FROM COLLEGE TO KINDERGARTEN:
TEACHER EDUCATION BACKGROUND AND STUDENT ACHIEVEMENT

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ABSTRACT

LEE BOYD CHARLTON: From College to Kindergarten: Teacher Education Background and Student Achievement
(Under the direction of Dr. Kathleen Gallagher)

This study examined teacher education background and developmentally based teaching practices as predictors of student achievement in kindergarten. Participants were approximately 17,000 kindergarteners and 3,000 teachers from a national longitudinal study. Using multilevel regression and hierarchical linear models, this study found that only Elementary Certification was associated with math achievement in kindergarten, and this association was negative. Additionally, while certain aspects of a teacher education background (including Early Childhood Certification and Early Education coursework) predict different developmentally based practices, these developmentally based practices were not found to have a significant association with Spring kindergarten student achievement in either reading or math. Further, the only teacher characteristic found to significantly influence spring achievement scores in both math and reading was instructional time. This study's findings stress the importance of family and individual characteristics as predictors of kindergarten student achievement and the necessity to continue research in these areas.

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TABLE OF CONTENTS

LIST OF TABLES

Table

LIST OF FIGURES

Figure

Chapter One – Statement of the Problem

Many researchers have studied teacher education and its relationship with student achievement. One area of inquiry examines the hypothesis that teachers who develop a strong use of developmentally based practices produce higher achieving students in academics in the primary grades (Goldstein, 1997). Another hypothesis suggests that teachers who matriculate with a strong sense of self-efficacy produce higher student achievement (Mullholland & Wallace, 2001) using successful traditional teaching practices. Yet a third hypothesis contends that teacher certification classification – elementary versus early childhood – predicts student achievement more than education attainment – Masters degree versus Bachelor's degree (Darling-Hammond, 2000). Regarding the latter, evidence suggests that teachers whose certifications are aligned with the grade they teach (e.g. a kindergarten teacher with Early Childhood certification) produce students with higher academic achievement (Roth & Swail, 2000). This study examined associations among aspects of teacher education (certification and courses) and teaching practices (use of developmentally based practices) and student achievement in kindergarten.

Historically, in the United States, both early childhood education and elementary teacher education programs have prepared kindergarten teachers (Goldstein, 1997). While the National Association for the Education of Young Children (NAEYC) defines early childhood as the developmental period from birth to age 8 (Bredekemp & Copple, 1997, 2007, p.3) kindergarteners are typically taught in an elementary school setting

(Goldstein, 1997). Since research suggests that preparing teachers to use the key components of child development, academics and methods in their classrooms is critical for student success (Ryan & Grieshaber, 2005; Bowman, Donovan, & Burns, 2001), it is important to examine how preservice teacher preparation is associated with teaching kindergarteners in the context of elementary school.

Traditionally, early childhood teacher education programs take an approach to teaching that includes child development and focuses largely on the student (Bredekemp & Copple, 1997, 2007), while elementary teacher education programs tend to focus on accountability and subject matter knowledge (Goldstein, 1997). This study focused on teaching and student achievement in kindergarten and expanded on the current research base by including specific aspects of teacher education and teaching practices and their links with student achievement. When these links are established, teacher education programs will be able to give teachers specific instruction on how to target higher academic achievement in kindergarten students. This study aimed to accomplish this.

Chapter Two – Review of the Literature

Social Cognitive Theory provided a theoretical base for this study, and literature on effective teaching practices supported the questions to be examined. The relevant literature is reviewed in the pages that follow.

Theoretical Foundations

This study examined ways in which teacher education programs prepare teachers for attaining high student achievement in kindergarten. Because these teacher education programs have a student teaching component and preparatory coursework, the theoretical frame used for research should consider the dual role of preservice teacher as student. A study of this type must have a theoretical framework in which it is conducted. This framework must have application specifically within the realms of both the teacher education program and the schools in which teachers work. Social cognitive theory provides this framework and will be described next.

Social Cognitive Theory

Social Cognitive Theory (SCT) serves as a lens for examining how teacher education programs affect kindergarten teaching. Social Cognitive Theory emphasizes that observation is a primary context of learning. Kessler and White first studied observational learning and found that learning through observation is more effective than learning through direct participation (1973). In the context of teacher preparation, this indicates that watching, rather than practicing, will enable teachers to use more effective practices. Figure 1 shows the SCT triadic reciprocation model that Bandura proposed (1976). For the

preservice teacher at the center of this model, each of the influences starts as behavioral and becomes cognitive, as the educator symbolically represents the behavior, the environment, the personal traits and the relationship amongst the three. In this way, the preservice coursework and experience, the educator's own education background and his/her personal beliefs all interact to shape the teacher.

In the context of a teacher education program, preservice teachers become the individual at the center of SCT. The practices they develop and use (developmentally appropriate or traditional) comprise the behavioral component. The coursework they undertake and the modeling they witness become the environmental component. Finally, the self-efficacy they develop is part of the personal component. These three components mentioned above interact in a bi-directional manner (Bandura, 1976), such that each has influences on the others and, therefore, on the development of the individual (Bandura, 1986).

For the study, there are a few influences that are specific to how SCT works for examining teacher education programs and the development of preservice educators. These are modeling, instruction, and self-efficacy. Furthermore, these aspects are all critical in the development and use of developmentally based practices.

Modeling. The first of the three aspects key to this study is modeling (Bandura, 1976). Teacher education programs tend to have multiple opportunities for preservice teachers to learn effective teaching practices via modeling. Miller and Dollard have said that imitation is not only powerful, but learned through various types of reinforcement (1941). In preservice teacher education, this might appear as students teaching the way

they see their professors teach. They have the opportunity to see a professor or other role model at work in the classroom.

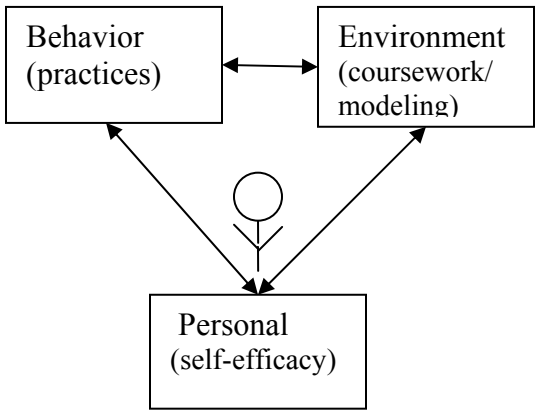

Figure 1. Triadic reciprocation model showing bi-directionality of the major Social Cognitive Theory components.

More importantly, future teachers get to observe their cooperating teachers and often their peers in action. Cooperating teachers often play a critical role in the development of new teachers, because they are the models that are observed most frequently. So, when a preservice teacher observes the cooperating teacher engage in developmentally based practices, she is more likely to internalize this environmental influence and use it in the future. This can be a high level of social learning and very effective in a teacher's developing her own effective teaching practices (Miller and Dollard, 1941). These learned teaching practices can adapt into developmentally based practices as the teacher enters into the profession.

Peer modeling can also be important for the preservice teacher. In numerous studies, Wentzel (1994, 1999, 2002, 2006) found a relationship between socialization and learning. Students who are in a positive social setting tend to be more motivated in school (Wentzel, 1999). This may appear as student teachers watching their peers as they teach and interact with students. The result of this peer modeling will be observational learning, further influenced by seeing similar models produced by professors and cooperating teachers (Kessler & White, 1973).

Instruction. Another environmental aspect key to effective teaching practices is instruction (Bandura, 1976). What a preservice teacher learns in coursework, through reading, lectures, discussion and research, will influence her development as a teacher. Luria's research (1963) has shown that behavior is initially controlled by verbal instructions from others, which later can translate into self-instruction. Direct verbal instruction occurs during the teacher education program, with self-instruction occurring after matriculation. Coursework can impact teacher effectiveness (Darling-Hammond,

2000), though studies have found mixed results as to which types of coursework (subject matter or pedagogy) are most influential on student achievement (Ashton & Crocker, 1987; Haney et al, 1986).

Self-efficacy. The final aspect of SCT important in this study is self-efficacy, which falls into the personal realm of the model (Bandura, 1976). Preservice teachers can gain self-efficacy from all aspects of teacher education programs. The expectations set by the programs and the student's success rate (either grades or feedback) both can add to self-efficacy. Furthermore, there are standards to which preservice teachers must adhere…and failing to meet those standards, or exceeding them, will change their self-efficacy.

Kindergarten teachers may learn that high self-efficacy can impact the achievement of their students. For example, high teacher self-efficacy promotes academic competencies in most students (Zimmerman, 1990). This information, alone, may motivate preservice teachers to develop and strengthen their own sense of high self-efficacy.

Imitating a cooperating teacher's behavior will most certainly have an outcome in the kindergarten classroom, possibly via self-efficacy (Bandura, 1986; Miller and Dollard, 1941). The preservice teacher engaged in the imitation will internalize that outcome as success or failure and develop accordingly. Finally, reinforcement plays a role in the development of self-efficacy (Bandura, 1976). When a learner's behavior is reinforced, they are more apt to internalize the behavior as a success or failure, recall the reinforcement and behave correspondingly in the future. For example, a preservice

teacher who is told by a cooperating teacher that she is interacting appropriately with students is more likely to continue that type of interaction.

Summary

Social Cognitive Theory is a framework through which to examine the influence teacher education and teaching practices have on children's achievement through the teachers they produce and the teaching practices they use. This is especially true since early childhood teacher education programs (ECED) often have different foci from the more traditional elementary education programs. ECED programs tend to focus on the child at the center, using various child development theories and developmentally based practices (Goldstein, 1997). If research finds that some programs are addressing the achievement of young children better than others, teacher education programs can strengthen their own preservice teachers by making necessary adjustments to their programs. Furthermore, if student achievement is tied to the teacher characteristics developed during the preservice years, then the teacher education programs should ensure that teachers are given the opportunity to observe and are being taught these characteristics via the triadic reciprocation model.

Teacher Education and Student Achievement

For the most part, preservice teachers are well trained and prepared to support high student achievement (Quezada, 2004). However, teachers who are not properly equipped to teach or are under qualified do not support academic success for their students (Center for the Future of Teaching and Learning, 2000). Studies (e.g. NEA, 1999; Leibbrand, 2000) have documented this link between teacher education and student achievement. In one study, teachers' certification status, degree and student outcomes

were positively correlated (Darling-Hammond, 2000). Teachers with higher levels of certification and degrees matching their teaching placement had students who achieved higher academic scores than those of other teachers. This study examines the coursework and licensure aspects of formal teacher preparation and student outcomes.

Many teacher education programs have attempted to integrate theoretical concepts of learning and methods. Preservice programs might teach progressive pedagogies and theory, but often the schools are geared more toward content coverage and methods (Smagorinsky et. al., 2003). This push for content knowledge is emphasized by the No Child Left Behind Act (NCLB) of 2001, in which content knowledge is considered imperative to being a "highly qualified teacher" (Hyun, 2003). According to the NCLB, a highly qualified teacher is one who demonstrates verbal ability and content knowledge. "Highly qualified teachers" who are educated and certified are more successful in obtaining high student achievement (Hoffman et al, 2005) than teachers who are not prepared. These cited studies agree that methods courses and content knowledge are critical to student achievement, but they do not address other aspects of teacher education programs that may also be important.

