0044)	(0.0044)
Subject Matter	0.0010	0.0052*	0.0012	0.0030
	(0.0016)	(0.0027)	(0.0011)	(0.0021)
Pedagogy	0.0022*	-0.0091	0.0044	-0.0007
	(0.0013)	(0.0120)	(0.0030)	(0.0018)
Technology	0.0185***	-0.0098	-0.0116**	-0.0107
	(0.0061)	(0.0331)	(0.0047)	(0.0102)
Other course	-0.0025	0.0179	0.0918**	0.0279
	(0.0203)	(0.2540)	(0.0325)	(0.0240)
Early field hours	-0.0003	0.0013	-0.0007	0.0025**
	(0.0006)	(0.0015)	(0.0009)	(0.0011)
Weeks full time teaching	-0.0007	-0.0151***	0.0014	-0.0001
	(0.0027)	(0.0036)	(0.0064)	(0.0030)
Minimum Observations	0.0035			0.0391
	(0.0216)			(0.0251)
Seminar	-0.0228	-0.0185		-0.0409*
	(0.0152)	(0.2651)		(0.0231)
Male	-0.0037	-0.0265**	-0.0025	-0.0034
	(0.0075)	(0.0119)	(0.0066)	(0.0075)
Black	-0.1366***	-0.1533***	-0.1417***	-0.1361***
	(0.0115)	(0.0190)	(0.0116)	(0.0115)
Hispanic	-0.0310*	-0.0488*	-0.0331	-0.0312*
	(0.0174)	(0.0249)	(0.0189)	(0.0174)
Asian	-0.0140	-0.0143	-0.0257	-0.0135

	(0.0253)	(0.0435)	(0.0217)	(0.0254)
Other race	-0.0652***	-0.0553**	-0.0712***	-0.0644***
	(0.0196)	(0.0252)	(0.0219)	(0.0195)
Free lunch	-0.0573***	-0.0610***	-0.0541***	-0.0574***
	(0.0089)	(0.0141)	(0.0095)	(0.0089)
Reduced lunch	-0.0418***	-0.0400*	-0.0409***	-0.0410***
	(0.0139)	(0.0211)	(0.0130)	(0.0138)
Was LEP	0.0523**	0.0638**	0.0457***	0.0526**
	(0.0221)	(0.0298)	(0.0132)	(0.0220)
Is LEP	-0.1465***	-0.1426***	-0.1405***	-0.1456***
	(0.0258)	(0.0368)	(0.0261)	(0.0258)
Gifted	0.1784***	0.1927***	0.1698***	0.1786***
	(0.0146)	(0.0236)	(0.0085)	(0.0146)
Special Education	-0.0908***	-0.1178***	-0.0908***	-0.0909***
	(0.0165)	(0.0238)	(0.0150)	(0.0165)
Grade	-0.0077	0.0074	-0.0065*	-0.0058
	(0.0066)	(0.0296)	(0.0034)	(0.0066)
Over/ Underage	-0.0649***	-0.0668***	-0.0670***	-0.0650***
	(0.0094)	(0.0132)	(0.0069)	(0.0094)
Days absent	-0.0042***	-0.0039***	-0.0047***	-0.0042***
	(0.0006)	(0.0009)	(0.0002)	(0.0006)
Moved in year	-0.0387**	-0.0311	-0.0275	-0.0396**
	(0.0187)	(0.0310)	(0.0233)	(0.0186)
Variation in Peer prior achievement	-0.0003	-0.0369	-0.0167	-0.0016
	(0.0256)	(0.0477)	(0.0255)	(0.0252)
Peer prior achievement	0.1093***	0.1025***	0.1110***	0.1081***
	(0.0115)	(0.0170)	(0.0072)	(0.0115)
School level % Asian	0.0011		0.0029**	0.0019
	(0.0015)		(0.0011)	(0.0016)
School level % black	-0.0000		-0.0002	-0.0002
	(0.0003)		(0.0003)	(0.0003)
School level % Hispanic	0.0012		0.0008	0.0012*
	(0.0007)		(0.0005)	(0.0007)
School level % other race	-0.0015		-0.0014	-0.0018*
	(0.0012)		(0.0011)	(0.0010)
School level % FRL	-0.0006		-0.0004	-0.0004
	(0.0004)		(0.0004)	(0.0004)
Per pupil expenditure	-0.0002		-0.0002	-0.0003
	(0.0003)		(0.0005)	(0.0003)
Female teacher	0.0327**	0.0543***	0.0328**	0.0340**
	(0.0152)	(0.0059)	(0.0109)	(0.0143)

Teaching experience	0.0134**	-0.0308	0.0150**	0.0152***
	(0.0060)	(0.0283)	(0.0062)	(0.0058)
Bachelors degree	-0.0186	0.0414	0.0918**	0.0071
	(0.0325)	(0.1909)	(0.0383)	(0.0386)
Remedial curriculum	0.0102	0.0249	0.0260	0.0160
	(0.0412)	(0.2843)	(0.0291)	(0.0414)
Advanced curriculum	0.0063	-0.0191	0.0072	0.0111
	(0.0224)	(0.0324)	(0.0312)	(0.0225)
Class size	-0.0009	0.0022	-0.0010	-0.0009
	(0.0010)	(0.0019)	(0.0009)	(0.0010)
Black teacher	0.0322**	0.1380	0.0404**	0.0365**
	(0.0157)	(0.2286)	(0.0163)	(0.0164)
Asian teacher	0.0721*		0.1381***	0.0661
	(0.0390)		(0.0179)	(0.0439)
Hispanic teacher	-0.0358	0.0763	-0.0488	-0.0188
	(0.0272)	(0.1728)	(0.0323)	(0.0360)
Other race teacher	-0.0153	-0.0566*	-0.0290	
	(0.0423)	(0.0303)	(0.0596)	
HS licensure	0.0232			-0.0379
	(0.0405)			(0.0565)
Educational Psychology				0.0110
				(0.0303)
Development				0.0603**
				(0.0290)
Special Education class				0.0513**
				(0.0204)
ELL class				0.0231
				(0.0313)
Classroom management				0.0568**
				(0.0268)
Constant	0.1154	0.0206	0.0354	-0.0644
	(0.1625)	(0.6136)	(0.1105)	(0.1773)
R-sq		0.6625	0.6974	
N	24269	11433	24269	24269
Standard errors in parentheses				
* p<0.10, ** p<0.05, *** p<0.01				

Table A10: Middle Grades ELA, varying levels of experience

	1st year teachers	1st year teachers w/ classes	2nd year teachers	2nd year teachers w/ classes	3rd-5th year teachers	3rd-5th year teachers w/ classes
Prior	0.6930***	0.6931***	0.6866***	0.6865***	0.6722***	0.6717***

Achievement	(0.0087)	(0.0087)	(0.0129)	(0.0129)	(0.0152)	(0.0151)
Foundations	-0.0002	-0.0105**	-0.0027	-0.0219**	-0.0078	-0.0531*
	(0.0040)	(0.0051)	(0.0045)	(0.0095)	(0.0088)	(0.0300)
Subject Matter	0.0030	0.0057**	0.0019	0.0030	-0.0008	-0.0063
	(0.0024)	(0.0026)	(0.0027)	(0.0029)	(0.0032)	(0.0199)
Pedagogy	0.0008	-0.0066**	0.0035**	0.0025	0.0004	-0.0125
	(0.0019)	(0.0027)	(0.0015)	(0.0024)	(0.0065)	(0.0392)
Technology	0.0155*	-0.0223	0.0142	-0.0091	0.0386	0.0200
	(0.0081)	(0.0140)	(0.0096)	(0.0171)	(0.0445)	(0.0247)
Other course	0.0038	0.0315	-0.0181	-0.0378	-0.0741*	-0.2106
	(0.0279)	(0.0306)	(0.0279)	(0.0337)	(0.0433)	(0.5145)
Early field hours	-0.0006	0.0015	0.0012	0.0066***	0.0001	0.0041
	(0.0008)	(0.0012)	(0.0010)	(0.0021)	(0.0027)	(0.0057)
Weeks full time teaching	0.0015	0.0021	-0.0076	-0.0077	-0.0017	-0.0220
	(0.0034)	(0.0035)	(0.0046)	(0.0066)	(0.0188)	(0.0722)
Minimum Observations	-0.0049	0.0422	0.0103	0.0376	-0.0475	-0.1347
	(0.0272)	(0.0279)	(0.0448)	(0.0425)	(0.2052)	(1.0737)
Seminar	-0.0132	0.0039	-0.0324	-0.1018**	-0.0917	-0.1491
	(0.0220)	(0.0223)	(0.0226)	(0.0415)	(0.0778)	(0.2803)
Male	0.0060	0.0061	0.0014	0.0018	-0.0351*	-0.0343*
	(0.0109)	(0.0109)	(0.0125)	(0.0124)	(0.0179)	(0.0179)
Black	-0.1453***	-0.1453***	-0.1209***	-0.1194***	-0.1252***	-0.1242***
	(0.0164)	(0.0164)	(0.0204)	(0.0201)	(0.0273)	(0.0274)
Hispanic	-0.0222	-0.0231	-0.0241	-0.0236	-0.0682*	-0.0694*
	(0.0227)	(0.0227)	(0.0393)	(0.0395)	(0.0410)	(0.0409)
Asian	-0.0238	-0.0239	0.0122	0.0148	-0.0398	-0.0385
	(0.0400)	(0.0400)	(0.0396)	(0.0396)	(0.0578)	(0.0577)
Other race	-0.0458*	-0.0461*	-0.0429	-0.0418	-0.1485***	-0.1482***
	(0.0273)	(0.0272)	(0.0331)	(0.0330)	(0.0459)	(0.0460)
Free lunch	-0.0561***	-0.0560***	-0.0311*	-0.0328*	-0.0997***	-0.1032***
	(0.0119)	(0.0119)	(0.0184)	(0.0183)	(0.0241)	(0.0239)
Reduced lunch	-0.0462**	-0.0457**	-0.0538**	-0.0545**	-0.0135	-0.0174
	(0.0193)	(0.0193)	(0.0232)	(0.0227)	(0.0341)	(0.0338)
Was LEP	0.0570**	0.0571**	0.0072	0.0064	0.1105*	0.1119*
	(0.0287)	(0.0285)	(0.0400)	(0.0406)	(0.0586)	(0.0585)
Is LEP	-0.1417***	-0.1411***	-0.2109***	-0.2085***	-0.0631	-0.0616
	(0.0338)	(0.0336)	(0.0521)	(0.0524)	(0.0647)	(0.0652)
Gifted	0.1864***	0.1858***	0.1667***	0.1670***	0.1613***	0.1629***
	(0.0211)	(0.0211)	(0.0255)	(0.0259)	(0.0352)	(0.0345)
Special Education	-0.0977***	-0.0971***	-0.0848***	-0.0837***	-0.0912***	-0.0875***
	(0.0239)	(0.0240)	(0.0312)	(0.0314)	(0.0323)	(0.0321)