For example, teacher education programs that focus on teaching literacy will enhance student engagement and, therefore, increase student achievement in the classroom (Hoffman et al, 2005). Teaching literacy is not only a content specific goal, meeting the National Standards, it encompasses a pedagogy of learning as well. This combination of pedagogy and content is especially crucial for teaching in the primary grades (Jacobs, 2001) because the children in these grades fall into the overlap of early childhood and elementary schooling.

Some educators believe that teacher education programs focus too intently on abstract theoretical ideals and pedagogy, when more emphasis is needed in using the day-to-day tools teachers need in order to teach effectively, such as curricular goals and materials (Smagorinsky et. al., 2003). The Torch Lighters Study (1962), the first major examination of teacher preparation programs in the United States, reported that not enough attention was given to reading instruction in teacher education programs. In order to best reach the highest number of students, teacher education programs need to specifically address teaching reading (Austin and Morrison, 1962). The follow up study reported improvements, including more coursework and topics covered, but teachers still were not as prepared as researchers thought they should be (Hoffman et. al., 2003).

In addition to coursework and training, certification level is also associated with student achievement. A 1999 study by the National Education Association found that nearly 30% of teachers are not certified in the area they teach (Roth & Swail, 2000), suggesting that their students are not as likely to achieve highly (NEA, 1999). Furthermore, student scores on math exams increases by close to 50% when taught by a certified teacher (Darling-Hammond, 1999). A more recent study suggests that subject-certified teachers have higher student achievement and are more likely to increase intellectual engagement with their students (Dee & Cohodes, 2008).

These studies suggest that full certification and teacher education matched to the grade level are associated with student achievement (Darling-Hammond, 2000). For example, teachers who are certified in elementary education are expected to elicit greater student achievement teaching an elementary class than a teacher certified in secondary math education (Darling-Hammond, 2000). The current study examined areas where a

background in early childhood teacher education may elicit high student achievement in kindergarten,

Two types of knowledge inform early education preservice teacher education programs: 1) process knowledge (philosophical/theoretical bases of learning and practical experience) and 2) content knowledge (subject matter and methods). Early childhood teacher education programs typically focus heavily on child development as a primary knowledge base (Williams, 1994; Goldstein, 1997), stemming from a belief that children develop and learn in similar ways (Lubeck, 1994). Additionally, the NAEYC position on Developmentally Appropriate Practice for early childhood education stresses the importance of recognizing the differences in children's backgrounds as well as the need for positive teacher-child relationships and a variety of teaching strategies and practices (Bredekemp & Copple, 2009). Other types of programs, combining traditional pedagogies with post-modern beliefs, typically focus on young children in context, teaching more methodology and multiculturalism (Ryan, 2005) in order to meet the needs of a traditional elementary context. However, many of these programs prepare teachers for elementary education rather than early childhood specifically. Additionally, most early education teachers matriculate from Elementary education programs rather than Early Childhood programs (Vartuli, 1999). Having been prepared with more Elementary and less Early Childhood training, these teachers gain more content knowledge than process knowledge (Roth and Swail, 2000).

Preservice teachers require field and lecture experiences that will prepare them for a future in teaching (Jacobs, 2001) with the possibility of high student achievement. Field experiences offer process knowledge while lecture experiences offer content

knowledge (Hoffman et al, 2005). Early educators need both the pedagogical background of an early childhood program as well as the elementary education focus on content knowledge to have a positive impact on student achievement.

In this study, I examined how characteristics of a formal education background in early childhood education are associated with kindergarten student achievement.

Research on Certification and Licensure

While the distinction between licensure and certification remains the part of an ongoing debate amongst educators (Roth & Swail, 2000), it is important to discuss the basic differences and how the terms are used in this study. Often, teacher certification simply denotes that a teacher received a degree from an accredited teacher education program, while licensure includes the legal standards and principles of becoming a teacher (Hutton, 1999). Since the decision still remains mostly within the states, the terms have often been used interchangeably.

So, while the ECLS-K uses a variable addressing teacher certification, this study made no distinction as to whether or not the teachers involved are certified, licensed or both. The state requirements and procedures not being measured and reported allows for the interchanging of these terms. For this study, teacher licensure and teacher certification were used to represent that a teacher has met the standards to teach in his/her state, although the standards may not be equal for each teacher (Roth & Swail, 2000; AFT, 2000).

Research on Self-Efficacy

One teacher characteristic associated with student achievement is teacher self-efficacy. Defined as "beliefs in one's capabilities to organize and execute courses of

action required to produce given attainments" (Bandura, 1997), self-efficacy can be interpreted for any teaching situation. In an interview with Shaughnessy, Woolfolk describes teachers' self-efficacy as the "perceptions about their own capabilities to foster students' learning and engagement" (Shaughnessy, 2004). The study focused on self-efficacy as it related to instructional time in the classroom. This teacher self-efficacy will be described further in the next section.

This study examined kindergarten student achievement beyond behaviors and beliefs that have been associated with teacher self-efficacy in the research literature, including amount of time spent on academic subjects.

In a study of 231 preservice teachers in Taiwan and the US, time spent in the classroom was associated with teacher self-efficacy. Early childhood and elementary education preservice teachers believed that the hours in the classroom had great influence on children (Lin et al, 2002). The proposed study will examine time spent on content knowledge as an aspect of teacher self-efficacy. Additionally, instructional time has been directly associated to gains in student achievement (Stallings & Kakowtiz).

Self-efficacy and teacher education. Teacher education programs can support preservice teachers' development of self-efficacy (Bandura, 1987). In one study (Evans and Tribble, 1986) 179 preservice teachers completed surveys regarding perceived problems in the field of teaching. Preservice teachers with field experience reported a higher sense of self-efficacy than those who had not yet engaged in field experiences. A later study reported that elementary education majors with more field experiences demonstrated increased self-efficacy (Tosun, 2000). Finally, a recent study reported that teacher self-efficacy developed more over time and via more mastery experiences (Long

& Moore, 2008). Further findings from this study suggested that self-efficacy was more malleable for newer and preservice teachers, due to having fewer mastery experiences than more veteran teachers. These novice teachers had not developed a concrete sense of self-efficacy. In the context of this study, preservice teacher field experience, as part of a formal teacher preparation background, was examined in relation to student achievement.

Self-efficacy can also be attained through coursework. Child study and methods courses often provide experiences with content knowledge and have more ability to shape self-efficacy (Evans and Tribble, 1986). Numerous studies have found that teachers who lack of content-specific coursework report a lower sense of self-efficacy (Long & Moore, 2008; Yoon et al, 2006; Shaw & Dvorak, 2007; Bleicher, 2004). In another study, preservice teachers reported methods courses were more influential in the development of their self-efficacy (Evans & Tribble, 1986). None of these studies, however, quantified how much of the coursework was methods based and how much was content based. Therefore, the study aims to more specifically examine preservice coursework in relation to student achievement, specifically addressing math and reading methods courses, and instructional time spent in those content areas.

Self-efficacy and student achievement. Preservice teacher education is associated with teacher self-efficacy, and teacher self-efficacy is thought to be associated with student achievement (Woolfolk Hoy & Spero, 2005). One way that self-efficacy may influence student achievement is through teacher practices. In one study, researchers assessed the effects of a workshop in teacher self-efficacy with 62 teachers (Tucker et al, 2005). According to the teachers' reports, the workshop not only increased teacher self-

efficacy but also increased teacher behaviors associated with student academic success, though student achievement was not measured. Muijs and Reynolds reported similar associations with 100 primary school teachers: teacher self-efficacy significantly influenced student achievement via teacher behaviors (Muijs & Reynolds, 2002). While these studies suggest a link between teacher self-efficacy and student achievement, this study explored this link between self-efficacy and student achievement as it exists through the specific teaching behavior of instructional time and with a large, nationally representative sample.

Literature suggests that teacher self-efficacy can influence student achievement via specific planning and teaching strategies. For example, teachers with high self-efficacy spend more time planning and more time on academic content in the classroom (Gibson and Dembo, 1984). Furthermore, teachers with high self-efficacy are less likely to use ability sorting and socially competitive grading in their classrooms, favoring evaluation relative to set standards. In a study of elementary school staff development, teachers with higher self-efficacy allowed more socialization opportunities and heterogeneous group work, which is associated with increased student achievement (Krol et al, 2002; Creemers & de Jong, 2002). The 2002 Krol et al study examined in-service staff development, though, and this study examined beliefs gained through prior experiences (possibly teacher education background) and behaviors shown in their teaching practice.

When addressing affects on student achievement, research shows that teaching methods and self-efficacy associated with those methods vary across grade levels. Vartuli (1999) supports results found in a study regarding early education beliefs between

different primary grades (Spodek, 1988). Kindergarten teachers tend to focus on the socialization of children while the older primary grade teachers tend to stress more skill-based learning (Spodek, 1988). This might indicate that kindergarten teachers might be more concerned with socialization than academic achievement. Moreover, teachers with academic and methods backgrounds tend to have higher self-efficacy in teaching skills and tend to come from elementary education programs rather than early childhood programs (Vartuli, 1999). Teachers have higher self-efficacy in teaching the academics when they come from teacher education programs that focus more on methods and academics than on child development (Mullholland & Wallace, 2001).

This study examined whether or not an early childhood teacher education background is associated with student achievement beyond the self-efficacy behavior of instructional time in the classroom. Although it is clear that is a more involved in a teacher's self-efficacy than the time he/she spends teaching both reading and math, this study only addresses self-efficacy as it pertains to instructional time. The proposal will also address the use of developmentally based practices and its association with student achievement.

Research on Developmentally Based Practices

Developmentally based practices are those practices derived from studies about primary grade teaching and the NAEYC description of DAP for children aged five through eight. These practices include addressing children's individual differences, using materials relevant to children's lives and teaching based on a child's intrinsic motivation (Smith, 1997) as well as child-directed activities and language, whole group instruction, a developmentally appropriate environment, and lots of child choice (Maxwell et al, 2001).

A teacher's beliefs regarding her role in the classroom, her goals for the development of her students and her beliefs on how children learn are all important to developmentally based practices (Vartuli, 1999). However, Vartuli also states that these teacher beliefs all exist on a spectrum that ranges from child-centered to teacher-centered, making it that much more important to tease out those practices that are appropriate for early education or primary grades. Three variables have been identified in the literature as effective practices in the kindergarten classroom and are used to represent developmentally based practices for the study: 1) use of a developmentally based environment; 2) child selected activities and 3) use of formative assessment.

"Learning centers are one of the best ways that pre-school, kindergarten, and elementary students become actively involved in their environment" (Jacobs, 2001, p.127). Active learning is also stressed in the NAEYC's position on Developmentally Appropriate Practices (DAP) (Bredekemp & Copple, 1997, 2007). Centers are often found in early childhood and elementary classrooms. According to Vartuli, classroom practices that are found in developmentally appropriate classrooms should be considered as appropriate practices (1999). Centers also provide many opportunities for hands-on learning (Bredekemp & Copple, 1997, 2007; Maxwell et al, 2001). In the current study, learning centers are explored as they combine to form a developmentally based environment for a kindergarten classroom.