Grade	-0.0114	-0.0119	0.0039	0.0104	-0.0178	-0.0237*
	(0.0091)	(0.0092)	(0.0106)	(0.0112)	(0.0152)	(0.0130)
Over/Underage	-0.0570***	-0.0570***	-0.0786***	-0.0780***	-0.0626***	-0.0612***
	(0.0134)	(0.0135)	(0.0176)	(0.0177)	(0.0167)	(0.0168)
Days absent	-0.0043***	-0.0043***	-0.0053***	-0.0053***	-0.0020	-0.0017
	(0.0007)	(0.0007)	(0.0010)	(0.0010)	(0.0019)	(0.0019)
Moved in year	-0.0390	-0.0393	-0.0317	-0.0321	-0.0716	-0.0704
	(0.0251)	(0.0250)	(0.0349)	(0.0349)	(0.0480)	(0.0481)
Variation in Peer prior ach	0.0186	0.0093	0.0307	0.0257	-0.1224*	-0.1690***
	(0.0352)	(0.0346)	(0.0409)	(0.0413)	(0.0690)	(0.0640)
Peer prior achievement	0.1074***	0.1081***	0.1277***	0.1234***	0.1002***	0.0930***
	(0.0165)	(0.0165)	(0.0205)	(0.0205)	(0.0231)	(0.0222)
School level % Asian	0.0036	0.0042*	-0.0035	-0.0019	0.0064**	0.0072***
	(0.0024)	(0.0025)	(0.0027)	(0.0025)	(0.0027)	(0.0024)
School level % Black	0.0001	0.0000	-0.0015***	-0.0018***	-0.0005	-0.0005
	(0.0005)	(0.0004)	(0.0006)	(0.0005)	(0.0010)	(0.0010)
School level % Hispanic	0.0011	0.0014	0.0050***	0.0047***	0.0022	0.0010
	(0.0009)	(0.0010)	(0.0011)	(0.0011)	(0.0023)	(0.0023)
School level % other race	-0.0020*	-0.0023***	-0.0002	-0.0014	-0.0026	-0.0038**
	(0.0011)	(0.0009)	(0.0021)	(0.0021)	(0.0025)	(0.0019)
School level % FRL	-0.0008	-0.0005	-0.0004	0.0001	-0.0003	0.0001
	(0.0005)	(0.0005)	(0.0007)	(0.0007)	(0.0011)	(0.0010)
Per pupil expenditure	0.0001	-0.0001	-0.0018***	-0.0017***	0.0010	0.0007
	(0.0004)	(0.0004)	(0.0005)	(0.0005)	(0.0012)	(0.0010)
Female teacher	0.0157	0.0135	0.0415*	0.0540**	0.0791***	0.0677**
	(0.0232)	(0.0222)	(0.0235)	(0.0240)	(0.0293)	(0.0336)
Teaching experience					0.0138	-0.0071
					(0.0278)	(0.0253)
Bachelors degree	-0.0038	0.0396	0.0134	0.0096	-0.1366	-0.1731
	(0.0397)	(0.0403)	(0.0473)	(0.0622)	(0.0896)	(0.3509)
Remedial curriculum	0.1140	0.1164	-0.0049	0.0048		
	(0.1643)	(0.1670)	(0.0339)	(0.0374)		
Advanced curriculum	-0.0269	-0.0257	0.0189	0.0165	0.0765	0.0724*
	(0.0309)	(0.0301)	(0.0283)	(0.0282)	(0.0483)	(0.0431)
Class size	-0.0010	-0.0013	-0.0012	-0.0006	0.0004	0.0019
	(0.0014)	(0.0014)	(0.0017)	(0.0018)	(0.0025)	(0.0022)
Black teacher	0.0228	0.0270	0.0276	0.0344	0.0569	0.0667
	(0.0213)	(0.0228)	(0.0225)	(0.0230)	(0.0451)	(0.0454)
Asian teacher	0.0499	0.0592				
	(0.0502)	(0.0540)				
Hispanic teacher	-0.0383	-0.0055				

	(0.0309)	(0.0399)				
Other race teacher	-0.0250	-0.0459	0.0996*	0.0516	-0.0736	-0.4851
	(0.0604)	(0.0575)	(0.0572)	(0.0548)	(0.1728)	(0.8530)
HS License	-0.0038	-0.0975	0.0444	0.0235	-0.0341	
	(0.0568)	(0.0670)	(0.0574)	(0.0755)	(0.1446)	
Educational psychology		0.0557**		-0.0263		-0.1352
		(0.0281)		(0.0544)		(0.1772)
Development		0.0778**		0.1336*		0.2165***
		(0.0338)		(0.0701)		(0.0517)
Special Education class		0.0873***		0.0009		-0.0418
		(0.0309)		(0.0299)		(0.0581)
ELL class		-0.0889**		0.0538		
		(0.0373)		(0.0471)		
Classroom management		-0.0060		0.1174***		0.0059
		(0.0318)		(0.0446)		(0.6538)
Constant	0.0885	-0.1103	0.0898	0.0070	0.5686	1.9934
	(0.2252)	(0.2056)	(0.2677)	(0.2724)	(0.9159)	(2.9112)
R-sq						
N	12115	12115	7502	7502	4652	4652
Standard errors in parentheses						
* p<0.10, ** p<0.05, *** p<0.01						

Table A11: Middle grades ELA, ELL and special education students

	ELL	ELL w/ classes	Special Education	Special Education w/ classes
Prior achievement	0.7439***	0.7480***	0.7393***	0.7385***
	(0.0262)	(0.0259)	(0.0192)	(0.0192)
Foundations	0.0190	0.0227	0.0124	0.0042
	(0.0144)	(0.0215)	(0.0096)	(0.0149)
Subject Matter	0.0016	-0.0009	0.0151**	0.0155**
	(0.0050)	(0.0063)	(0.0061)	(0.0064)
Pedagogy	0.0003	-0.0003	0.0036	0.0038
	(0.0046)	(0.0072)	(0.0039)	(0.0049)
Technology	0.0166	-0.0059	0.0199	-0.0167
	(0.0234)	(0.0458)	(0.0161)	(0.0299)
Other	-0.0823	-0.0517	-0.0587	-0.0572
	(0.0541)	(0.0871)	(0.0620)	(0.0642)
Early Field Hours	-0.0002	0.0032	-0.0021	0.0046
	(0.0024)	(0.0036)	(0.0018)	(0.0031)
Weeks full time teaching	-0.0117	-0.0084	-0.0122*	-0.0096
	(0.0088)	(0.0130)	(0.0073)	(0.0078)

Minimum Observations	0.1071*	0.1363	0.0378	0.0448
	(0.0604)	(0.0939)	(0.0465)	(0.0579)
Seminar	-0.0570	-0.1529**	0.0227	-0.0828
	(0.0490)	(0.0718)	(0.0496)	(0.0630)
Male	0.0652	0.0714*	-0.0318	-0.0341
	(0.0399)	(0.0403)	(0.0302)	(0.0301)
Black	0.0605	0.0633	-0.1292***	-0.1267***
	(0.1860)	(0.1861)	(0.0422)	(0.0422)
Hispanic	-0.1358	-0.1337	-0.1660**	-0.1618*
	(0.1277)	(0.1286)	(0.0845)	(0.0844)
Asian	-0.1428	-0.1451	0.0395	0.0221
	(0.1414)	(0.1421)	(0.1193)	(0.1161)
Multiracial	0.0812	0.0863	-0.0291	-0.0217
	(0.2759)	(0.2719)	(0.0825)	(0.0829)
American Indian			-0.0908	-0.0792
			(0.0926)	(0.0945)
Free lunch	-0.0344	-0.0393	-0.0182	-0.0218
	(0.0443)	(0.0447)	(0.0315)	(0.0315)
Reduced lunch	-0.0954	-0.0851	-0.0618	-0.0615
	(0.1020)	(0.1038)	(0.0560)	(0.0558)
Was LEP			0.1517	0.1473
			(0.1617)	(0.1615)
Is LEP			0.0603	0.0627
			(0.0897)	(0.0893)
Gifted	0.0825	0.0863	0.0765	0.0799
	(0.1233)	(0.1239)	(0.0557)	(0.0552)
Special Education	-0.0467	-0.0458		
	(0.0606)	(0.0612)		
Underage	0.0343	0.0344	0.1553	0.1434
	(0.1246)	(0.1251)	(0.1778)	(0.1810)
Overage	-0.0933**	-0.0925**	-0.0507*	-0.0506*
	(0.0399)	(0.0400)	(0.0308)	(0.0306)
Days absent	-0.0078***	-0.0080***	-0.0075***	-0.0072***
	(0.0021)	(0.0021)	(0.0016)	(0.0016)
Moved in year	-0.0703	-0.0746	-0.1044	-0.1099*
	(0.0703)	(0.0710)	(0.0669)	(0.0667)
Peer prior achievement	0.0411	0.0363	0.1640***	0.1616***
	(0.0413)	(0.0431)	(0.0294)	(0.0293)
Variation in peer prior achievement	-0.0920	-0.0817	-0.0279	-0.0224
	(0.0943)	(0.0935)	(0.0809)	(0.0803)
Female teacher	0.0431	0.0253	0.0002	-0.0060

	(0.0496)	(0.0525)	(0.0460)	(0.0464)
Teaching experience	0.0236	0.0297	0.0229	0.0265
	(0.0234)	(0.0240)	(0.0171)	(0.0165)
Bachelors degree	-0.2111**	-0.2553**	0.1205*	0.0884
	(0.0978)	(0.1205)	(0.0708)	(0.0811)
Remedial curriculum	-0.1149	-0.1054	0.0888	0.1065
	(0.1523)	(0.1553)	(0.0961)	(0.0959)
Advanced curriculum	0.2333*	0.2324*	-0.1574	-0.1485
	(0.1232)	(0.1247)	(0.0966)	(0.0963)
Class size	-0.0008	0.0000	-0.0073**	-0.0070**
	(0.0043)	(0.0046)	(0.0032)	(0.0032)
Black teacher	0.0465	0.0466	-0.0414	-0.0505
	(0.0573)	(0.0617)	(0.0482)	(0.0494)
Asian teacher	0.0056	0.0621	0.2307**	0.1438
	(0.1555)	(0.1738)	(0.0898)	(0.0973)
Hispanic teacher	-0.1603	-0.1578	-0.3670***	-0.3782***
	(0.1101)	(0.1144)	(0.0777)	(0.0732)
Other race teacher	-0.2841***	-0.3237***	0.0981	0.0381
	(0.1033)	(0.1062)	(0.0839)	(0.0706)
HS License	-0.0084	0.0666	-0.2177*	-0.2251
	(0.1238)	(0.1587)	(0.1188)	(0.1393)
School level % Asian	-0.0082	-0.0066	-0.0084*	-0.0063
	(0.0069)	(0.0069)	(0.0044)	(0.0045)
School level % black	-0.0020	-0.0024*	0.0000	-0.0004
	(0.0012)	(0.0013)	(0.0015)	(0.0015)
School level % Hispanic	-0.0003	-0.0001	0.0024	0.0024
	(0.0023)	(0.0025)	(0.0024)	(0.0025)
School level % multiracial	0.0049	0.0048	-0.0049	-0.0033
	(0.0114)	(0.0121)	(0.0082)	(0.0083)
School level % American Indian	0.0025	0.0032	-0.0007	-0.0010
	(0.0024)	(0.0023)	(0.0025)	(0.0023)
School level % FRL	0.0009	0.0009	-0.0022	-0.0017
	(0.0016)	(0.0016)	(0.0017)	(0.0018)
Per pupil expenditure	0.0009	0.0010	0.0009	0.0009
	(0.0008)	(0.0008)	(0.0007)	(0.0007)
Educational psychology		-0.1171		-0.0901
		(0.0995)		(0.0598)
Development		-0.0162		0.0963
		(0.1300)		(0.0934)

Special Education class		0.0510		0.0182
		(0.0794)		(0.0567)
ELL class		0.5337		0.1491
		(0.3284)		(0.1203)
Classroom management		0.1491		0.1892***
		(0.1003)		(0.0716)
Constant	0.2516	0.3349	0.2409	0.2615
	(0.2199)	(0.3159)	(0.1809)	(0.2159)
R-sq				
N	1006	1006	2193	2193
Standard errors in parentheses				
* p<0.10, ** p<0.05, *** p<0.01				

Table A12: High School English I, all teachers

	HLM	School FE	University FE	HLM w/ classes
Prior Achievement	0.5244***	0.4947***	0.5317***	0.5263***
	(0.0082)	(0.0116)	(0.0062)	(0.0083)
Foundations	-0.0065*	-4.0129**	-0.0084	0.0047
	(0.0039)	(1.8596)	(0.0160)	(0.0080)
Subject Matter	0.0013	-0.0539*	0.0134**	-0.0003
	(0.0019)	(0.0302)	(0.0046)	(0.0022)
Pedagogy	-0.0020	0.6701**	0.0125	0.0002
	(0.0030)	(0.2624)	(0.0083)	(0.0031)
Technology	-0.0046	-15.5030**	0.0399	0.0093
	(0.0107)	(6.9577)	(0.0384)	(0.0157)
“Other” course	0.0089	2.8669**	0.2676	-0.0442
	(0.0264)	(1.2974)	(0.1733)	(0.0332)
Early field hours	0.0030	3.3735**	0.0018	0.0042
	(0.0023)	(1.5386)	(0.0057)	(0.0027)
Weeks full time teaching	0.0055*	-0.4976**	-0.0093	0.0090***
	(0.0032)	(0.2233)	(0.0334)	(0.0032)
Minimum observations	-0.0188	-8.5020**	-0.0630	-0.0297*
	(0.0137)	(3.8985)	(0.0413)	(0.0171)
Seminar	0.0080	-1.6972***		-0.0084
	(0.0340)	(0.4934)		(0.0393)
Male	-0.1151***	-0.1154***	-0.1201***	-0.1167***
	(0.0077)	(0.0107)	(0.0054)	(0.0078)
Black	-0.1200***	-0.1195***	-0.1124***	-0.1179***
	(0.0122)	(0.0184)	(0.0104)	(0.0124)
Hispanic	0.0173	-0.0244	0.0143	0.0178

	(0.0184)	(0.0294)	(0.0112)	(0.0187)
Asian	-0.0031	-0.0625*	0.0121	-0.0062
	(0.0252)	(0.0346)	(0.0266)	(0.0258)
Multiracial	-0.0118	0.0148	0.0010	-0.0081
	(0.0235)	(0.0347)	(0.0185)	(0.0236)
American Indian	-0.0096	-0.0750	0.0104	-0.0137
	(0.0374)	(0.0558)	(0.0358)	(0.0374)
Free lunch	-0.0609***	-0.0769***	-0.0544**	-0.0608***
	(0.0094)	(0.0140)	(0.0185)	(0.0095)
Reduced lunch	-0.0279*	-0.0069	-0.0182	-0.0278*
	(0.0158)	(0.0213)	(0.0158)	(0.0159)
Was LEP	-0.0599**	-0.0398	-0.0480*	-0.0622***
	(0.0233)	(0.0343)	(0.0256)	(0.0238)
Is LEP	-0.1544***	-0.1170***	-0.1851***	-0.1515***
	(0.0254)	(0.0359)	(0.0258)	(0.0259)
Gifted	0.2570***	0.2402***	0.2541***	0.2584***
	(0.0124)	(0.0170)	(0.0148)	(0.0126)
Special Education	-0.1731***	-0.1782***	-0.1639***	-0.1693***
	(0.0172)	(0.0270)	(0.0175)	(0.0171)
Under age	0.1103***	0.0785	0.0942**	0.0996***
	(0.0353)	(0.0534)	(0.0379)	(0.0353)
Over age	-0.1263***	-0.1335***	-0.1297***	-0.1265***
	(0.0103)	(0.0165)	(0.0149)	(0.0105)
Days absent	-0.0076***	-0.0071***	-0.0072***	-0.0076***
	(0.0005)	(0.0008)	(0.0006)	(0.0005)
Moved in year	-0.0747***	-0.0772***	-0.0775***	-0.0771***
	(0.0211)	(0.0294)	(0.0227)	(0.0214)
Variation in peer achievement	0.0071	0.0493	0.0200	0.0121
	(0.0335)	(0.0511)	(0.0290)	(0.0338)
Peer achievement	0.1150***	0.1421***	0.1184***	0.1148***
	(0.0178)	(0.0252)	(0.0188)	(0.0178)
School level % Asian	0.0078***		0.0091***	0.0083***
	(0.0022)		(0.0030)	(0.0022)
School level % Black	0.0007		0.0008	0.0007
	(0.0005)		(0.0006)	(0.0005)
School level % Hispanic	-0.0005		-0.0005	-0.0010
	(0.0013)		(0.0016)	(0.0013)
School level % multiracial	-0.0033		-0.0044	-0.0039
	(0.0033)		(0.0034)	(0.0032)
School level %	-0.0019		-0.0033	0.0004

American Indian	(0.0021)		(0.0040)	(0.0022)
School level % FRL	0.0002		-0.0002	0.0003
	(0.0006)		(0.0005)	(0.0006)
Per pupil expenditure (/100)	-0.0005		-0.0006	-0.0006
	(0.0004)		(0.0005)	(0.0004)
Female teacher	0.0332*	0.0866	0.0395*	0.0338*
	(0.0197)	(0.0811)	(0.0199)	(0.0194)
Teaching experience	0.0290***	0.0201	0.0378***	0.0337***
	(0.0076)	(0.0356)	(0.0094)	(0.0077)
Bachelor's degree	-0.0107		0.2836	-0.0800*
	(0.0398)		(0.3026)	(0.0409)
Remedial curriculum	0.0744***	0.0189	0.0782**	0.0695***
	(0.0227)	(0.0296)	(0.0331)	(0.0227)
Advanced curriculum	0.1324***	0.0969***	0.1189***	0.1297***
	(0.0201)	(0.0337)	(0.0245)	(0.0202)
Class size	0.0009	0.0006	-0.0001	0.0007
	(0.0010)	(0.0018)	(0.0011)	(0.0011)
Black teacher	0.0067	0.2900***	0.0122	0.0075
	(0.0259)	(0.0942)	(0.0259)	(0.0260)
Asian teacher	0.0388	0.1973**	0.0705	0.0304
	(0.0470)	(0.0942)	(0.0445)	(0.0461)
Hispanic teacher	0.1529***		0.0780	0.1867***
	(0.0554)		(0.0558)	(0.0636)
American Indian teacher	0.0726**		0.0534*	0.0568*
	(0.0302)		(0.0285)	(0.0343)
Multiracial teacher	0.0231		0.0451**	0.0253
	(0.0460)		(0.0204)	(0.0466)
Other race teacher	0.0562*		0.0190	0.0469
	(0.0314)		(0.0198)	(0.0306)
HS license	0.0881*	-11.2551**		0.1489***
	(0.0456)	(5.2207)		(0.0483)
Educational psychology				-0.0798**
				(0.0351)
Development				-0.0091
				(0.0292)
Special Ed class				-0.0714**
				(0.0320)
Teaching ELLs				0.0535
				(0.0605)
Classroom Mgmt				0.0701**

				(0.0352)
Constant	0.0940	54.7536**	-0.4761	0.1547
	(0.1432)	(24.8410)	(0.4176)	(0.1393)
R-sq		0.6080	0.6712	
N	22329	8437	22329	22001
Standard errors in parentheses				
* p<0.10, ** p<0.05, *** p<0.01				

Table A13: High school English I, varying years of experience

	1st year teachers	1st year w/ classes	2nd year teachers	2nd year w/ classes	3rd-5th year	3rd-5th year w/ classes
Prior Ach	0.5362***	0.5361***	0.5292***	0.5292***	0.5004***	0.5054***
	(0.0130)	(0.0130)	(0.0131)	(0.0131)	(0.0145)	(0.0154)
Foundations	-0.0010	-0.0029	-0.0153***	-0.0120	-0.0090	0.0244
	(0.0063)	(0.0130)	(0.0049)	(0.0109)	(0.0107)	(0.0177)
Subject Matter	0.0028	0.0009	0.0024	0.0036	0.0036	0.0032
	(0.0039)	(0.0038)	(0.0023)	(0.0027)	(0.0042)	(0.0074)
Pedagogy	0.0015	0.0017	-0.0074*	-0.0071	-0.0120	-0.0122
	(0.0054)	(0.0092)	(0.0039)	(0.0044)	(0.0081)	(0.0137)
Technology	-0.0228	-0.0166	-0.0223	0.0023	0.0321*	0.0636**
	(0.0172)	(0.0282)	(0.0145)	(0.0289)	(0.0173)	(0.0270)
Other	0.0671	0.0475	0.0410	-0.0094	-0.0783	-0.1594**
	(0.0461)	(0.0621)	(0.0374)	(0.0516)	(0.0635)	(0.0659)
Early field hours	0.0054	0.0098**	0.0089***	0.0080**	-0.0007	-0.0036
	(0.0038)	(0.0042)	(0.0031)	(0.0037)	(0.0062)	(0.0074)
Wks full time teaching	0.0096*	0.0102*	0.0122***	0.0137***	-0.0031	0.0073
	(0.0055)	(0.0062)	(0.0045)	(0.0046)	(0.0063)	(0.0101)
Minimum obs	-0.0172	-0.0227	-0.0138	-0.0243	-0.0219	-0.0019
	(0.0249)	(0.0381)	(0.0309)	(0.0292)	(0.0206)	(0.0346)
Seminar	-0.0011	-0.0238	-0.0171	0.0182	0.1118*	0.1054
	(0.0605)	(0.0618)	(0.0412)	(0.0509)	(0.0641)	(0.1055)
Male	-0.1155***	-0.1159***	-0.1324***	-0.1328***	-0.0966***	-0.1006***
	(0.0118)	(0.0119)	(0.0147)	(0.0148)	(0.0132)	(0.0140)
Black	-0.1178***	-0.1182***	-0.0885***	-0.0888***	-0.1559***	-0.1501***
	(0.0194)	(0.0194)	(0.0204)	(0.0204)	(0.0222)	(0.0235)
Hispanic	-0.0089	-0.0105	0.1181***	0.1178***	-0.0460	-0.0474
	(0.0280)	(0.0281)	(0.0281)	(0.0283)	(0.0328)	(0.0341)
Asian	-0.0366	-0.0368	0.0962*	0.0964*	-0.0415	-0.0527
	(0.0341)	(0.0341)	(0.0543)	(0.0542)	(0.0437)	(0.0464)
Multiracial	-0.0216	-0.0219	0.0140	0.0152	-0.0327	-0.0198
	(0.0399)	(0.0399)	(0.0371)	(0.0368)	(0.0434)	(0.0446)