Child selected activities also qualifies as a developmentally appropriate practice. The Assessment of Practices in Early Education Classrooms (APEEC) Item Eleven regards the child's role in decision making (Maxwell et al, 2001). The APEEC was developed to measure individualized and developmentally appropriate practices in the

primary grades. Item 11 examined, through observation and interview, the importance and frequency of children's role in decision making within the classroom setting. The pilot use of this APEEC tool found a significant link between teacher beliefs about DAP and student decision making in the classroom.

Other studies have found that student choice in the classroom was listed near the top of what makes a developmentally based practice. Teachers stated that students should be able to make some decisions about the learning that takes place, whether by asking questions or the sharing of ideas (Griesemer, 1997). The NAEYC suggests that student initiative in learning is important (Bredekemp & Copple, 1997, 2009) as is flexible grouping as part of every early education classroom. This includes whole group activities, small group activities and individual activities. The key to this teaching practice is flexible grouping, rather than a rigid grouping structure (Bredekemp & Copple, 1997, 2009). Flexible grouping is also included on the APEEC within the item of instructional methods (Maxwell et al, 2001). Early education grades with reported use of developmentally based practices were found to have multiple teaching methods and grouping throughout any given day (Maxwell et al, 2001) rather than all day use of whole group instruction. These findings align well with the NAEYC position on DAP. Teachers should use a variety of methods and tools to teach each child at an individual level, allowing for child initiative through comments and questions (Bredekemp & Copple, 2009).

Formative assessment, or evaluating a child relative to his own growth via observation (Wright, 1989), is another practice that was used in this study. Children are more motivated to learn when their own needs are being met and developed

(Charlesworth, 1998). Rather than teaching to a standard or assessment, an effective developmentally based practice would be to evaluate a child against himself and his growth in the class (Van Horn et al, 2005) and basing assessments on the strengths and weaknesses of each child (Bredekemp & Copple, 1997, 2009). In this study, formative assessment as a practice was examined through the ways teachers described their own views of classroom assessment.

The above three practices, use of developmentally based environment, child selected activities and formative assessment, are supported by the NAEYC's stand on DAP in the primary grades (Bredekemp and Copple, 1997, 2009) and were representative of developmentally based practices for this study.

Developmentally based practices, student race and SES. Studies have shown that using developmentally based practices in the classroom promotes equity in developmental outcomes, especially when considering race and SES in a child's background (Charlesworth, 1998). Children of different ethnicities and backgrounds may respond differently in classrooms that use developmentally based practices and those which do not (Van Horn et al, 2005). At least one study has found that high quality teaching and teachers can overcome the setbacks a student might face due to his/her SES (Myrberg, 2007). However, several studies have shown that classroom and teacher characteristics, including the use of developmentally based practices, struggle to overcome the influence that a family background – race and SES – have on the academic achievement of young children (Whitehurst, 2002; Haskins & Loeb, 2007).

Developmentally based practices and teacher education. Primary grades in elementary school are included in early childhood but are often taught differently than

pre-school. A recent study surveyed 119 preservice teachers, of which more than 60% were elementary education (ELED) students and the remainder early childhood education (ECED) students (File and Gullo, 2002). Results upheld the hypothesis that ECED students supported developmentally appropriate practice beliefs and practices more than ELED students. ECED students showed a preference to teach pre-kindergarten and kindergarten, which traditionally encourage more developmentally based practices, while ELED students were more likely to choose grades one through three. Finally, ECED students used fewer teacher directed activities than the ELED students (File and Gullo, 2002). The findings of this survey study showed that, preservice teachers are not only "primed" to develop different environments and practices for their own classrooms, but that these differences in teaching beliefs and practices may follow teachers throughout their careers in education (Vartuli, 1999; File & Gullo, 2002).

Literature suggests that the teacher education program type might be the biggest factor in forming beliefs and use of developmentally based practices among early educators (Smith, 1997 and Lin et al, 2002). However, some preservice teachers do not yet have strong beliefs about these practices, implying that they might not have developed during the preservice experience (Hudson, 2003).

A study of preservice educators was conducted targeting student teacher beliefs about developmentally based practices in primary grades (Smith, 1997) with results supporting ECED beliefs about appropriate teaching practices. ECED students reported stronger beliefs on using developmentally based practices, while ELED students supported more traditional practices (Smith, 1997). Sixty preservice teachers completed several questionnaires derived to explore beliefs about developmentally based practices.

The teachers' beliefs and practices scores, computed using Likert scale responses to multiple questions regarding teaching practices, reflect the difference in preparation, suggesting that the difference in teaching practice beliefs is due mainly to the program type (Smith, 1997). While Smith directly addressed program type to find this connection, the current study extended beyond program type to examine the types of courses and preparation included in the teacher education program.

A study similar to Smith's was conducted with inservice teachers in Head Start classrooms through third grade (Vartuli, 1999). Teachers were asked to complete a battery of assessments to target their use of developmentally based practices and traditional practices. Results showed that effective teaching is more evident where beliefs and practices are congruent (Vartuli, 1999), meaning that teachers who both believe in and use developmentally based practices are more effective teachers. When teachers believe that these practices are best but use more traditional practices, the teaching may lose effectiveness. Additionally, years of experience and level of education are not determinants of developmentally based practices, whereas grade level and teacher education program type are determinants of beliefs and use of developmentally based practices (Vartuli, 1999).

Use of developmentally based practices may be more common in certain early education grades than in others. Compared to first through third grade teachers, kindergarten teachers use more developmentally based practices, have more child-centered activities and more opportunities for active learning (Vartuli, 1999). These types of practices decrease as the grade level increases. A recent study found supporting evidence that classrooms in higher grade levels use fewer appropriate practices than

lower early education grades (Maxwell, et. al., 2001). Teacher beliefs about developmentally based practices do, in fact, predict use of such practices in classrooms. This means that teachers who believe that a developmentally based practice will be more effective in eliciting student achievement will more likely use these practices in their teaching. In addition, teacher education program type predicts both beliefs and use of developmentally based practices. ECED graduates have stronger beliefs in and use of these practices than ELED grads (Maxwell et al, 2001). Primary teachers with either certification in early childhood education, a major in early childhood education or practical experience in an early childhood setting had stronger beliefs in developmentally based practices than those without these early childhood training experiences (Vartuli, 1999). In an international comparative study, it was again found that early childhood education produces teachers with higher beliefs and use of developmentally based practices than does elementary education, in both the United States and Taiwan (Lin et. al., 2002).

This study examined the link between formal teacher education and developmentally based practices, and the association between use of these practices and kindergarten student achievement.

Developmentally based practices and student achievement. Research suggests that it is difficult to connect developmentally based practices and student achievement (Van Horn & Ramey, 2004). This may be partially due to the fact that developmentally based practices have more often been studied in terms of pre-school classrooms, and the rigorous academic standards usually present in a typical elementary school classroom has been the site for study of academic achievement (Van Horn et al, 2005; Wright, 1989;

Ryan & Grieshaber, 2005). However, this trend to study specific curricula, standards and academic programs have also been more popular in accounting for student achievement; therefore, these studies must be reviewed in light of how they might connect with developmentally based practices.

The National Council of Teachers of Mathematics (NCTM), in a strong backing of the NAEYC's stance on DAP, suggests that the use of varied manipulatives in the teaching of math increases student achievement. Research in one elementary school did not support this expectation for primary grade teaching. Interviews, observations, and questionnaires were completed in first grade, second grade and a multiage special education class. The study found, through descriptive analysis only, that student achievement was not, in fact, linked to the use of math manipulatives (Griesemer, 1997). This study, which targeted math only, did not include any teacher background data nor did it involve direct student assessments. The current study examined student achievement for math and reading and included actual child scores and formal teacher education background, which have been associated with developmentally based practices.

Another study, using student test scores from 67 different schools, examined differences among three curricula and their associations with student achievement. Two of the NCTM based curricula were standards based, which align with developmentally based practices, while the control curriculum was textbook based, aligning with more traditional practices. This study focused on intermediate and middle grades, and examined whether or not each of the different curricula could increase student achievement. Results showed an increase in student achievement when using the more standards based primary grade teaching practices versus the traditional textbook

practices. Additionally, no single subgroup performed better using traditional methods (Riordan & Noyce, 2001). Although this study focused on older students, similar results could be expected with early education students. Therefore, the study links the use of developmentally based practices with student achievement in kindergarten. Because this study suggests findings may be similar with younger students, the current study would likely show an increase in kindergarten math achievement when more developmentally based practices were present in the classroom. A primary goal of this study is to show associations between higher kindergarten student achievement and developmentally based practices.

Research Questions and Hypotheses

The literature has informed the following research questions which were examined for kindergarten.

1. Are teacher certification and early childhood coursework associated with use of developmentally based practices?
2. Is teacher certification type (elementary, early childhood or both) associated with student achievement scores in kindergarten?
3. Is teacher use of developmentally based practices associated with children's level of academic achievement beyond the teaching certification?

It was hypothesized that having a license or certification in early childhood education would be an indicator of student achievement in kindergarten. Additionally, those teachers prepared in early childhood with an accompanying licensure will have significant use of developmentally based practices. It was further hypothesized that this

use of developmentally based practices would be associated with the academic achievement of children in kindergarten.

The study used multiple regression and hierarchical linear modeling to explore the above research questions. These methodologies are described in Chapter Three.

Chapter Three – Methodology

Overview

This investigation involved secondary analysis of the Early Childhood Longitudinal Study - Kindergarten (ECLS-K) data, a study designed to be a representative sample of kindergarteners in the 1998-1999 school year. The ECLS-K data has been used to examine several issues in early education (see NCES, 2006; Lanahan et al, 2006), and this study examined associations among features of formal teacher education and student achievement for kindergarten.

Early Childhood Longitudinal Study – Kindergarten Class of 1998-1999

The ECLS-K sample consists of approximately 22,000 students with 3,300 teachers in different kindergarten classrooms during the 1998-1999 academic year. Classrooms sampled included both full day and part day programs in both public and private schools. Participating students represented diverse ethnicity, socio-economic status (SES), and learning abilities.

Data were collected beginning in the fall of the cohort's kindergarten year and continued at least once per academic year through the fifth grade year, second grade excepting. Data gathered included student assessments in reading and mathematics, parent interviews and teacher questionnaires. Benefits of using the ECLS-K data include its large and diverse sample and access to multiple measures that address a large number of variables.

Research Questions & Hypotheses

The study examined associations among teacher education/preparation backgrounds and student achievement. The following research questions and hypotheses were examined:

1. Are teacher certification and early childhood coursework associated with use of developmentally based practices?
    - Teachers with early childhood certification who have taken courses in early childhood education will report using developmentally based practices in the kindergarten classroom.
2. Is teacher certification type (elementary, early childhood or both) associated with student achievement scores in kindergarten?
    - Early childhood certification will be associated with student achievement in kindergarten.
3. Is teacher use of developmentally based practices associated with children's level of academic achievement beyond the teaching certification?
    - Use of developmentally based practices will be positively associated with student achievement beyond the teaching certification.