American Indian	0.0752	0.0767	-0.0136	-0.0150	-0.1461	-0.1658
	(0.0512)	(0.0518)	(0.0538)	(0.0532)	(0.1082)	(0.1133)
Free lunch	-0.0536***	-0.0524***	-0.0827***	-0.0826***	-0.0486***	-0.0472***
	(0.0153)	(0.0154)	(0.0166)	(0.0167)	(0.0160)	(0.0161)
Reduced lunch	-0.0488*	-0.0480*	-0.0501**	-0.0499**	0.0306	0.0354
	(0.0250)	(0.0250)	(0.0222)	(0.0223)	(0.0329)	(0.0342)
Was LEP	-0.0242	-0.0225	-0.1141**	-0.1162**	-0.0487	-0.0511*
	(0.0374)	(0.0378)	(0.0559)	(0.0565)	(0.0302)	(0.0311)
Is LEP	-0.1335***	-0.1319***	-0.2158***	-0.2156***	-0.1230***	-0.1133**
	(0.0356)	(0.0357)	(0.0485)	(0.0484)	(0.0424)	(0.0442)
Gifted	0.2737***	0.2727***	0.2674***	0.2671***	0.2482***	0.2534***
	(0.0198)	(0.0198)	(0.0213)	(0.0211)	(0.0222)	(0.0228)
Special Education	-0.1944***	-0.1964***	-0.1603***	-0.1601***	-0.1601***	-0.1438***
	(0.0270)	(0.0270)	(0.0287)	(0.0287)	(0.0320)	(0.0312)
Underage	0.0570	0.0563	0.0737	0.0744	0.2421***	0.2148***
	(0.0562)	(0.0561)	(0.0521)	(0.0519)	(0.0736)	(0.0758)
Overage	-0.1380***	-0.1380***	-0.1064***	-0.1073***	-0.1312***	-0.1309***
	(0.0169)	(0.0169)	(0.0198)	(0.0198)	(0.0156)	(0.0165)
Days absent	-0.0084***	-0.0084***	-0.0066***	-0.0066***	-0.0069***	-0.0069***
	(0.0008)	(0.0008)	(0.0010)	(0.0010)	(0.0010)	(0.0011)
Moved in year	-0.0596**	-0.0596**	-0.0802*	-0.0805*	-0.0983**	-0.1062***
	(0.0295)	(0.0297)	(0.0465)	(0.0463)	(0.0383)	(0.0409)
Variation in Peer Ach	0.0220	0.0238	-0.0191	-0.0194	0.0407	0.0346
	(0.0559)	(0.0562)	(0.0550)	(0.0537)	(0.0592)	(0.0632)
Peer Ach	0.1114***	0.1106***	0.1497***	0.1524***	0.0959***	0.0998***
	(0.0309)	(0.0310)	(0.0279)	(0.0275)	(0.0324)	(0.0325)
School level % Asian	0.0095***	0.0099***	0.0049	0.0047	0.0121***	0.0126***
	(0.0030)	(0.0030)	(0.0034)	(0.0034)	(0.0045)	(0.0040)
School level % black	0.0011	0.0010	0.0007	0.0010	0.0001	0.0002
	(0.0007)	(0.0008)	(0.0007)	(0.0007)	(0.0011)	(0.0011)
School level % Hispanic	0.0018	0.0015	0.0007	0.0001	-0.0007	-0.0022
	(0.0019)	(0.0019)	(0.0024)	(0.0025)	(0.0022)	(0.0021)
School level % multiracial	-0.0014	-0.0038	-0.0054	-0.0057	-0.0131*	-0.0087
	(0.0072)	(0.0074)	(0.0038)	(0.0037)	(0.0069)	(0.0069)
School level % AmIndian	-0.0075**	-0.0046	0.0005	0.0014	0.0026	0.0073
	(0.0033)	(0.0043)	(0.0024)	(0.0026)	(0.0046)	(0.0090)
School level % FRL	-0.0014*	-0.0015*	-0.0002	-0.0000	0.0012	0.0013
	(0.0008)	(0.0008)	(0.0007)	(0.0008)	(0.0010)	(0.0010)
Per pupil expenditure	0.0000	0.0002	-0.0007	-0.0007	0.0001	-0.0002
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0011)	(0.0012)
Female	0.0593*	0.0675**	0.0181	0.0210	0.0354	0.0184

teacher	(0.0315)	(0.0306)	(0.0253)	(0.0269)	(0.0399)	(0.0407)
Teaching experience					0.0580***	0.0548***
					(0.0190)	(0.0203)
Bachelor's degree	0.0369	0.0062	-0.0276	-0.0656	-0.0364	-0.1738
	(0.0653)	(0.0683)	(0.0549)	(0.0683)	(0.0667)	(0.1367)
Remedial Curriculum	0.0610	0.0538	0.0823**	0.0737**	0.0974***	0.0877**
	(0.0471)	(0.0470)	(0.0367)	(0.0374)	(0.0347)	(0.0365)
Advanced Curriculum	0.1267***	0.1268***	0.1610***	0.1593***	0.1228***	0.1067***
	(0.0292)	(0.0299)	(0.0337)	(0.0330)	(0.0389)	(0.0395)
Class size	0.0015	0.0010	-0.0026*	-0.0033*	0.0031*	0.0029
	(0.0017)	(0.0017)	(0.0016)	(0.0017)	(0.0018)	(0.0021)
Black teacher	-0.0017	-0.0264	-0.0042	-0.0011	-0.0023	0.0288
	(0.0471)	(0.0501)	(0.0355)	(0.0351)	(0.0431)	(0.0464)
Asian teacher	0.0245	0.0140	0.1034***	0.0968***	0.1124**	0.0895*
	(0.0938)	(0.0942)	(0.0298)	(0.0307)	(0.0478)	(0.0477)
Hispanic teacher	0.1007	0.0943				
	(0.0931)	(0.0783)				
Am Indian teacher	0.1152**	0.0872*				
	(0.0448)	(0.0473)				
Multiracial teacher	-0.0305	-0.0410				
	(0.0830)	(0.0851)				
Other race teacher	0.1103	0.1001	-0.0068	-0.0071		
	(0.0681)	(0.0706)	(0.0361)	(0.0388)		
HS license	0.0763	0.1464	0.0446	0.0225	0.1977*	0.3205**
	(0.1186)	(0.1005)	(0.0555)	(0.0718)	(0.1035)	(0.1345)
Educational Psychology		-0.0146		-0.0146		-0.0146
		(0.0595)		(0.0595)		(0.0595)
Development		0.0192		0.0192		0.0192
		(0.0773)		(0.0773)		(0.0773)
Special Ed class		-0.0828		-0.0828		-0.0828
		(0.0717)		(0.0717)		(0.0717)
Teaching ELLs		0.0798		0.0798		0.0798
		(0.1038)		(0.1038)		(0.1038)
Classroom Manageme nt		0.0843		0.0843		0.0843
		(0.0761)		(0.0761)		(0.0761)
Constant	-0.1661	-0.1064	0.2641	0.3191	-0.1206	-0.2499
	(0.2385)	(0.2411)	(0.2161)	(0.2081)	(0.2793)	(0.4401)
N	9512	9512	6841	6841	5976	5976

Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01

Table A14: High School English I, ELL and Special Education students

	ELL students	ELL students w/ classes	Special Education students	Special Ed students w/ classes
Prior Achievement	0.4945***	0.5018***	0.4646***	0.4626***
	(0.0249)	(0.0262)	(0.0253)	(0.0254)
Foundations	-0.0347***	0.0246	0.0081	-0.0093
	(0.0117)	(0.0318)	(0.0085)	(0.0157)
Subject Matter	-0.0013	-0.0073	-0.0001	-0.0017
	(0.0055)	(0.0068)	(0.0047)	(0.0049)
Pedagogy	-0.0017	0.0095	-0.0136*	-0.0007
	(0.0117)	(0.0135)	(0.0074)	(0.0068)
Technology	-0.0361	-0.0546	0.0303	-0.0088
	(0.0227)	(0.0336)	(0.0228)	(0.0298)
Other course	0.0194	-0.0807	0.0261	0.0521
	(0.0774)	(0.1106)	(0.0539)	(0.0691)
Early field hours	0.0094	0.0005	-0.0024	0.0032
	(0.0067)	(0.0087)	(0.0043)	(0.0049)
Weeks full time teaching	0.0050	0.0172	0.0124*	0.0085
	(0.0094)	(0.0121)	(0.0073)	(0.0076)
Minimum Observations	-0.0367	0.0045	0.0541	0.0096
	(0.0354)	(0.0561)	(0.0360)	(0.0427)
Seminar	0.0577	-0.0502	-0.0956	-0.1775*
	(0.1146)	(0.1506)	(0.0856)	(0.0945)
Male	-0.1106***	-0.1025***	-0.0769**	-0.0812**
	(0.0285)	(0.0296)	(0.0319)	(0.0321)
Black	0.0579	0.0001	-0.1053***	-0.1183***
	(0.1465)	(0.1316)	(0.0389)	(0.0373)
Hispanic	-0.0866	-0.1317	0.1280*	0.1527**
	(0.1362)	(0.1196)	(0.0725)	(0.0614)
Asian	-0.0561	-0.0903	0.1149	0.1999
	(0.1464)	(0.1309)	(0.1501)	(0.1566)
Multiracial	-0.1812	-0.2358	0.1738**	0.1711**
	(0.2380)	(0.2326)	(0.0838)	(0.0832)
American Indian		-0.0668	-0.0732	
			(0.1186)	(0.1175)
Free lunch	-0.0756	-0.0754	-0.1230***	-0.1256***
	(0.0485)	(0.0501)	(0.0338)	(0.0337)
Reduced Lunch	0.0880	0.0849	-0.0869*	-0.1007**
	(0.0847)	(0.0870)	(0.0447)	(0.0441)
Was LEP			-0.0972	-0.1033

			(0.0966)	(0.1106)
Is LEP			-0.1537*	-0.1875**
			(0.0859)	(0.0790)
Gifted	0.1983**	0.1974**	0.4382***	0.4464***
	(0.0942)	(0.0958)	(0.0924)	(0.0938)
Special Education	-0.1539**	-0.1494**		
	(0.0614)	(0.0669)		
Underage	0.1820*	0.1688	0.0156	0.0229
	(0.1063)	(0.1096)	(0.2436)	(0.2396)
Overage	-0.0513	-0.0539	-0.1116***	-0.1154***
	(0.0326)	(0.0333)	(0.0318)	(0.0313)
Days absent	-0.0065***	-0.0062***	-0.0087***	-0.0090***
	(0.0017)	(0.0018)	(0.0015)	(0.0015)
Moved in year	-0.0038	-0.0007	-0.0342	-0.0379
	(0.0888)	(0.0898)	(0.0688)	(0.0701)
Peer Achievement	0.1129**	0.1006*	0.1651***	0.1605***
	(0.0510)	(0.0552)	(0.0440)	(0.0429)
Variation in peer achievement	-0.2698**	-0.2173	-0.0939	-0.0607
	(0.1337)	(0.1349)	(0.1036)	(0.1013)
Female teacher	0.1371**	0.1292**	0.1177**	0.1242***
	(0.0611)	(0.0607)	(0.0463)	(0.0436)
Teaching experience	0.0562***	0.0555***	0.0629***	0.0820***
	(0.0166)	(0.0169)	(0.0154)	(0.0158)
Bachelor's degree	0.0161	-0.1065	-0.1700*	-0.1251
	(0.1334)	(0.1583)	(0.0888)	(0.0966)
Remedial curriculum	-0.0195	-0.0214	0.1052*	0.0914
	(0.0933)	(0.0951)	(0.0598)	(0.0625)
Advanced curriculum	0.0353	0.0285	0.2129***	0.2030***
	(0.0728)	(0.0735)	(0.0657)	(0.0634)
Class size	0.0008	-0.0007	-0.0006	-0.0002
	(0.0040)	(0.0040)	(0.0030)	(0.0033)
Black teacher	0.0344	0.0378	0.0543	0.0461
	(0.0894)	(0.0916)	(0.0531)	(0.0522)
Asian teacher	0.1661*	0.1148	0.2760***	0.2307***
	(0.0920)	(0.0971)	(0.0766)	(0.0685)
Hispanic teacher	0.0101	0.5456**	0.2419**	0.2942***
	(0.2236)	(0.2579)	(0.1013)	(0.1079)
American Indian teacher	0.1210	0.1250	0.3160***	0.2881***
	(0.0986)	(0.1017)	(0.0768)	(0.0861)
Multiracial teacher	-0.0242	0.0715		

	(0.2077)	(0.1961)		
Other race teacher	-0.1014	-0.1522	0.1430*	0.1280
	(0.1850)	(0.1630)	(0.0831)	(0.0804)
HS License	-0.0080	0.3066	0.0085	0.1057
	(0.1533)	(0.2090)	(0.1100)	(0.1103)
School level % Asian	0.0012	0.0012	0.0126**	0.0152***
	(0.0070)	(0.0071)	(0.0049)	(0.0048)
School level % Black	0.0002	-0.0002	0.0019*	0.0015
	(0.0012)	(0.0013)	(0.0011)	(0.0011)
School level % Hispanic	-0.0057*	-0.0065**	-0.0034	-0.0032
	(0.0029)	(0.0028)	(0.0032)	(0.0032)
School level % Multiracial	0.0078	0.0068	-0.0083	-0.0113
	(0.0139)	(0.0135)	(0.0096)	(0.0094)
School level % American Indian	0.0061	0.0042	-0.0005	0.0011
	(0.0126)	(0.0131)	(0.0035)	(0.0038)
School level % FRL	0.0046***	0.0045***	-0.0000	0.0007
	(0.0015)	(0.0015)	(0.0012)	(0.0013)
Per pupil expenditure	-0.0009	-0.0013	0.0001	-0.0004
	(0.0010)	(0.0010)	(0.0008)	(0.0008)
Educational Psychology		-0.3780**		0.0010
		(0.1580)		(0.0756)
Development		0.0422		0.2057***
		(0.1025)		(0.0704)
Special Education class		0.0150		-0.0957
		(0.0839)		(0.0743)
Teaching ELLs		0.0576		-0.0039
		(0.1444)		(0.1792)
Classroom management		0.1437		0.0317
		(0.1104)		(0.0751)
Constant	-0.0759	0.1871	0.0394	-0.1230
	(0.2402)	(0.2647)	(0.1841)	(0.2420)
R-sq				
N	1321	1321	2110	2110
Standard errors in parentheses				
* p<0.10, ** p<0.05, *** p<0.01				

References

Aaronson, D., Barrow, L., & Sander, W. (2007). Teachers and student achievement in the Chicago public high schools. *Journal of Labor Economics, 25*(1), 95-135.

Aldosary, A. S., & Assaf, S. A. (1996). Analysis of factors influencing the selection of college majors by newly admitted students. *Higher Education Policy*, *9*(3), 215-220.

Allday, R. A., Neilsen-Gatti, S., & Hudson, T. M. (2013). Preparation for Inclusion in Teacher Education Pre-Service Curricula. *Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children*, *36*(4), 298-311.

Allen, M. (2003). Eight Questions on Teacher Preparation: What Does the Research Say? A Summary of Findings. Denver, CO: Education Commission of the States.

American Association of Colleges of Teacher Education. (2012a). Where We Stand: Clinical Preparation. Washington, D.C.: AACTE.

American Association of Colleges of Teacher Education. (2012b). Where We Stand: Selectivity of Education Preparation Programs. Washington, D.C.: AACTE.

Andrew, M., Cobb, C., & Giampietro, P. (2005). Verbal ability and teacher effectiveness. *Journal of Teacher Education, 56*(4), 343-354.

Angrist, J. D., & Guryan, J. (2008). Does teacher testing raise teacher quality? Evidence from state certification requirements. *Economics of Education Review*, *27*(5), 483-503.

Angrist, J., & Lavy, V. (2001). The Effect of Teachers' Training on Student Achievements. *Journal of Labor Economics*, *19*(2), 343-369.

Arcidiacono, P. (2004). Ability sorting and the returns to college major. *Journal of Econometrics*, *121*(1), 343-375.

Arcidiacono, P., Hotz, V. J., & Kang, S. (2012). Modeling college major choices using elicited measures of expectations and counterfactuals. *Journal of Econometrics*, *166*(1), 3-16.

Arends, R. & Winitzky, N. (1996). Program structures and learning to teach. In F. Murray (Ed.), *The Teacher Educator's Handbook* (pp. 526-556). San Francisco: Jossey-Bass.

Ball, D., Thames, M., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education, 59*(5) 389-407.

Ballou, D., & Podgursky, M. (1998). The case against teacher certification. *The Public Interest, 132,* 17-29.

Barker, K. S., Shoho, A. R., & Van Reusen, A. K. (2000). High school teacher attitudes toward inclusion (statistical data included). *High School J*, *84*(2), 7-20.

Bastian, K. (2013). Do teachers' non-cognitive skills and traits predict effectiveness and evaluation ratings? Paper presented at the 38th annual conference of the Association for Education Finance and Policy, New Orleans, LA.

Bastian, K. & Henry, G. (2014). Teachers without borders: consequences of teacher labor force mobility. Manuscript submitted for publication.

Beisenherz, P. & Dantonio, M. (1991). Preparing secondary teachers to student science teaching. *Journal of Science Teacher Education, 2*(2) 40-44.

Betts, J. R., Zau, A., & Rice, L. (2003). *Determinants of student achievement: New evidence from San Diego* (pp. 1-5821). San Francisco: Public Policy Institute of California.

Boe, E. E., Bobbitt, S. A., Cook, L. H., Whitener, S. D., & Weber, A. L. (1997). Why didst thou go? Predictors of retention, transfer, and attrition of special and general education teachers from a national perspective. *The Journal of Special Education*, *30*(4), 390-411.

Borko, H. & Mayfield, V. (1995). The roles of the cooperating teacher and university supervisor in learning to teach. *Teaching and Teacher Education, 11*(5), 501-518.

Borko, H., Michalec, P., Siddle, J., & Timmons, M. (1997). Student teaching portfolios: A tool for promoting reflective practice. *Journal of Teacher Education, 48*(5), 345-357.

Boyd, D., Dunlop, E., Lankford, H., Loeb, S., Mahler, P., O'Brien, R., & Wyckoff, J. Alternative Certification in the Long Run: A Decade of Evidence on the Effects of Alternative Certification in New York City. Paper presented at the 37th annual conference of the Association for Education Finance and Policy, Boston, MA.

Boyd, D., Goldhaber, D., Lankford, H., & Wyckoff, J. (2007). The effect of certification and preparation on teacher quality. *The Future of Children, 17*(1) 45-68.

Boyd, D., Grossman, P. L., Hammerness, K., Lankford, R. H., Loeb, S., McDonald, M., Reininger, M., Ronfeldt, M., & Wyckoff, J. (2008). Surveying the landscape of teacher education in New York City: Constrained variation and the challenge of innovation. *Educational Evaluation and Policy Analysis*, *30*(4), 319-343.

Boyd, D., Grossman, P., Lankford, H., Loeb, S., & Wyckoff, J. (2006). How changes in entry requirements alter the teacher workforce and affect student achievement. *Education*, *1*(2), 176-216.

Boyd, D., Grossman, P., Lankford, H., Loeb, S., & Wyckoff, J. (2009). Teacher preparation and student achievement. *Educational Evaluation and Policy Analysis*, *31*(4), 416-440.

Boyd, D., Lankford, H., Loeb, S., Rockoff, J., & Wyckoff, J. (2008). The narrowing gap in New York City teacher qualifications and its implications for student achievement in high-poverty schools. *Journal of Policy Analysis and Management*, *27*(4), 793-818.

Brouwer, N., & Korthagen, F. (2005). Can teacher education make a difference?. *American Educational Research Journal*, *42*(1), 153-224.

Brown, Patrick, Patricia Friedrichsen, and Sandra Abell. "The Development of Prospective Secondary Biology Teachers PCK." *Journal of Science Teacher Education* 24.1 (2013): 133-155.

Brush, T., Glazewski, K., Rutowski, K., Berg, K., Stromfors, C., Van-Nest, M. H., Stock, L. & Sutton, J. (2003). Integrating technology in a field-based teacher training program: The PT3@ ASU project. *Educational Technology Research and Development*, *51*(1), 57-72.

Burant, T. (1999). Finding, using, and losing(?) voice: A preservice teachers' experiences in an urban *educative practicum. Journal of Teacher Education, 50*(3), 209-219.

Burks, M. P. (1987). *Requirements for Certification for Elementary Schools, Secondary Schools, Junior Colleges: Teachers, Counselors, Librarians, Administrators. 1987-88*. The University of Chicago Press, 580l S. Ellis Ave., Chicago, IL 60637.

Capps, R., Fix, M., Murray, J., Ost, J., Passel, J., & Herwantoro-Hernandez, S. (2005). *The new demography of America's schools: Immigration and the No Child Left Behind Act*. Washington, DC: Urban Institute.

Casey, C. & Childs, R. (2007). Teacher education program admission criteria and what beginning teachers need to know to be successful teachers. *Canadian Journal of Educational Administration and Policy, 67.*

Caskey, M., Peterson, K., & Temple, J. (2001). Complex admission selection procedures for a graduate preservice teacher education program. *Teacher Education Quarterly, 28*(4) 7-21.

Causey, V., Thomas, C., & Armento, B. (2000). Cultural diversity is basically a foreign term to me: The challenges of diversity for preservice teacher education. *Teaching and Teacher Education, 16*(1), 33-45.

Causey, V. E., Thomas, C. D., & J Armento, B. (2000). Cultural diversity is basically a foreign term to me: The challenges of diversity for preservice teacher education. *Teaching and Teacher Education*, *16*(1), 33-45.

Cheng, M., Tang, S., & Cheng, A. (2012). Practicalising theoretical knowledge in student teachers' professional learning in initial teacher education. *Teaching and Teacher Education, 28,* 781-790.

Clabaugh, G. & Rozycki, E. (1996). Foundations of education and the devaluation of teacher preparation. In F. Murray (Ed.), *The Teacher Educator's Handbook: Building a Knowledge Base for the Preparation of Teachers. (pp. 395-418).* San Francisco: Jossey-Bass.

Clark, M., Chiang, H., McConnell, S., Silva, T., Sonnenfeld, K., Erbe, A., & Puma, M. (2013). *The Effectiveness of Secondary Math Teachers from Teach For America and the Teaching Fellows Programs* (No. 7890). Mathematica Policy Research.

Clark, S., Jones, C., Reutzel, D.R., Andreasen, L. (2013). An examination of the influences of a teacher preparation program on beginning teachers' reading instruction. *Literacy Research and Instruction, 52*(2), 87-105.

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2007). Teacher credentials and student achievement: Longitudinal analysis with student fixed effects. *Economics of Education Review*, *26*(6), 673-682.

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2010). Teacher credentials and student achievement in high school a cross-subject analysis with student fixed effects. *Journal of Human Resources*, *45*(3), 655-681.

Cochran-Smith, M. (2005). 2005 Presidential address: The new teacher education: For better or for worse? *Educational Researcher,* 37(7) 3-17.

Coleman, J. S., Campbell, E. Q., Hobson, C. J., McPartland, J., Mood, A. M., Weinfeld, F. D., & York, R. (1966). *Equality of educational opportunity*. Washington, D.C.

College Board. (2005). 2005 college-bound seniors: Total group profile report. New York: College Board.

Conderman, G., & Johnston-Rodriguez, S. (2009). Beginning teachers' views of their collaborative roles. *Preventing School Failure*, 53, 235-244.