Participants

ECLS-K Participants

The base year sample of the ECLS-K data included 22,782 children representing 3,305 teachers in 1,277 kindergarten classes during the 1998-1999 school year. The sampling process to obtain these children involved a multistage design. The first stage selected 100 Primary Sampling Units (counties and county groups) from which public

and private schools were then selected. In the second stage, children were then randomly sampled from these schools– approximately 23 at each school location.

The base year of the study response rates included 944 of the original sample of 1,277 schools. Over 99% of the respondents participated in both the Fall 1998 and Spring 1999 collection periods. 92% of the children selected were then assessed during the base year, with 95% participating in both the Fall and Spring times. Non-response did not significantly affect the ability to generalize from the sample, according to studies that examine bias due to school non-response (NCES, 2001).

Study Participants

This study excluded children who did not participate in both of the assessment periods during the kindergarten year. This is because the fall scores were needed to serve as a baseline assessment for the spring scores. Teachers without some form of certification or licensure were also excluded. Teachers with partial, full, regular, temporary and emergency certification were included in the sample. After the exclusions, the sample size for question 1 ranged from N=2,855 to N=3,142 questions. The samples for questions 2 and 3 range from N=14,861 to N=17,613. There are different sample sizes throughout the three questions because not all students participated in both reading and math assessments, and this study examined reading and math separately. Further, question 1 was analyzed using teacher level data while the others used child level data.

This study's sample was very comparable to the original ECLS-K base sample in both ethnic representation and SES representation. The base year student sample had the following ethnic distribution, after non-respondents were excluded: 10,975 white, 3,021

black, 2,631 Hispanic, 1,652 Asian/Pacific Islander, 339 American Indian/Alaskan Native, and 555 other race or unknown. SES was calculated and reported in quintiles, with a fairly even distribution of approximately 20% of the sample per quintile. This study only used the kindergarten base year sample. Table 1 shows the base year and current study sample distribution by race.

Race/Ethnicity	ECLS-K Base Year	Current Study
White	10,975	10,091
Black	3,021	2,466
Hispanic	2,631	2,935
Asian/Pacific Islander	1,652	1,321
American Indian/Alaskan Native	339	312
Other/Unknown	555	478
Total	19,173	17,613

Table 1 Sample distribution by race

Question one. The first research question (range N = 2,855 to 3,142) examined the association between teacher certification and use of developmentally based practices.

Question two. The second research questions explored the association between certification type and student achievement. This research question addressed student achievement in both reading and math, meaning that there were two different sample sizes. For student achievement in reading, N = 14,861 and for student achievement in math, N = 15,611.

Question three. The final research question in this study was designed to explore the association between use of developmentally based practices and student achievement in kindergarten. Again, student achievement in both reading and math were examined separately, so the sample sizes are different; N reading = 14,861 and N math = 15,611.

Measures

Multiple measures were used in the ECLS-K study. This study used variables either taken directly from the ECLS-K or combined from existing ECLS-K variables. Measures used in the study include teacher self-report and direct child assessments. All teacher information was gathered from self-administered paper-and-pencil questionnaires in Sections A and B of the Teacher Questionnaires. Student achievement is measured through direct cognitive assessments of the children. All data used for the kindergarten model were collected in Fall 1998 and Spring 1999. Details on each of the measures included are provided below.

Formal Teacher Education Background

The study used data collected from teachers in Spring 1999 on the A and B teacher questionnaire forms. Teachers reported their certification type and formal education courses. Appendix B shows the list of items included in considering the formal education background.

Certification. ECLS-K data includes information on both level of certification and type of certification. This study included only teachers with some type of certification, which omits 2% of the original teacher sample. This study also included data on the area(s) in which teachers are certified. This can be Elementary, Early Childhood or, as is the case in many states, a dual Elementary/Early Childhood

certification. The study is concerned mainly with those teachers licensed/certified in Early Childhood Education.

Coursework. This study also included type and number of formal education courses, including early childhood courses, child development courses, and reading and math methods courses.

Teaching Practices

The study used data collected from teachers in Spring 1999 on the A and B teacher questionnaire forms to examine various teaching practices, both traditional and developmentally based.

Traditional practices via self-efficacy. Teacher self-efficacy was examined as it pertains to instructional time spent on both reading and math.

Developmentally based practices. The study examined three developmentally based practices. A composite variable of eight items included in the original ECLS-K teacher questionnaires and will target use of centers in a developmentally based environment in the kindergarten classroom. Use of child selected activities is the second variable in this construct. Use of formative assessment is the third marker of developmentally based teaching practices. A list of the items used can be found in Appendix C. The study used data collected from teachers in 1999 on the A and B teacher questionnaire forms.

Student Achievement

*S*tudent Achievement (SA) scores for the study included children's math and reading scores from direct student assessments given during the kindergarten year. Achievement was measured as Spring scores controlling for Fall scores. The full test

took approximately 50 to 70 minutes per student and was performed via a computer-assisted personal interview. Tests were given in a two-stage design, with the first stage being a routing test administered to all students. The second phase was administered to students based on their performance on the first phase of testing. The reasoning for this design was that it minimized administration time and maximized measurement accuracy (NCES, 2006).

Intercorrelations among the direct measures were shown to be both high and stable through the first four rounds of data collection, ranging from 0.74 to 0.77 and can be used to show construct validity of the direct achievement measures (NCES, 2002). Interviewer variance was considered as a possible threat to validity; however, tests showed little variance between interviewers, ranging from 1.3% to 2.4% in reading and mathematics tests.

Student math achievement. The math tests specifications were drawn from the National Council of Teachers of Mathematics standards and the National Association of Educational Progress (NAEP) math framework. The tests included questions from the following five strands: number sense, properties and operations; measurement; geometry and spatial sense; data analysis, statistics and probability; and patterns, algebra and functions. Reliabilities were calculated for both phases of the tests. The most appropriate estimate of reliability for the entire math assessments were the Item Response Theory (IRT) theta scores (NCES, 2002), which ranged from 0.92 to 0.94 throughout rounds of data collection.

Student reading achievement. The reading test specifications were based on the NAEP reading framework categories and opinions of literacy consultants. Tests were

designed to target the following six reading comprehension skills: basic skills; vocabulary; initial understanding; developing interpretation; personal reflection; and critical stance. Reliabilities were calculated for both phases of the tests. The most appropriate estimate of reliability for the entire reading assessments were the Item Response Theory theta scores (NCES, 2002), which ranged from 0.93 to 0.97 throughout rounds of data collection.

Plan of Analysis

Construction of Proposed Data Set

Three steps were necessary to construct an analysis data set from the ECLS-K data sets. Step 1 involved selecting appropriate child and teacher variables. These variables were then combined to form the independent variables needed for the study. Step 2 involved the exclusion of teachers and students who did not meet the criteria of the study. Step 3 involved the recoding of certain variables in order that they can be analyzed using the HLM program. Certification variables were recoded such that "0" meant no certification and "1" meant a teacher possessed that certification. Next, a series of dummy race variables was created, such that every child had a "0" or "1" (no or yes) response to being of each ethnicity. Finally, for the variable measuring use of formative assessment, those cases with recorded answers of "not applicable" were recoded as missing and given a ".".

For the second and third research questions, the data were split into two separate data sets. These were on the child level and teacher level and were necessary for HLM to account for the nesting of the data in classrooms.

Missing Data

Data were examined for any patterns in missing data. No discernable patterns were discovered. The ECLS-K coded missing data using a negative score system, with some missing values being replaced with a dot/period "." (NCES, 2001). For the purposes of this study, the missing values were treated in accordance with the ECLS-K process, being replaced with a dot/period ".".

Weighting

Because the ECLS-K is such a complicated data set, with original intentions for being generalizable for children across the country, the data were weighted to adjust for non-response as well as differential probabilities of selection throughout sampling. Some groups were over sampled in order to best produce results for certain subgroups. It is essential, then, that appropriate weights are used when running analyses on these data in order to have the truest representation of results for kindergarten students and their teachers.

Therefore, when running the hierarchical linear models for both questions 2 and 3, the weight BYCW0 was used. This weight was selected per the ECLS-K base year guidelines which offer the following reason for using this weight:

> "to be used for analysis of - child direct assessment data and child characteristics from both fall- and spring-kindergarten, alone or in conjunction with any combination of a) a limited set of child characteristics (e.g. age, sex, race-ethnicity), b) fall and/or spring- kindergarten teacher questionnaires A, B or C data, and c) data from the school administrator questionnaire or facilities checklist."

This paper uses child direct assessment, child characteristics and teacher questionnaires on a longitudinal basis. Because the data used in this paper involved only child data from the base year, this weight is the only one necessary to achieve generalizability and accurate results.

Model Specification and Analyses

This study explored the association between teacher education background and student achievement. Preliminary analyses examined the correlations between all included variables. An exploratory factor analysis examined the multi-variable construct of developmentally based practices. Results can be found in the next chapter. From here, the study measured the association of developmentally based practices with formal teacher education background using multiple regression. Next, the study examined the association between teaching certification and student achievement using hierarchical linear modeling. Finally, a hierarchical linear model was used in order to test the association of developmentally based practices with student achievement beyond the early childhood certification.

Hierarchical linear modeling. Because many students in the sample will be in the same class and school as other students, the data were nested (student in class/teacher). Using hierarchical linear modeling (HLM) offers methodological advantages to other techniques because it can address multiple nesting issues within a single analysis (Raudenbush & Bryk, 2002; Bickel, 2007). This method of analysis is appropriate as it is assumed that students who are members of the same classroom will have more similar scores than two students of two different classrooms. In these analyses, HLM allows for the estimation of the influence of classroom- or teacher-level variables on the relationship between student-level variables and the dependent variable in question. Hierarchical linear modeling was used in order to examine the relationship between the dependant variable, student achievement, and student- as well as teacher/classroom-level predictor variables. In addition to the individual-level predictor variables, contextual explanatory factors included both the formal education background of the teacher as well as the use of developmentally based practices. The possibility of both contextual

effects and individual level effect in the same analysis is an important reason to use HLM in this study (Raudenbush & Bryk, 2002; Bickel, 2007).

The models created for the third question in this study also use interaction terms, or interaction effects, basically allowing for Level 1 and Level 2 variables to interact as they exert influence on the Spring achievement score variables. While some research suggests that the use of interaction terms may muddle the already complex results of HLM, coefficient estimates for cross-level interaction terms are known to be highly reliable and stable when large sample sizes are used (Bickel, 2007). In this study, then, the interaction effects should not change the significance outcomes of the model. Furthermore, the cross-level interaction of variables in this study, although they may slightly decrease effect sizes, is important because it enables the specific distinction of the relationship from level to level among variables (Bickel, 2007).

Variables

Multiple items from the ECLS-K data are used in the study. Table 2 shows ECLS-K item names and descriptions for all items and variables to be used in the study. From this point, the descriptive names will be used rather than the original variable names.