Conklin, H. G. (2012). Company Men Tracing Learning from Divergent Teacher Education Pathways Into Practice in Middle Grades Classrooms. *Journal of Teacher Education*, *63*(3), 171-184.

Council for the Accreditation of Education Preparation. (2013). Draft Recommendations for the CAEP Board. CAEP: Washington, DC.

Crampton, W. J., Walstrom, K. A., & Schambach, T. P. (2006). Factors influencing major selection by college of business students. *Issues in Information Systems*, *7*(1), 226-230.

Daisey, P. (2012). The promise of secondary content area literacy field experiences. *Literacy Research and Instruction, 51*(3) 214-232.

Darling-Hammond, L. (1996). What matters most: Teaching for America's future. *National Commission on Teaching and America's Future*.

Darling-Hammond, L. (1999). *Teacher quality and student achievement: A review of state policy evidence*. Seattle, WA: Center for the Study of Teaching and Policy, University of Washington.

Darling-Hammond, L. (2006). Constructing 21st-century teacher education. *Journal of Teacher Education, 57*(3), 300-314.

Darling-Hammond, L. & Cobb, V. (1996). The changing context of teacher education. In F. Murray (Ed.), *The Teacher Educator's Handbook* (pp. 14-62). San Francisco: Jossey-Bass.

Darling-Hammond, L. and MacDonald, M. (2000). Where there is learning there is hope: The preparation of teachers at the Bank Street College of Education. In L. Darling-Hammond (Ed.), *Studies of excellence in teacher education: Preparation at the graduate level* (pp. 1-95). Washington, D.C. American Association of Colleges for Teacher Education.

Darling-Hammond, L., Hammerness, K., Grossman, P., Rust, F., & Shulman, L. (2005). The design of teacher education programs. In L. Darling-Hammond and J. Bransford (Eds.), *Preparing Teachers for a Changing World* (390-441). San Francisco: Jossey-Bass.

Darling-Hammond, L., Holtzman, D., Gatlin, S., & Henig, J. (2005). Does teacher preparation matter? Evidence about teacher certification, Teach for America, and teacher effectiveness. *Education Policy Analysis Archives, 13*(42).

Dexter, S., & Riedel, E. (2003). Why improving preservice teacher educational technology preparation must go beyond the college's walls. *Journal of teacher education*, *54*(4), 334-346.

Dinkelman, T. (2000). An inquiry into the development of critical reflection in secondary student teachers. *Teaching and Teacher Education, 16, 195-222.*

Dobbie, William. (2011). Teacher characteristics and student achievement: Evidence from Teach For America. Available from: http://www.people.fas.harvard.edu.

Dotts, B. (2013). Schooling in the 'Iron Cage'and the Crucial Role of Interpretive, Normative, and Critical Perspectives in Social Foundations Studies. *Educational Studies*, *49*(2), 148-168.

Druva, C. & Anderson, R. (1983). Science teacher characteristics by teacher behavior and by student outcome: A meta-analysis of research. *Journal of Research in Science Teaching, 20*(5) 467-379.

Eckert, S.A. (2013). What do teaching qualifications mean in urban schools? A mixed-methods study of teacher preparation and qualification. *Journal of Teacher Education, 64*(1) 75-89.

Evans, C., Arnot-Hopffer, E., & Jurich, D. (2005). Making ends meet: Bringing bilingual education and mainstream students together in preservice teacher education. *Equity & Excellence in Education*, *38*(1), 75-88.

Evertson, C. M., Hawley, W. D., & Zlotnik, M. (1985). Making a difference in educational quality through teacher education. *Journal of Teacher Education*,*36*(3), 2-12.

Fairbanks, C., Freedman, D., & Kahn, C. (2000). The role of effective mentors in learning to teach. *Journal of Teacher Education, 51*(2), 102-112.

Feiman-Nemser, S. (1990). Teacher preparation: Structural and conceptual alternatives. In W. Robert Houston (Ed.), *Handbook of Research on Teacher Education* (212-233). New York: MacMillan.

Feiman-Nemser, S. (2001). From preparation to practice: Designing a continuum to strengthen and sustain teaching. Teachers College Record, 103, 1013 – 1055.

Feiman-Nemser, S. (2001). Helping novice teachers learn to teach: Lessons from an exemplary support teacher. *Journal of Teacher Education, 52*(1), 17-30.

Feiman-Nemser, S., & Buchmann, M. (1987). When is student teaching teacher education?. *Teaching and teacher education*, *3*(4), 255-273.

Fendler, L. (2012). The Magic of Psychology in Teacher Education. *Journal of Philosophy of Education*, *46*(3), 332-351.

Ferguson, R. F.,& Ladd, H. F. (1996). How and why money matters: An analysis of Alabama schools. In H. F. Ladd (Ed.), *Holding schools accountable: Performance-based reform in education* (pp. 265-298). Washington, DC: Brookings Institution.

Fletcher, S. & Luft, J. (2011). Early career secondary science teachers: A longitudinal study of beliefs in relation to field experiences. *Science Teacher Education, 95,* 1124-1146.

Floden, R. E., & Meniketti, M. (2005). Research on the effects of coursework in the arts and sciences and in the foundations of education. In M. Cochran-Smith & K. M. Zeichner (Eds.), *Studying teacher education: The report of the AERA panel on research and teacher education* (pp. 261–308). Mahwah, NJ: Erlbaum.

Forlin, Chris, and Dianne Chambers. "Teacher preparation for inclusive education: Increasing knowledge but raising concerns." *Asia-Pacific Journal of Teacher Education* 39.1 (2011): 17-32.

Friedrichsen, P. J., Abell, S. K., Pareja, E. M., Brown, P. L., Lankford, D. M., & Volkmann, M. J. (2009). Does teaching experience matter? Examining biology teachers' prior knowledge for teaching in an alternative certification program. *Journal of Research in Science Teaching*, *46*, 357-383.

Gandara, P., Maxwell-Jolly, J., & Driscoll, A. (2005). Listening to Teachers of English Language Learners: A Survey of California Teachers' Challenges, Experiences, and Professional Development Needs. *Policy Analysis for California Education*, Berkeley, CA.

Gansle, K. A., Noell, G. H., & Burns, J. M. (2012). Do student achievement outcomes differ across teacher preparation programs? An analysis of teacher education in Louisiana. *Journal of Teacher Education*, *63*(5), 304-317.

García, E., & Jensen, B. (2009). Early educational opportunities for children of Hispanic origins. *Social Policy Report*, *23*(2), 1-20.

Giroux, H. A., & McLaren, P. (1986). Teacher education and the politics of engagement: The case for democratic schooling. *Harvard Educational Review*,*56*(3), 213-239.

Gitomer, D. & Latham, A. (1999). *The academic quality of prospective teachers: The impact of admissions and licensure testing*. Educational Testing Service: Princeton, NJ.

Glazerman, S., Isenberg, E., Dolfin, S., Bleeker, M., Johnson, A., Grider, M., & Jacobus, M. (2010). *Impacts of comprehensive teacher induction: Final results from a randomized controlled study* (No. 6811). Mathematica Policy Research.

Glazerman, S., Mayer, D., & Decker, P. (2006). Alternative routes to teaching: The impacts of Teach for America on student achievement and other outcomes. *Journal of Policy Analysis and Management*, *25*(1), 75-96.

Goldhaber, D. (2007). Everyone's Doing It, But What Does Teacher Testing Tell Us About Teacher Effectiveness?. *Journal of Human Resources*, *42*(4), 765-794.

Goldhaber, D. and Brewer, D. (1997). Why don't schools and teachers seem to matter? Assessing the impact of unobservables on educational productivity. *Journal of Human Resources, 32*(3) 505-523.

Goldhaber, D and Brewer, D. (2000). Does teacher certification matter? High school teacher certification status and student achievement. *Educational evaluation and policy analysis*, *22*(2), 129-145.

Goldhaber, D., & Hansen, M. (2010). Using performance on the job to inform teacher tenure decisions. *The American Economic Review*, 250-255.

Goldhaber, D., Liddle, S., & Theobald, R. (2013). The gateway to the profession: Assessing teacher preparation programs based on student achievement. *Economics of Education Review*, *34*, 29-44.

Goodlad, J. I. (1990). *Teachers for our nation's schools*. San Francisco: Jossey-Bass.

Graham, P. (1997). Tensions in the mentor teacher-student teacher relationship: Creating productive sites for learning within a high school English teacher education program. *Teaching and Teacher Education, 13*(5), 513-527.

Greenberg, J., McKee, A., & Walsh, K. (2013). Teacher Prep Review: A Review of the Nation's Teacher Preparation Programs. Washington, D.C.: National Council on Teacher Quality.

Greenwald, R., Hedges, L. V., & Laine, R. D. (1996). The effect of school resources on student achievement. *Review of educational research*, *66*(3), 361-396.

Griffin, G. (1989). A descriptive study of student teaching. *Elementary School Journal, 89*(3), 343-364.

Grossman, P. (2008). Responding to our critics: From crisis to opportunity in research on teacher education." *Journal of Teacher Education, 59*(10), 1-23.

Guyton, E., & McIntyre, D. J. (1990). Student teaching and school experiences. In W. Robert Houston (Ed.), *Handbook of research on teacher education*, *1*, 514-534. New York: MacMillan.

Haberman, M. (1986) Proposals for recruiting minority teachers: Promising practices and attractive detours. *Journal of Teacher Education*, 39(4), 38-44.

Hadadian , A., & Chiang, L. (2007). Special education training and preseervice teachers. *International Journal of Special Education*. 22(1).

Hanich, L. B., & Deemer, S. (2005). The relevance of educational psychology in teacher education programs. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *78*(5), 189-191.

Harper, C. A., & de Jong, E. J. (2009). English language teacher expertise: The elephant in the room. *Language and Education*, *23*(2), 137-151.

Harris, D. N., & Sass, T. R. (2011). Teacher training, teacher quality and student achievement. *Journal of public economics*, *95*(7), 798-812.

Henry, G.T., Bastian, K., Fortner, C.K., Kershaw, D., Purtell, K., Thompson, C., & Zulli, R. (in press). Teacher preparation policies and their effects on student achievement. *Education Finance and Policy.*

Henry, G. T., Bastian, K. C., & Smith, A. A. (2012). Scholarships to Recruit the "Best and Brightest" Into Teaching Who Is Recruited, Where Do They Teach, How Effective Are They, and How Long Do They Stay?. *Educational Researcher*, *41*(3), 83-92.

Henry, G. T., Campbell, S. L., Thompson, C. L., Patriarca, L. A., Luterbach, K. J., Lys, D. B., & Covington, V. M. (2013). The Predictive Validity of Measures of Teacher Candidate Programs and Performance Toward an Evidence-Based Approach to Teacher Preparation. *Journal of Teacher Education*, *64*(5), 439-453.

Henry, G. T., Kershaw, D. C., Zulli, R. A., & Smith, A. A. (2012). Incorporating teacher effectiveness into teacher preparation program evaluation. *Journal of Teacher Education*, *63*(5), 335-355.

Henry, G.T, Patterson, K., Campbell, S., & Yi, P. (2013). UNC Teacher Quality Report: 2013 Teacher Preparation Program Effectiveness Report. Chapel Hill, NC: Education Policy Initiative at Carolina.

Henry, G. T., Purtell, K. M., Bastian, K. C., Fortner, C. K., Thompson, C. L., Campbell, S. L., & Patterson, K. M. (2014). The Effects of Teacher Entry Portals on Student Achievement. *Journal of Teacher Education*, *65*(1), 7-23.