Item Name	Item Description
EARLY	Early Education Courses
DEVLP	Child Development Courses
MTHDRD	Reading Methods Courses
MTHDMA	Math Methods Courses
ERLYCT	Early Childhood Certification
ELEMCT	Elementary Certification
TXRDLA	Instructional Time Reading
TXMTH	Instructional Time Math
CHCLDS	Child Selected Activities
IMPRVM	Formative Assessment
READAR	Use of reading center/area
LISTNC	Use of listening center
WRTCNT	Use of writing center
SCIAR	Use of science center/area
ARTARE	Use of art center/area
COMPAR	Use of computer center/area
DRAMAR	Use of drama center/area
MATHAR	Use of math center/area
MSCALE	Math student achievement score
RSCALE	Reading student achievement score

Table 2 Item names and descriptions for original ECLS-K items used in study

Formal Teacher Education Background

Items in a teacher's formal education background (FEB) were the primary independent variables throughout this study. This included type of certification as well as courses in early childhood education, child development and reading and math methods. Table 3 shows the ECLS-K items included in this variable for the proposed study.

Item Name	N (Q2,3)	N (Q1)	Original Response Codes	
Early Childhood Certification Elementary Certification	21260	3191	(1) Yes (2) No	(-9) Not ascertained
Reading Methods Courses Math Methods Courses Early Education Courses Child Development Courses	21260	3191 3191	(0) 0 (1) 1 (2) 2 (3) 3 (4) 4 (5) 5	(6) 6 or more (-9) Not Ascertained

Table 3 - Descriptives for ECLS-K items used in Formal Education Background variables

Question one. For the first research question, the study is concerned with only early childhood background, therefore early childhood certification and different early childhood coursework (including early education and child development) are the variables included.

Question two. The second research question addressed only certification type, and Early Childhood Certification and Elementary Certification are included.

Question three. Research question three addressed all of the variables listed in Table 2 except early childhood coursework. Reading Methods Courses and Math Methods Courses are included in Level 2 of the final regression model. Certification type (Early Childhood Certification and Elementary Certification) are included in Level 3 of the final model.

Instructional Time

Based on several independent studies (Denzine et al, 2005, Deemer & Minke, 1999; Lin et al, 2002) and derived from Gibson & Dembo's 1984 Teacher Efficacy Scale, the following ECLS-K items were used to explore instructional time as pertaining to teacher self-efficacy: the amount of time spent on reading and the amount of time spent on math. Teachers with high self-efficacy will also report spending a larger amount of time on reading and math.

Table 4 shows the items, response numbers and codes.

Item Name	**N**	**Original Response Codes**	
Instructional		(1) Up to 30 min	(-1) Not applicable
Time Reading	21260	(2) 31 to 60 min	(-9) Not ascertained
Instructional		(3) 61 to 90 min	
Time Math		(4) More than 90 min	

Table 4 Descriptives for ECLS-K items time spent on reading and math

Question one and question two. Teacher self-efficacy variables are not included in the analysis for the first and second research questions.

Question three. The final hierarchical linear model is the only one that included information about self-efficacy, in the form of instructional time. Instructional Time Reading and Instructional Time Math are included as variables in the final research question.

Developmentally Based Practices

Following guidelines set by the NAEYC and studies by multiple researchers (Bredekamp & Copple, 1996; Maxwell et al, 2001; Vartuli, 1999; File & Gullo, 2002; Smith, 1997; Goldstein, 1997), the following ECLS-K items were used to represent developmentally based practices: child selected activities, developmentally based environment, and formative assessment. Every teacher has an environment score (use of the eight centers), a score on child selected activities and a score on formative assessment. Teachers who reported use of developmentally based practices used many child selected activities and multiple centers in their classrooms. Further, these same teachers also reported evaluating students formatively, based on individual progress and relative to the class.

The developmentally based practices variables include child selected activities, developmentally based environment (which is a combinations of reading area, listening center, writing center, science area, computer area, math area, drama area, and art area) and formative assessment. Table 5 shows the items, response numbers and codes.

Item Name	N (Q2,3)	N (Q1)	Original Response Codes
Child Selected Activities	21260	3191	(1) None (2) Less than 30 min (3) 60 min (4) 120 min (5) More than 180 min (-9) Not ascertained
Formative Assessment	21260	3191	(1) Not important (2) Somewhat important (3) Very important (4) Extremely important (5) Not applicable (-9) Not ascertained
Developmentally Based Environment	21260	3191	(1) Yes (2) No (-9) Not ascertained

Table 5 Descriptives for ECLS-K items used in developmentally based practices

Question one. For the first research question, all of the developmentally based practices variables are included. Each of the three main areas of developmentally based practices - developmentally based environment, child selected activities and formative assessment – were included as independent variables in each of three different analyses for the first research question. The first analysis examined the association between an early childhood formal education background and a developmentally based environment. The second explored the connection between an early childhood formal education background and child selected activities. The final analysis for research question one

looked at the association between an early childhood formal education background and formative assessment.

Question two. The second research question does not address the use of developmentally based practices.

Question three. The last research question includes all of the variables in developmentally based practices in the final hierarchical linear model. This analysis explores the association between these variables and student achievement in kindergarten, in both reading and math.

Dependent Variables

Student achievement in math and reading are the main dependent variables in the study model. Math and reading scores were measured by direct assessment and reported on the ECLS-K study. As shown above, on page 30, reliabilities of both reading and math assessments were high, as were intercorrelations among the measures.

IRT scores for math and reading are used to represent student achievement in these areas. IRT scores are used for two main reasons: 1) IRT scores compensate for random guessing and 2) IRT scores are broad and evaluate children's performance on the whole set of questions, regardless of how their peers score. Table 6 shows the items, response numbers and codes.

Item Name	N	Scale – K
Math Score	21260	6 – 60 (-9) Not ascertained
Reading Score	17060	10 – 71 (-9) Not ascertained

Table 6 Descriptives for ECLS-K items used in Student Achievement

Question one. Student achievement is not included in the analysis for the first research question

Question two. For the second research question, both math and reading student achievement scores from Spring are explored. These achievement scores are examined in association with teacher certification type.

Question three. For the third research question, math and reading achievement scores are included in the analysis twice. In the final analysis model, Fall scores of reading and math were examined in two separate analyses. Spring scores in reading and math are the dependent variables in these analyses.

Control Variables

One aim of the study was to show whether or not the use of developmentally based practices accounts for variance in student achievement above and beyond other variables. These other variables can be seen as control variables. In addition to using the above independent variables as 'controls' in the final model, teacher's years experience, student race and student SES will be used as control variables.

Teacher's years experience. According to Darling-Hammond (2000), the teacher's years of experience may influence student achievement. The study, therefore, controlled for the number of years a teacher has taught at the kindergarten level.

Teacher's years experience was used as a control in the final hierarchical linear model of research question 3.

Student socio-economic status and race. Previous studies using the ECLS-K found that student achievement can be hindered by multiple risk factors, including family SES and race (West et al, 2001). The study explored associations between teacher characteristics and student achievement and will have a mix of student representation (across socioeconomic status and race); therefore, the study controlled for these variables.

Both SES and race were examined as control variables in the final analyses, with specific examination of the impacts these variables have on other predictor variables' relationships with student achievement.

Chapter Four – Results

Preliminary Analyses

Zero-order correlations were computed for all of the variables to be used in the study, including both continuous and dichotomous variables. The results of this analysis are available upon request. Correlation coefficients were computed among the variables. A significance level was set at $p < 0.05$. Of the 117 correlations, 92 were significant. In general, the results suggest that teachers with more methods courses do not necessarily spend more time on the subject matter, nor do their students attain higher IRT scores. However, a certification in Early Childhood is significantly and positively correlated to the number of methods courses a teacher takes. Correlations that were not only statistically significant but important to the findings of this study will be discussed throughout the chapter.

Results of the Exploratory Factor Analysis using SPSS 12 showed that there is likely to be an underlying factor influencing the 10 items in the developmentally based practices variable. Running this analysis showed a Kaiser-Meyer-Olkin (KMO) value of 0.926. The KMO is a measure of sampling adequacy which assesses whether there appears to be a latent structure in the data. A KMO value, which is greater than 0.6, implies the existence of an underlying factor. Based on this standard, a factor does exist for the 10 variables. Additionally, Bartlett's test of sphericity had a $p = 0.000$, less than the 0.05 required for significance. However, this test is not as reliable since the sample is so large. The factor matrix for this analysis is shown in Table 7.

	Factor 1
READING AREA	.849
MATH AREA	.820
ART AREA	.803
COMPUTER AREA	.713
LISTENING CENTER	.706
DRAMA AREA	.696
WRITING CENTER	.647
SCIENCE AREA	.549
CHILD SELECTED ACTIVITIES	
FORMATIVE ASSESSMENT	

Table 7 Factor matrix for developmentally based practices variable

Because the factor matrix showed a distinct latent structure for the use of centers in the classroom, the eight centers were combined into one developmentally based environment variable. This variable will be one of three used to represent use of developmentally based practices in the multilevel regression model. The other two variables representing developmentally based practices are child selected activities and use of formative assessment.

Descriptive Analyses

Descriptive analyses (SPSS 12.0) were conducted for the dissertation sample. These can be found in Table 8. It is important to note, however, that these descriptive analyses were used for the entire study sample, even though each research question may

have excluded certain individual cases. Previous ECLS-K reports have controlled for race and SES (NCES 2004, 2006). These reports, along with additional research, support using these variables as controls for this study in the final regression analysis. Descriptive analyses of race and SES are available upon request.

Variable	N	Min	Max	Mean	Std. Deviation
Fall Math Score	15611	6.65	59.82	19.62	7.35
Spring Math Score	15611	7.54	59.34	27.78	8.84
Fall Reading Score	14861	10.08	69.66	22.45	8.50
Spring Reading Score	14861	11.00	70.80	32.46	10.29
Instructional Time Math	14651	1	4	1.79	.73
Instructional Time Reading	14011	1	4	2.57	.93
Child Selected Activities	14829	1	5	2.64	.74
Formative Assessment	15398	1	5	3.66	.55
Years Experience	14878	0	30	9.2	7.63
Early Education Course	15611	0	6	3.58	3.67
Child Development	15611	0	6	2.72	3.50

Courses					
Reading Methods Courses	14851	0	6	3.29	1.82
Math Methods Courses	14798	0	6	2.63	1.69
Elementary Certification	15601	1	2	1.11	.32
Early Childhood Certification	15610	1	2	1.45	.50
Dual Certification	15600	2	3	2.56	.50
Developmentally Based Environment	15256	8	16	9.05	1.32

Table 8 Descriptive analyses

Question One – Teacher Education and Developmentally Based Practices

The first research question explored in this study examined the association of certification and courses in early childhood education and the use of developmentally based practices in the kindergarten classroom.

Three multiple regression analyses were conducted to evaluate how well early childhood teacher education predicted the use of developmentally based practices in the kindergarten classroom. The predictors were teacher licensure/certification in early childhood, courses in early education and courses in child development. The criterion variables were the inclusion of a developmentally based environment (use of centers), child selected activities and formative assessment.

Teacher Education and Developmentally Based Environment

The first analysis examined how well the predictor variables predicted a developmentally based environment. The linear combination of certification, early education courses and child development courses was significantly related to use of developmentally based environments, $F(3, 3106) = 33.06$, $p < 0.01$. The sample multiple correlation coefficient was $R = 0.18$, indicating that approximately 3% of the variance in the use of developmentally based environments in the sample can be accounted for by the linear combination of early childhood teacher education measures.

Table 9 presents indices to indicate the relative strength of the individual predictors. All of the bivariate correlations were significant at $p<0.01$. Courses taken were negatively correlated with the use of developmentally based practices. The partial correlations for both early childhood certification and early education courses were significant, as well, the latter being negative. Finally, the partial correlation for child development courses was not significant.

Developmentally Based Environment	**Zero Order Correlation**	**Partial Correlation**
Early Childhood Certification	0.157*	0.125*
Child Development Courses	-0.076*	-0.018
Early Education Courses	-0.124*	-0.057*

*$p<0.01$

Table 9 Bivariate and partial correlations of the predictors with developmentally based environment

Judgments about the relative importance of these predictors are difficult because they are correlated. The correlations among the predictors ranged from -0.329 to 0.541, with the positive correlation existing between early education and child development courses.

Teacher Education and Child Selected Activities

A multiple regression analysis was conducted to evaluate how well the predictor variables predicted the use of child selected activities. The linear combination of certification, early education courses and child development courses was significantly related to use of developmentally based environments, F (3, 2851) = 26.81, $p < 0.01$. The sample multiple correlation coefficient was $R = 0.17$, indicating that approximately 3% of the variance in the use of child selected activities in the sample can be accounted for by the linear combination of early childhood teacher education measures.

Table 10 presents indices to indicate the relative strength of the individual predictors. The bivariate correlations for both early childhood certification and early education courses were significant at $p<0.01$. Early childhood certification was negatively correlated with the use of child selected activities. The partial correlations were significant for early childhood certification and early education courses, as well. The partial for early childhood certification was negative, while the partial correlation between early education courses and child selected activities was positive.

Child Selected Activities	Zero Order Correlation	Partial Correlation
Early Childhood Certification	-0.154*	-0.126*
Child Development Courses	0.029	-0.024
Early Education Courses	0.104*	0.061*

*p<0.01

Table 10 Bivariate and partial correlations of the predictors with child selected activities

Judgments about the relative importance of these predictors are difficult because, as seen above, they are correlated. The correlations among the predictors for this analysis ranged from -0.334 to 0.522, with the positive correlation existing between early education and child development courses.

Teacher Education and Formative Assessment

A multiple regression analysis was conducted to evaluate how well the predictor variables predicted evaluation of children based on formative assessment. The linear combination of certification, early education courses and child development courses was not significantly related to formative assessment, F (3, 3138) = 1.025, p = 0.380. The p value indicates that none of the variance in using formative assessment in the sample can be accounted for by the linear combination of early childhood teacher education measures.

Table 11 presents indices to indicate the relative strength of the individual predictors. Only the bivariate correlation between certification and formative assessment

was significant at $p < 0.05$. Neither type of courses was significantly correlated with formative assessment. Further, none of the partial correlations were significant.

Formative Assessment	Zero Order Correlation	Partial Correlation
Early Childhood Certification	0.030*	0.030
Child Development Courses	0.003	0.005
Early Education Courses	-0.005	0.001

*p<0.05

Table 11 Bivariate and partial correlations of the predictors with formative assessment

Judgments about the relative importance of these predictors are difficult because, as seen above, they are correlated. The correlations among the predictors for this analysis ranged from -0.330 to 0.543, with the positive correlation existing between early education and child development courses.

Question Two - Teacher Certification Type and Student Achievement

The second research question explored in this study asked whether or not the type of teacher certification was associated with Spring student achievement scores, controlling for Fall scores in the same subject.

A hierarchical linear model was designed to evaluate how well certification type predicted the Spring math and reading scores in kindergarten, controlling for Fall scores in the same subject area.

Certification Type and Student Achievement in Reading

The first model served to test the second research question, and focused on reading scores. This model's equations are presented in Figure 2. In this model, spring

reading scores were included as the dependent variable, with fall reading scores included as a level 1 control variable. Elementary certification and early childhood certification were included as level 2 predictor variables. Initially, the variable representing dual certification was planned to be included in the analysis; however, this variable had too high of an association with these two certification variables, and could not be included in the analysis.

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$C2RSCALE = \beta_0 + \beta_1(\boldsymbol{C1RSCALE}) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + \gamma_{01}(B2ELEMCT) + \gamma_{02}(B2ERLYCT) + u_0$$

$$\beta_1 = \gamma_{10} + \gamma_{11}(B2ELEMCT) + \gamma_{12}(B2ERLYCT) + u_1$$

Figure 2 Question 2 Reading Equations

HLM 6 was used to test this model. The main results from this analysis can be seen in Table 12.

Fixed Effect	Coeff.	Standard Error	T-ratio	DF	P val
Spring Reading Scores					
INTRCPT2	32.102	0.610	52.661	855	0.000
Elementary Certification	-0.235	0.369	-0.637	855	0.524
Early Childhood Certification	-0.336	0.223	-1.506	855	0.132
Fall Reading Score Effects					
INTRCPT2	0.950	0.053	17.921	855	0.000*
Elementary Certification	0.000	0.031	0.002	855	0.998
Early Childhood Certification	0.012	0.020	0.619	855	0.536

*$p<0.01$

Table 12 Fixed effects of certification on Spring reading scores

The intercept in this model, 32.10, represented the predicted spring reading score if all predictor variables in the model were equal to zero. Neither having an elementary certification nor having an early childhood certification was found to directly impact spring reading scores. Next, the control variable, fall reading scores, was found to significantly impact spring reading scores. Specifically, a one-point increase in fall

reading scores was associated with a 0.95 point increase in predicted spring reading scores. Finally, neither having an elementary nor an early childhood certification was found to significantly influence the effect of fall reading scores on spring reading scores.

Certification Type and Student Achievement in Math

The next model also served to test the second research question, but instead focused on math scores. While spring math scores was the dependent variable in this analysis, fall math scores were included as a level 1 control variable. Level 2 independent variables included whether the teacher had an elementary as well as an early childhood certification. Initially, the variable representing dual certification was planned to be included in the analysis; however, this variable had too high of an association with these two certification variables, and could not be included in the analysis. Figure 3 presents an illustration of the equations for this model.

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$C2MSCALE = \beta_0 + \beta_1(\boldsymbol{C1MSCALE}) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + \gamma_{01}(B2ELEMCT) + \gamma_{02}(B2ERLYCT) + u_0$$

$$\beta_1 = \gamma_{10} + \gamma_{11}(B2ELEMCT) + \gamma_{12}(B2ERLYCT) + u_1$$

Figure 3 Question 2 Math Equations

HLM 6 was used to test this model. Table 13 shows the main results from this analysis.

Fixed Effect	Coefficient	Standard Error	T-ratio	DF	P val
Spring Math Scores					
INTRCPT2	29.058	0.423	68.721	855	0.000
Elementary Certification	-0.724	0.248	-2.919	855	0.004*
Early Childhood Certification	-0.280	0.156	-1.792	855	0.073
Fall Math Score Effects					
INTRCPT2	1.009	0.046	21.994	855	0.000*
Elementary Certification	-0.040	0.031	-1.326	855	0.186
Early Childhood Certification	0.011	0.016	0.703	855	0.482

* $p<0.01$

Table 13 Fixed effects of certification on Spring math scores

The intercept, which is 29.06, represents the predicted spring math score if all the independent variables were equal to zero. The first significant p-value represents the effect of the elementary certification variable. The coefficient for this variable is -0.72, meaning that if the student's teacher had certification in elementary education, the student's predicted spring math score was expected to decrease by 0.72 points. Whether

the teacher had early childhood certification was only found to approach significance at the .05 level. Next, fall math scores were found to predict spring math scores. Specifically, a one-point increase in fall math scores was found to be associated with a 1.01 point increase in spring math scores. Finally, the type of certification held by the teacher was not found to significantly influence the effect of fall math scores on spring math scores.

Question Three - Developmentally Based Practices and Student Achievement

The final research question explored in this study examined the use of developmentally based practices in the kindergarten classroom in relation to student achievement scores above and beyond a teacher's certification. A hierarchical linear model was created to examine this question for both reading and math achievement.

Developmentally Based Practices and Student Achievement in Reading

This final model served to test the third research question, and focused on reading scores. In this analysis, spring reading scores were included in the model as the dependent variable, while fall reading scores, student SES (continuous), and student race were included as Level 1 predictors. In this analysis, race was categorized as white, black, Hispanic, Asian, or other race. The dummy variable representing white respondents was excluded from the analysis as the comparison category. The effects of the other race dummy variables included in the analysis represent the effect of being in that racial category as compared with being white. Next, a larger set of variables were included in the analysis as Level 2 predictors. First, reading instructional time was included as a predictor, and was treated as a continuous variable. Child selected activities was also included as a predictor, and was also treated as continuous. Next, formative

assessment was again treated as continuous and included in the model. Years of experience, reading methods courses (treated as continuous), elementary and early childhood certification, as well as having a developmentally based environment were also included as Level 2 predictors. Figure 4 shows the equations for this model, focusing on reading.

LEVEL 1 MODEL (bold: group-mean centering; bold italic: grand-mean centering)

$$\text{C2RSCALE} = \beta_0 + \beta_1(\boldsymbol{C1RSCALE}) + \beta_2(\boldsymbol{WKSESL}) + \beta_3(\text{BLACK}) + \beta_4(\text{HISPANIC}) + \beta_5(\text{ASIAN}) + \beta_6(\text{OTHER\_RA}) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + \gamma_{01}(\boldsymbol{A2TXRDLA}) + \gamma_{02}(\boldsymbol{B2CHCLDS}) + \gamma_{03}(\boldsymbol{B2IMPRVM}) + \gamma_{04}(\boldsymbol{B2YRSKIN}) + \gamma_{05}(\boldsymbol{B2MTHDRD}) + \gamma_{06}(\text{B2ELEMCT}) + \gamma_{07}(\text{B2ERLYCT}) + \gamma_{08}(\boldsymbol{DBENVIR1}) + u_0$$

$$\beta_1 = \gamma_{10} + \gamma_{11}(\boldsymbol{A2TXRDLA}) + \gamma_{12}(\boldsymbol{B2CHCLDS}) + \gamma_{13}(\boldsymbol{B2IMPRVM}) + \gamma_{14}(\boldsymbol{B2YRSKIN}) + \gamma_{15}(\boldsymbol{B2MTHDRD}) + \gamma_{16}(\text{B2ELEMCT}) + \gamma_{17}(\text{B2ERLYCT}) + \gamma_{18}(\boldsymbol{DBENVIR1}) + u_1$$

$$\beta_2 = \gamma_{20} + \gamma_{21}(\boldsymbol{A2TXRDLA}) + \gamma_{22}(\boldsymbol{B2CHCLDS}) + \gamma_{23}(\boldsymbol{B2IMPRVM}) + \gamma_{24}(\boldsymbol{B2YRSKIN}) + \gamma_{25}(\boldsymbol{B2MTHDRD}) + \gamma_{26}(\text{B2ELEMCT}) + \gamma_{27}(\text{B2ERLYCT}) + \gamma_{28}(\boldsymbol{DBENVIR1}) + u_2$$