Henry, G. T., Thompson, C., Bastian, K., Fortner, C. K., Kershaw, D., & Zulli, R. (2010). *The impact of teacher preparation on student learning in North Carolina public schools*. Carolina Institute for Public Policy.

Henry, G. T., Thompson, C., Bastian, K., Fortner, C. K., Kershaw, D., Purtell, K., & Zulli, R. (2010). *Portal report: Teacher preparation and student test scores in North Carolina*. Carolina Institute for Public Policy.

Henry, G. T., Thompson, C. L., Fortner, C. K., Zulli, R. A., & Kershaw, D. C. (2010). *The impact of teacher preparation on student learning in North Carolina public schools*. UNC Chapel Hill, Carolina Institute for Public Policy.

Hobson, A. J., Ashby, P., Malderez, A., & Tomlinson, P. D. (2009). Mentoring beginning teachers: What we know and what we don't. *Teaching and teacher education*, *25*(1), 207-216.

Hodkinson, A. (2006). Conceptions and misconceptions of inclusive education-one year on: A critical analysis of newly qualified teachers' knowledge and understanding of inclusion. Research in Education, 76, 43-55.

Holt-Reynolds, D. (1999). Good readers, good teachers? Subject matter expertise as a challenge in learning to teach. *Harvard Educational Review, 69*(1) 29-50.

Howey, K. and Zimpher, N. (1989). Profiles of Preservice Teacher Education. Albany, NY: State University of New York Press.

Howey, K. & Zimpher, N. (1996). Patterns in prospective teachers. In F. Murray (Ed.), *The Teacher Educator's Handbook* (pp. 14-62). San Francisco: Jossey-Bass.

Hoy, A. (2000). Educational psychology in teacher education.*Educational Psychologist*, *35*(4), 257-270.

Hsu, P. S. (2012). Examining the impact of educational technology courses on pre-service teachers' development of technological pedagogical content knowledge. *Teaching Education*, *23*(2), 195-213.

Imig, D. & Imig, S. (2008). From traditional certification to competitive certification: A twenty-five year retrospective. In Cochran-Smith, M., Feiman Nemser, S., & McIntyre, D. J. (Eds.), Handbook of research on teacher education: Enduring issues in changing contexts, 3rd ed. Washington, DC: Association of Teacher Educators.

Interstate New Teacher Assessment and Support Consortium. (2001). Model standards for licensing general and special education teachers of students with disabilities: A resource for state dialogue. Washington, D.C.: Council of Chief State School Officers.

Jacob, B. A., & Lefgren, L. (2004). The Impact of Teacher Training on Student Achievement Quasi-Experimental Evidence from School Reform Efforts in Chicago. *Journal of Human Resources*, *39*(1), 50-79.

Kane, T., Rockoff, J., & Staiger, D. (2008). What does certification tell us about teacher effectiveness? Evidence from New York City. *Economics of Education Review, 27,* 615-631.

Kay, E. (2008). *Requirements for certification of teachers, counselors, librarians, administrators.* 73rd edition. Chicago: University of Chicago Press.

Kleickmann, T., Richter, D., Kunter, M., Elsner, J., Besser, M., Krauss, S., & Baumert, J. (2013). Teachers' content knowledge and pedagogical content knowledge: The role of structural differences in teacher education. *Journal of Teacher Education, 64*(1) 90-106.

Knapp, N. F. (2005). " They're Not All Like Me!": The Role of Educational Psychology in Preparing Teachers for Diversity. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *78*(5), 202-206.

Koedel, C., Parsons, E., Podgursky, M., & Ehlert, M. (2012). Teacher Preparation Programs and Teacher Quality: Are There Real Differences Across Programs?. *National Center for Analysis for Longitudinal Data in Education Research, Working Paper*, *79*.

Koerner, J. D. (1963). *The miseducation of American teachers*. Boston: Houghton Mifflin.

Koppich, J. (2000). Trinity University: Preparing teachers for tomorrow's schools. *Studies of excellence in teacher education: Preparation in a five-year program*, 1-48. Washington, D.C. American Association of Colleges for Teacher Education.

Labaree, D. F. (2004). *The Trouble with Ed Schools*. New Haven, CT: Yale University Press.

Labaree, D. (2008). An uneasy relationship: the history of teacher education in the university. In M. Cochran-Smith, et. al. (Eds.): *Handbook of Research on Teacher Education*: *Enduring Questions in Changing Contexts*, 290.

Laczko-Kerr, I. & Berliner, D. (2002). The effectiveness of "Teach for America" and other under-certified teachers on student academic achievement: A case of harmful public policy," *Education Policy Analysis Archives*, *10*(37).

Ladd, H. F. (2011). Teachers' Perceptions of Their Working Conditions How Predictive of Planned and Actual Teacher Movement?. *Educational Evaluation and Policy Analysis*, *33*(2), 235-261.

Lankford, H., Loeb, S., & Wyckoff, J. (2002). Teacher sorting and the plight of urban schools: A descriptive analysis. *Educational evaluation and policy analysis*, *24*(1), 37-62.

Levine, A. (2006). Educating School Teachers. Washington, D.C.: The Education Schools Project.

Liakopoulou, M. (2012). The role of field experience in the preparation of reflective teachers. *Australian Journal of Teacher Education, 37*(6), 42-54.

Liston, D., Whitcomb, J. & Borko, H. (2009). The end of education in teacher education: Thoughts on reclaiming the role of social foundations in teacher education. *Journal of Teacher Education, 60*(2) 107-111.

Little, J. W. (1990). The mentor phenomenon and the social organization of teaching. *Review of research in education*, 297-351.

Loeb, S., Darling-Hammond, L., & Luczak, J. (2005). How teaching conditions predict teacher turnover in California schools. *Peabody Journal of Education*,*80*(3), 44-70.

Loughran, J. & Corrigan, D. (1995). Teaching portfolios: A strategy for developing learning and teaching in preservice education. *Teaching and Teacher Education, 11*(6), 565-577.

Lucas, T., Villegas, A.M., & Freedson-Gonzalez, M. (2008). Linguistically responsive teacher education: Preparing classroom teachers to teach English Language Learners. *Journal of Teacher Education, 59*(4) 361-373.

Lutz, F.W. & Hutton, J.B. (1989). Alternative teacher certification: Its policy implications for classroom and personnel practice. *Educational Evaluation and Policy Analysis, 11*(3), 237-254.

McAninch, S. & McAninch, A.R. (1996). The social foundations of education: Retrospect and prospect. In F. Murray (Ed.), *The Teacher Educator's Handbook: Building a Knowledge Base for the Preparation of Teachers. (pp. 381-394).* San Francisco: Jossey-Bass.

McDiarmid, G.W. (1990). *What to do about differences? A study of multicultural education for teacher trainees in the Los Angeles Unified School District.* East Lansing, MI: National Center for Research on Teacher Education.

McHatton, P. A., & Parker, A. (2013). Purposeful Preparation Longitudinally Exploring Inclusion Attitudes of General and Special Education Pre-Service Teachers. *Teacher Education* *and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children*, *36*(3), 186-203.

Menken, K., & Antunez, B. (2001). An Overview of the Preparation and Certification of Teachers Working with Limited English Proficient (LEP) Students. National Clearinghouse for Bilingual Education. Washington, D.C.

Meyer, D. & Tusin, L. (1999). Preservice teachers' perceptions of portfolios: Process versus product. *Journal of Teacher Education, 50*(2), 131-139.

Mihaly, K., McCaffrey, D., Sass, T., & Lockwood, J.R. (2013). Where you come from or where you go? Distinguishing between school quality and the effectiveness of teacher preparation program graduates. *Education Finance and Policy, 8*(4), 459-493.

Milner, H.R. (2010). What does teacher education have to do with teaching? Implications for diversity studies. *Journal of Teacher Education, 61*(1-2), 118-131.

Monk, D. (1994). Subject matter preparation of secondary mathematics and science teachers and student achievement. *Economics of Education Review, 13*(2) 125-145.

National Academy of Education. (2005). *A good teacher in every classroom: Preparing the highly qualified teachers our children deserve*. San Francisco, CA: Wiley.

National Center for Educational Statistics. (2000). Progress through the teacher pipeline: 1992-93 college graduates and elementary/ secondary school teaching as of 1997. Washington, D.C.

National Center for Educatonal Statistics. (2007). To teach or not to teach?: Teaching experience and preparation among 1992-93 bachelor's degree recipients 10 years after college. Washington, D.C.

National Clearinghouse for English Language Acquisition. (2010). North Carolina Rate of EL Growth 1997/1998-2007/2008.

National Council for Accreditation of Teacher Education. (2010). Transforming Teacher Education through Clinical Practice: A National Strategy to Prepare Effective Teachers. Washington, D.C.

National Council for the Social Studies. (2004). National Standards for Social Studies Teachers.

National Council of Teachers of English. (2003). NCTE/NCATE Program Standards: Program for Initial Preparation of Teachers of Secondary English Language Arts Grades 7-12.

National Council of Teachers of English. (2012). NCTE/NCATE Program Standards: Program for Initial Preparation of Teachers of Secondary English Language Arts Grades 7-12.

National Council of Teachers of Mathematics. (2003). NCATE/NCTM Program standards:

Programs for initial preparation for mathematics teachers.

National Science Teachers Association. (2012). NSTA Preservice Science Standards.

Ng, W., Nicholas, H., & Williams, A. (2010). School experience influences on pre-service teachers' evolving beliefs about effective teaching. *Teaching and Teacher Education, 26*(2), 278-289.

Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and Teacher Education*, *21*(5), 509-523.

Nieto, S. (2003). Challenging current notions of "Highly Qualified Teachers" through work in a teachers' inquiry group. *Journal of Teacher Education, 54*(5), 386-398.

Noell, G., Porter, B., Pratt, R.M., & Dahir, A. (2008). Value Added Assessment of Teacher Preparation in Louisiana: 2004-2005 to 2006-2007. Baton Rouge, LA: Louisiana State University.

North Carolina Department of Public Instruction. (2005). North Carolina Program Approval Standards. Raleigh, NC: State Board of Education. Retrieved from http://www.ncpublicschools.org/docs/ihe/materials/programstandards.pdf

North Carolina Department of Public Instruction. (2013b).

Null, J.W. (2008). Is there a future for teacher education curriculum? *American Educational History Journal,* 35(1): 3-18.

Nye, B., Konstantopoulos, S., & Hedges, L. V. (2004). How large are teacher effects?. *Educational evaluation and policy analysis*, *26*(3), 237-257.

Ogren, C. (2005). *The American State Normal School.* New York: Palgrave Macmillan.

Parsons, E., Ehlert, M., Koedel, C., & Podgursky, M. (2013). Teacher preparation programs and teacher quality: Are there real differences across programs? Paper presented at the 38th annual meeting of the Association for Education Finance and Policy, New Orleans, LA.

Patrick, H., Anderman, L. H., Bruening, P. S., & Duffin, L. C. (2011). The role of educational psychology in teacher education: Three challenges for educational psychologists. *Educational Psychologist*, *46*(2), 71-83.

Plecki, M. L., Elfers, A. M., & Nakamura, Y. (2012). Using Evidence for Teacher Education Program Improvement and Accountability An Illustrative Case of the Role of Value-Added Measures. *Journal of Teacher Education*,*63*(5), 318-334.

Raymond, M., Fletcher, S., & Luque, J. (2001). Teach for America: An evaluation of teacher differences and student outcomes in Houston, Texas. Palo Alto, CA: Center for Research on Education Outcomes.