$$\beta_3 = \gamma_{30} + \gamma_{31}(\boldsymbol{A2TXRDLA}) + \gamma_{32}(\boldsymbol{B2CHCLDS}) + \gamma_{33}(\boldsymbol{B2IMPRVM}) + \gamma_{34}(\boldsymbol{B2YRSKIN}) + \gamma_{35}(\boldsymbol{B2MTHDRD}) + \gamma_{36}(\text{B2ELEMCT}) + \gamma_{37}(\text{B2ERLYCT}) + \gamma_{38}(\boldsymbol{DBENVIR1}) + u_3$$

$$\beta_4 = \gamma_{40} + \gamma_{41}(\boldsymbol{A2TXRDLA}) + \gamma_{42}(\boldsymbol{B2CHCLDS}) + \gamma_{43}(\boldsymbol{B2IMPRVM}) + \gamma_{44}(\boldsymbol{B2YRSKIN}) + \gamma_{45}(\boldsymbol{B2MTHDRD}) + \gamma_{46}(\text{B2ELEMCT}) + \gamma_{47}(\text{B2ERLYCT}) + \gamma_{48}(\boldsymbol{DBENVIR1}) + u_4$$

$$\beta_5 = \gamma_{50} + \gamma_{51}(\boldsymbol{A2TXRDLA}) + \gamma_{52}(\boldsymbol{B2CHCLDS}) + \gamma_{53}(\boldsymbol{B2IMPRVM}) + \gamma_{54}(\boldsymbol{B2YRSKIN}) + \gamma_{55}(\boldsymbol{B2MTHDRD}) + \gamma_{56}(\text{B2ELEMCT}) + \gamma_{57}(\text{B2ERLYCT}) + \gamma_{58}(\boldsymbol{DBENVIR1}) + u_5$$

$$\beta_6 = \gamma_{60} + \gamma_{61}(\boldsymbol{A2TXRDLA}) + \gamma_{62}(\boldsymbol{B2CHCLDS}) + \gamma_{63}(\boldsymbol{B2IMPRVM}) + \gamma_{64}(\boldsymbol{B2YRSKIN}) + \gamma_{65}(\boldsymbol{B2MTHDRD}) + \gamma_{66}(\text{B2ELEMCT}) + \gamma_{67}(\text{B2ERLYCT}) + \gamma_{68}(\boldsymbol{DBENVIR1}) + u_6$$

Figure 4 Question 3 Reading Equations

HLM 6 was used to test this model. The results for Level 1 variables are presented in Table 14 and Level 2 variables are presented in Table 15.

Random Effect for Spring Reading Score	Standard Deviation	Variance Component	df	Chi Squared	P value
Intercept	2.215	4.905	43	69.962	0.006*
Fall Reading Score	0.167	0.028	43	105.491	0.000*
SES	0.575	0.330	43	46.162	0.343
Black Race	0.695	0.483	43	35.055	> 0.500
Hispanic	1.302	1.695	43	39.308	>0.500
Asian	0.720	0.518	43	36.302	>0.500
Other Race	0.501	0.351	43	39.927	>0.500

**p<0.01*

Table 14 Random effects of Level 1 predictor variables on Spring reading scores

Fixed Effect	Coefficient	Standard Error	T-ratio	DF	P val
Spring Reading Scores					
INTRCPT2	32.585	0.659	49.479	792	0.000
Instructional Time Reading	0.723	0.130	5.567	792	0.000**
Child Selected Activities	-0.040	0.170	-0.237	792	0.813
Formative Assessment	0.211	0.217	0.971	792	0.332
Years Experience	-0.011	0.014	-0.822	792	0.411
Reading Methods Courses	-0.076	0.068	-1.111	792	0.267
Elementary Certification	-0.534	0.382	-1.398	792	0.162
Early Childhood Certification	-0.339	0.254	-1.336	792	0.182
Developmentally Based Environment	-0.059	0.095	-0.618	792	0.536
For Fall Reading Score Effects					
INTRCPT2	0.881	0.059	15.053	792	0.000**
Instructional Time Reading	0.011	0.011	1.04	792	0.299
Child Selected Activities	-0.003	0.015	-0.239	792	0.811

Formative Assessment	-0.043	0.020	-2.169	792	0.030*
Years Experience	0.000	0.001	-0.356	792	0.721
Reading Methods Courses	0.008	0.005	1.446	792	0.148
Elementary Certification	0.032	0.033	0.962	792	0.337
Early Childhood Certification	0.016	0.021	0.766	792	0.444
Developmentally Based Environment	0.002	0.008	0.266	792	0.791
For SES Effects					
INTRCPT2	1.261	0.500	2.52	792	0.012*
Instructional Time Reading	0.075	0.105	0.715	792	0.475
Child Selected Activities	-0.254	0.123	-2.075	792	0.038*
Formative Assessment	-0.141	0.177	-0.799	792	0.424
Years Experience	0.008	0.011	0.693	792	0.488
Reading Methods Courses	-0.092	0.053	-1.759	792	0.078
Elementary Certification	-0.397	0.289	-1.373	792	0.170
Early Childhood Certification	-0.071	0.199	-0.355	792	0.722
Developmentally Based Environment	0.075	0.078	0.963	792	0.336

For BLACK Effects					
INTRCPT2	-0.639	1.093	-0.585	792	0.558
Instructional Time Reading	0.087	0.229	0.38	792	0.703
Child Selected Activities	-0.013	0.301	-0.042	792	0.967
Formative Assessment	-0.176	0.416	-0.423	792	0.672
Years Experience	0.006	0.032	0.18	792	0.857
Reading Methods Courses	-0.136	0.117	-1.161	792	0.246
Elementary Certification	0.006	0.610	0.010	792	0.992
Early Childhood Certification	-0.502	0.479	-1.049	792	0.295
Developmentally Based Environment	0.426	0.192	2.213	792	0.027*
For HISPANIC Effects					
INTRCPT2	-0.915	1.252	-0.731	792	0.465
Instructional Time Reading	0.141	0.240	0.589	792	0.556
Child Selected Activities	-0.223	0.314	-0.71	792	0.478
Formative Assessment	0.006	0.353	0.016	792	0.987
Years Experience	-0.023	0.031	-0.738	792	0.461
Reading Methods Courses	0.095	0.120	0.787	792	0.432

Elementary Certification	-0.091	0.717	-0.127	792	0.900
Early Childhood Certification	0.568	0.467	1.217	792	0.224
Developmentally Based Environment	0.238	0.179	1.334	792	0.183
For ASIAN Effects					
INTRCPT2	0.416	1.667	0.25	792	0.803
Instructional Time Reading	0.183	0.288	0.637	792	0.524
Child Selected Activities	-0.599	0.377	-1.588	792	0.112
Formative Assessment	-0.042	0.486	-0.086	792	0.932
Years Experience	0.025	0.039	0.632	792	0.527
Reading Methods	-0.066	0.170	-0.39	792	0.696
Elementary Certification	-0.348	0.991	-0.352	792	0.725
Early Childhood Certification	0.682	0.623	1.094	792	0.275
Developmentally Based Environment	-0.391	0.239	-1.64	792	0.101
For OTHER Race Effects					
INTRCPT2	-0.788	1.811	-0.435	792	0.663
Instructional Time Reading	-0.576	0.324	-1.781	792	0.075

Child Selected Activities	-0.140	0.380	-0.369	792	0.712
Formative Assessment	-0.590	0.504	-1.171	792	0.242
Years Experience	-0.035	0.039	-0.893	792	0.373
Reading Methods Courses	-0.059	0.131	-0.445	792	0.656
Elementary Certification	1.067	1.252	0.852	792	0.394
Early Childhood Certification	-0.510	0.546	-0.935	792	0.351
Developmentally Based Environment	0.066	0.202	0.325	792	0.745

$^{**}p<0.01$, $^{*}p<0.05$

Table 15 Fixed effects of Level 2 predictor variables on Spring reading scores

First, the intercept in this model, which was 32.58, represented the predicted reading score when all independent variables were equal to zero. Next, one of the Level 2 predictors was found to have a direct impact on spring reading scores. Specifically, instructional time was found to impact reading scores. This variable consisted of four ordered categories: 1) 1-30 minutes a day, 2) 31-60 minutes a day, 3) 61-90 minutes a day, and 4) more than 90 minutes a day. Based on the results of this analysis, a one category increase in this variable was associated with an increase in predicted spring reading scores of 0.72 points.

Next, fall reading scores were found to significantly impact predicted spring reading scores. Specifically, a one-point increase in fall reading scores was associated with a 0.88 predicted increase in spring reading scores. Additionally, formative

assessment was found to significantly impact the relationship between fall reading scores and spring reading scores. Specifically, a one-unit increase in this variable was found to decrease the predicted impact of fall reading scores on spring reading scores by 0.04 points.

Student SES was also found to impact predicted spring reading scores. Specifically, a one-unit increase in student SES was associated with a predicted 1.26 unit increase in spring reading scores. Additionally, child selected activities was found to influence this relationship. Specifically, a one unit increase in this variable was associated with a 0.25 unit decrease in the effect of student SES on spring reading scores. Finally, no significant relationship was found between race and spring reading scores. Because, however, the equations for this model were designed to include interaction effects, the influence of Level 2 variables on Spring Reading scores may be slightly lower than if interaction terms had not been included. This does not decrease the significance of the findings of this study, though, as interaction effects are part of the specified model and desired outcomes.