Rivkin, S. G., Hanushek, E. A., & Kain, J. F. (2005). Teachers, schools, and academic achievement. *Econometrica*, *73*(2), 417-458.

Rockoff, J. E. (2004). The impact of individual teachers on student achievement: Evidence from panel data. *American Economic Review*, 247-252.

Rockoff, J., Jacob, B., Kane, T., & Staiger, D. (2011). Can you recognize an effective teacher when you recruit one? *Education Finance and Policy, 6*(1), 43-74.

Ronfeldt, M. (2012). Where should student teachers learn to teach? Effects of field placement school characteristics on teacher retention and effectiveness.*Educational Evaluation and Policy Analysis*, *34*(1), 3-26.

Ronfeldt, M., & Reininger, M. (2012). More or better student teaching?.*Teaching and Teacher Education*, *28*(8), 1091-1106.

Ronfeldt, M., Reininger, M., & Kwok, A. (2013). Recruitment or Preparation? Investigating the Effects of Teacher Characteristics and Student Teaching.*Journal of Teacher Education*, *64*(4), 319-337.

Rozelle, J. & Wilson, S. (2012). Opening the black box of field experiences: How cooperating teachers' beliefs and practices shape student teachers' beliefs and practices. *Teaching and Teacher Education, 28,* 1196-1205.

Rubin, D. B. (1974). Estimating causal effects of treatments in randomized and nonrandomized studies. *Journal of educational Psychology*, *66*(5), 688.

Russell, M., Bebell, D., O'Dwyer, L., & O'Connor, K. (2003). Examining teacher technology use implications for preservice and inservice teacher preparation.*Journal of Teacher Education*, *54*(4), 297-310.

Schwab, J. (1978). *Science*, *Curriculum, and liberal education.* Chicago: University of Chicago Press.

Schmidt, W. H., Cogan, L., & Houang, R. (2011). The role of opportunity to learn in teacher preparation: An international context. *Journal of Teacher Education*, *62*(2), 138-153.

Schweig, J. (2013). Cross-level measurement invariance in school and classroom environment surveys: Implications for policy and practice. In press, Educational Evaluation and Policy Analysis.

Sedlak, M. (2008). Competing visions of purpose, practice and policy: The history of teacher certification in the United States. In Cochran-Smith, Marilyn, Feiman Nemser, Sharon, & McIntyre, D. John (Eds.), Handbook of research on teacher education: Enduring issues in changing contexts, 3rd ed. Washington, DC: Association of Teacher Educators.

Shade, R. A., & Stewart, R. (2001). General education and special education preservice teachers' attitudes toward inclusion. *Preventing School Failure: Alternative Education for Children and Youth*, *46*(1), 37-41.

Shippen, M. E., Crites, S. A., Houchins, D. E., Ramsey, M. L., & Simon, M. (2005). Preservice teachers' perceptions of including students with disabilities.*Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children*, *28*(2), 92-99.

Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Research, 15*(2), 4-14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard educational review*, *57*(1), 1-23.

Smith, D. (1990). Intern satisfaction with cooperating teacher supervision. *The Alberta Journal of Educational Research, 36*(2), 133-140.

Smith, J. A., & Todd, P. E. (2001). Reconciling conflicting evidence on the performance of propensity-score matching methods. *American Economic Review*, 112-118.

Smith, R. (1999). Piecing it together: Student teachers building their repertoires in primary science. *Teaching and Teacher Education, 15*, 301-314.

Snyder, J. (2000). Knowing children-understanding teaching: The developmental teacher education program at the University of California-Berkeley. In L. Darling-Hammond (Ed.), *Studies of excellence in teacher education: Preparation at the graduate level* (pp. 1-95). Washington, D.C. American Association of Colleges for Teacher Education.

Stinebrickner, T. R., & Stinebrickner, R. (2011). *Math or science? Using longitudinal expectations data to examine the process of choosing a college major* (No. w16869). National Bureau of Economic Research.

Stoddart, T. (1990). *Perspectives on Guided Practice*. National Center for Research on Teacher Education.

Stoddart, T., & Floden, R. (1995). Traditional and alternative routes to teacher certification: Issues, assumptions, and misconceptions. *East Lansing, MI: National Center for Research on Teacher Learning*.

Stodden, R. A., Galloway, L. M., & Stodden, N. J. (2003). Secondary school curricula issues: Impact on postsecondary students with disabilities.*Exceptional Children*, *70*(1), 9-25.

Summers, A. A., & Wolfe, B. L. (1977). Do schools make a difference?. *The American Economic Review*, 639-652.

Tennessee Higher Education Commission. (2011). 2011 Report Card on the Effectiveness of Teacher Training Programs. Nashville, TN: State Board of Education.

Tennessee Higher Education Commission. (2012). 2012 Report Card on the Effectiveness of Teacher Training Programs. Nashville, TN: State Board of Education.

The White House, Office of the Press Secretary. (2014). FACT SHEET: Opportunity For All – Answering the President's Call to Enrich American Education Through ConnectED [Press Release]. Retrieved from http://www.whitehouse.gov/the-press-office/2014/02/04/fact-sheet-opportunity-all-answering-president-s-call-enrich-american-ed

Tozer, S., and McAninch, S. (1986). Social foundation of education in historical perspective. *Educational Foundations, 1*, 8-9.

Tryneski, J. (1993). *Requirements for Certification of Teachers, Counselors, Librarians, and Secondary Schools.* 57th ed. Chicago: University of Chicago Press.

Valencia, S. W., Martin, S. D., Place, N. A., & Grossman, P. (2009). Complex Interactions in Student Teaching Lost Opportunities for Learning. *Journal of Teacher Education*, *60*(3), 304-322.

Van Zandt, L. (1998). Assessing the effects of reform in teacher education: An evaluation of the 5-year MAT program at Trinity University. *Journal of Teacher Education, 49*(2), 120-131.

Walker, C. L., Ranney, S., & Fortune, T. W. (2005). Preparing preservice teachers for English language learners: A content-based approach. *Second language teacher education: International perspectives*, 313-333.

Walsh, K., & Jacobs, S. (2007). Alternative Certification Isn't Alternative. Washington, DC. Thomas B. Fordham Institute.

Whitehurst, G. (2002). Proceedings from White House Conference on Preparing Tomorrow's Teachers: *Scientifically Based Research on Teacher Quality: Research on Teacher Preparation and Professional Development.* Washington, D.C.

Whitford, B.L., Ruscoe, G., & Fickel, L. (2000). Knitting it all together: Collaborative teacher education in Southern Maine. In L. Darling-Hammond (Ed.), *Studies of excellence in teacher education: Preparation at the graduate level* (pp. 1-95). Washington, D.C. American Association of Colleges for Teacher Education.

Wilson, S. M., & Floden, R. E. (2003). *Creating Effective Teachers: Concise Answers for Hard Questions. An Addendum to the Report" Teacher Preparation Research: Current Knowledge, Gaps, and Recommendations."*. AACTE Publications, 1307 New York Avenue, NW, Suite 300, Washington, DC 20005-4701.

Wilson, S. M., Floden, R. E., & Ferrini-Mundy, J. (2001). *Teacher Preparation Research: Current Knowledge, Gaps, and Recommendations: a Research Report Prepared for the US Department of Education and the Office for Educational Research and Improvement, February 2001*. Center for the Study of Teaching and Policy.

Wilson, S. M., Floden, R. E., & Ferrini-Mundy, J. (2002). Teacher Preparation Research An Insider's View from the Outside. *Journal of teacher education*,*53*(3), 190-204.

Wilson, S., Rozelle, J. & Mikeska, J. (2011). Cacophony or embarrassment of riches: Building a system of support for quality teaching. *Journal of Teacher Education*, 62(4) 383-394.

Wiseman, D. (2012). The intersection of policy, reform, and teacher education. *Journal of Teacher Education, 63*(2) 87-91.

Woellner, E. (1984). *Requirements for Certification.* 49th edition. Chicago: University of Chicago Press.

Woellner, E. (1983). *Requirements for Certification.* 48th edition. Chicago: University of Chicago Press.

Woellner, E. (1975). *Requirements for Certification.* 40th edition. Chicago: University of Chicago Press.

Woellner, E. (1974). *Requirements for Certification.* 39th edition. Chicago: University of Chicago Press.

Woellner, E. (1973). *Requirements for Certification.* 38th edition. Chicago: University of Chicago Press.

Woellner, E. & Wood, M.A. (1971). *Requirements for Certification.* 36th edition. Chicago: University of Chicago Press.

Woellner, E. & Wood, M.A. (1969). *Requirements for Certification.* 34th edition. Chicago: University of Chicago Press.

Woellner, E. & Wood, M.A. (1966). *Requirements for Certification.* 31st edition. Chicago: University of Chicago Press.

Woellner, E. & Wood, M.A. (1963). *Requirements for Certification.* 28th edition. Chicago: University of Chicago Press.

Woellner, R.C. & Wood, M.A. (1951). *Requirements for Certification of Teachers and Administrators.* 15th edition. Chicago: University of Chicago Press.

Woellner, R.C. & Wood, M.A. (1945). *Requirements for Certification of Teachers and Administrators.* 9th edition. Chicago: University of Chicago Press.

Woellner, R.C. & Wood, M.A. (1936). *Requirements for Teaching Certificates.* Chicago: University of Chicago Press.

U.S. Department of Education, National Center for Education Statistics. (2011). IPEDS enrollment survey [Data file]. Retrieved from http://nces.ed.gov/forum/datamodel/eiebrowser/datasets.aspx July 8, 2013.

Xu, Z., Hannaway, J., & Taylor, C. (2011). Making a difference? The effects of Teach for America in high school. *Journal of Policy Analysis and Management, 30*(3), 447-469.

Yell, M. L., & Shriner, J. G. (1997). The IDEA amendments of 1997: Implications for special and general education teachers, administrators, and teacher trainers. *Focus on Exceptional Children*, *30*(1), 1-19.

Yoon, K., Duncan, T., Lee, S. W. Y., Scarloss, B., & Shapley, K. L. (2007). *Reviewing the evidence on how teacher professional development affects student achievement*. National Center for Educational Evaluation and Regional Assistance, Institute of Education Sciences, US Department of Education.

Youngs, P. & Qian, H. (2013). The influence of university courses and field experiences on Chinese elementary candidates' mathematical knowledge for teaching. *Journal of Teacher Education, 64*(3) 244-261.

Zeichner, K. (1984). The ecology of field experience: Toward an understanding of the role of field experiences in teacher development. Paper presented at the 64th annual meeting of the Association of Teacher Educators, New Orleans, LA.

Zeichner, K. (1999). The New Scholarship in Teacher Education. *Educational Researcher, 28,* (9) 4-15.

Zeichner, K. (2005). Research agenda for teacher education. In M. Cochran-Smith and K. Zeichner (Eds.). *Studying Teacher Education: The Report of the AERA Panel on Research and Teacher Education.* Mahwah, NJ: Lawrence Erlbaum.

Zeichner, K. (2006). Reflections of a university-based teacher educator on the future of college- and university-based teacher education. *Journal of Teacher Education*, *57*(3), 326-340.

Zeichner, K. M., & Schulte, A. K. (2001). What we know and don't know from peer-reviewed research about alternative teacher certification programs. *Journal of Teacher Education*, *52*(4), 266-282.

Zhang, S. & Stephens, V. (2013). Learning to teach English-Language Learners in mainstreamed secondary classrooms. *Teacher Education and Practice, 26*(1), 99-116.