Developmentally Based Practices and Student Achievement in Math

The next analysis served to explore the third research question presented in this study, focusing on math scores. In this analysis, spring math scores were included in the model as the dependent variable, while fall math scores, student SES (continuous), and student race were included as Level 1 predictors. In this analysis, race was categorized as white, black, Hispanic, Asian, or other race. The dummy variable representing white respondents was excluded from the analysis as the comparison category. The effects of the other race dummy variables included in the analysis represent the effect of being in

that racial category as compared with being white. Next, a larger set of variables were included in the analysis as Level 2 predictors. First, instructional time was included as a predictor, and was treated as a continuous variable. Child selected activities was also included as a predictor, and was also treated as continuous. Next, formative assessment was again treated as continuous and included in the model. Years of experience, methods courses (treated as continuous), elementary and early childhood certification, as well as having a developmentally based environment were also included as Level 2 predictors. This model's equations are presented in Figure 5.

$$\text{C2MSCALE} = \beta_0 + \beta_1(\textbf{\textit{C1MSCALE}}) + \beta_2(\textbf{\textit{WKSESL}}) + \beta_3(\text{BLACK}) + \beta_4(\text{HISPANIC}) + \beta_5(\text{ASIAN}) + \beta_6(\text{OTHER\_RA}) + r$$

LEVEL 2 MODEL (bold italic: grand-mean centering)

$$\beta_0 = \gamma_{00} + \gamma_{01}(\textbf{\textit{A2TXMTH1}}) + \gamma_{02}(\textbf{\textit{B2CHCLDS}}) + \gamma_{03}(\textbf{\textit{B2IMPRVM}}) + \gamma_{04}(\textbf{\textit{B2YRSKIN}}) + \gamma_{05}(\textbf{\textit{B2MTHDMA}}) + \gamma_{06}(\text{B2ELEMCT}) + \gamma_{07}(\text{B2ERLYCT}) + \gamma_{08}(\textbf{\textit{DBENVIR1}}) + u_0$$

$$\beta_1 = \gamma_{10} + \gamma_{11}(\textbf{\textit{A2TXMTH1}}) + \gamma_{12}(\textbf{\textit{B2CHCLDS}}) + \gamma_{13}(\textbf{\textit{B2IMPRVM}}) + \gamma_{14}(\textbf{\textit{B2YRSKIN}}) + \gamma_{15}(\textbf{\textit{B2MTHDMA}}) + \gamma_{16}(\text{B2ELEMCT}) + \gamma_{17}(\text{B2ERLYCT}) + \gamma_{18}(\textbf{\textit{DBENVIR1}}) + u_1$$

$$\beta_2 = \gamma_{20} + \gamma_{21}(\textbf{\textit{A2TXMTH1}}) + \gamma_{22}(\textbf{\textit{B2CHCLDS}}) + \gamma_{23}(\textbf{\textit{B2IMPRVM}}) + \gamma_{24}(\textbf{\textit{B2YRSKIN}}) + \gamma_{25}(\textbf{\textit{B2MTHDMA}}) + \gamma_{26}(\text{B2ELEMCT}) + \gamma_{27}(\text{B2ERLYCT}) + \gamma_{28}(\textbf{\textit{DBENVIR1}}) + u_2$$

$$\beta_3 = \gamma_{30} + \gamma_{31}(\textbf{\textit{A2TXMTH1}}) + \gamma_{32}(\textbf{\textit{B2CHCLDS}}) + \gamma_{33}(\textbf{\textit{B2IMPRVM}}) + \gamma_{34}(\textbf{\textit{B2YRSKIN}}) + \gamma_{35}(\textbf{\textit{B2MTHDMA}}) + \gamma_{36}(\text{B2ELEMCT}) + \gamma_{37}(\text{B2ERLYCT}) + \gamma_{38}(\textbf{\textit{DBENVIR1}}) + u_3$$

$$\beta_4 = \gamma_{40} + \gamma_{41}(\textbf{\textit{A2TXMTH1}}) + \gamma_{42}(\textbf{\textit{B2CHCLDS}}) + \gamma_{43}(\textbf{\textit{B2IMPRVM}}) + \gamma_{44}(\textbf{\textit{B2YRSKIN}}) + \gamma_{45}(\textbf{\textit{B2MTHDMA}}) + \gamma_{46}(\text{B2ELEMCT}) + \gamma_{47}(\text{B2ERLYCT}) + \gamma_{48}(\textbf{\textit{DBENVIR1}}) + u_4$$

$$\beta_5 = \gamma_{50} + \gamma_{51}(\textbf{\textit{A2TXMTH1}}) + \gamma_{52}(\textbf{\textit{B2CHCLDS}}) + \gamma_{53}(\textbf{\textit{B2IMPRVM}}) + \gamma_{54}(\textbf{\textit{B2YRSKIN}}) + \gamma_{55}(\textbf{\textit{B2MTHDMA}}) + \gamma_{56}(\text{B2ELEMCT}) + \gamma_{57}(\text{B2ERLYCT}) + \gamma_{58}(\textbf{\textit{DBENVIR1}}) + u_5$$

$$\beta_6 = \gamma_{60} + \gamma_{61}(\textbf{\textit{A2TXMTH1}}) + \gamma_{62}(\textbf{\textit{B2CHCLDS}}) + \gamma_{63}(\textbf{\textit{B2IMPRVM}}) + \gamma_{64}(\textbf{\textit{B2YRSKIN}}) + \gamma_{65}(\textbf{\textit{B2MTHDMA}}) + \gamma_{66}(\text{B2ELEMCT}) + \gamma_{67}(\text{B2ERLYCT}) + \gamma_{68}(\textbf{\textit{DBENVIR1}}) + u_6$$

Figure 5 Question 3 Math Equations

HLM 6 was used to run the model. Table 16 presents the results of the Level 1 analysis, while results for Level 2 variables can be found in Table 17.

Random Effect for Spring Math Score	Standard Deviation	Variance Component	df	Chi Squared	P value
Intercept	1.611	2.595	42	66.995	0.009**
Fall Math Score	0.115	0.013	42	97.669	0.000**
SES	0.352	0.124	42	65.045	0.013*
Black Race	1.068	1.140	42	44.616	0.362
Hispanic	1.015	1.030	42	35.272	>0.500
Asian	0.723	0.522	42	31.784	>0.500
Other Race	0.757	0.573	42	46.834	0.280

***p<0.01 *p<0.05*

Table 16 Random effects of Level 1 predictor variables on Spring math scores

Fixed Effect	Coefficient	Standard Error	T-ratio	DF	P val
For Spring Math Scores					
INTRCPT2	29.213	0.507	57.626	790	0.000
Instructional Time Math	0.414	0.130	3.196	790	0.002**
Child Selected Activities	-0.165	0.124	-1.327	790	0.185
Formative Assessment	-0.244	0.170	-1.429	790	0.153
Years Experience	-0.017	0.011	-1.597	790	0.110
Math Methods Courses	0.026	0.057	0.46	790	0.645
Elementary Certification	-0.722	0.307	-2.352	790	0.019*
Early Childhood Certification	-0.140	0.185	-0.759	790	0.448
Developmentally Based Environment	-0.021	0.075	-0.283	790	0.777
For Fall Math Score Effects					
INTRCPT2	0.967	0.051	18.813	790	0.000**
Instructional Time Math	0.017	0.011	1.495	790	0.135
Child Selected Activities	-0.006	0.012	-0.471	790	0.637
Formative Assessment	-0.016	0.016	-0.976	790	0.330
Years Experience	0.001	0.001	0.748	790	0.455

Math Methods Courses	-0.001	0.005	-0.105	790	0.917
Elementary Certification	-0.027	0.036	-0.756	790	0.450
Early Childhood Certification	0.007	0.017	0.402	790	0.687
Developmentally Based Environment	0.001	0.007	0.171	790	0.864
For SES Effects					
INTRCPT2	0.609	0.395	1.54	790	0.124
Instructional Time Math	-0.079	0.097	-0.813	790	0.417
Child Selected Activities	0.045	0.090	0.502	790	0.615
Formative Assessment	-0.033	0.121	-0.275	790	0.783
Years Experience	-0.021	0.008	-2.487	790	0.013*
Math Methods Courses	0.019	0.043	0.445	790	0.656
Elementary Certification	-0.100	0.261	-0.382	790	0.702
Early Childhood Certification	0.058	0.144	0.403	790	0.687
Developmentally Based Environment	-0.002	0.064	-0.024	790	0.981
For BLACK Effects					
INTRCPT2	-1.047	0.821	-1.276	790	0.203
Instructional Time Math	-0.251	0.224	-1.121	790	0.263
Child Selected Activities	0.338	0.228	1.48	790	0.139
Formative Assessment	0.151	0.334	0.452	790	0.651

Years Experience	-0.005	0.022	-0.209	790	0.835
Math Methods Courses	-0.065	0.110	-0.641	790	0.522
Elementary Certification	-0.005	0.433	-0.012	790	0.991
Early Childhood Certification	-0.306	0.375	-0.817	790	0.414
Developmentally Based Environment	0.133	0.139	0.953	790	0.341
For HISPANIC Effects					
INTRCPT2	-0.561	0.913	-0.614	790	0.539
Instructional Time Math	0.505	0.280	1.805	790	0.071
Child Selected Activities	-0.111	0.222	-0.502	790	0.615
Formative Assessment	0.323	0.263	1.228	790	0.220
Years Experience	-0.016	0.018	-0.917	790	0.360
Math Methods Courses	-0.099	0.107	-0.925	790	0.355
Elementary Certification	0.168	0.463	0.363	790	0.716
Early Childhood Certification	-0.223	0.349	-0.64	790	0.522
Developmentally Based Environment	0.031	0.140	0.221	790	0.825
For ASIAN Effects					
INTRCPT2	1.410	1.514	0.931	790	0.353
Instructional Time Math	0.031	0.426	0.072	790	0.943
Child Selected Activities	-0.082	0.363	-0.224	790	0.823

Formative Assessment	0.837	0.403	2.077	790	0.038*
Years Experience	0.044	0.0314	1.395	790	0.163
Math Methods Courses	-0.182	0.149	-1.223	790	0.222
Elementary Certification	-1.272	0.853	-1.491	790	0.136
Early Childhood Certification	-0.142	0.568	-0.25	790	0.803
Developmentally Based Environment	-0.282	0.195	-1.445	790	0.149
For OTHER Race Effects					
INTRCPT2	-1.761	1.783	-0.988	790	0.324
Instructional Time Math	-0.032	0.347	-0.092	790	0.927
Child Selected Activities	0.001	0.321	0.003	790	0.998
Formative Assessment	0.225	0.442	0.51	790	0.610
Years Experience	-0.014	0.031	-0.455	790	0.649
Math Methods Courses	-0.173	0.135	-1.282	790	0.201
Elementary Certification	1.933	1.370	1.412	790	0.158
Early Childhood Certification	-0.482	0.489	-0.985	790	0.325
Developmentally Based Environment	0.0413	0.183	0.226	790	0.821

***p<0.01, *p<0.05*

Table 17 Fixed effects of Level 2predictor variables on Spring math scores

First, the intercept, 29.21, represents the predicted spring math score if all independent variables in the model were equal to zero. Next, two of the Level 2 predictors were found to directly impact predicted spring math scores. First, instructional time was found to have a significant impact on spring math scores. This variable consisted of four ordered categories: 1) 1-30 minutes a day, 2) 31-60 minutes a day, 3) 61-90 minutes a day, and 4) more than 90 minutes a day. Based on the results of this analysis, a one category increase in this variable was associated with an increase in predicted spring math scores of 0.41 points. Next, having an elementary certification was also associated with spring math scores. Specifically, if a child's teacher had an elementary certification, the student's spring math scores were predicted to decrease by 0.72 points. None of the other Level 2 predictors were found to have a direct impact on spring math scores.

Next, fall math scores were found to significantly influence spring math scores. Specifically, a one-point increase in fall math scores was associated with a 0.97 point increase in spring math scores. None of the Level 2 predictors were found to significantly influence the relationship between fall and spring math scores. No other Level 1 predictors were found to significantly influence spring math scores.

Finally, the equations for this model were designed to include interaction effects; therefore, the influence of Level 2 variables on Spring Math scores may be slightly lower than if interaction terms had not been included. This does not decrease the significance of the findings of this study, though, as interaction effects are part of the specified model and desired outcomes.

Chapter Five – Discussion

Using data drawn from the ECLS-K Base Year Public-Use data, this study examined the influence of formal teacher education on the development and use of developmentally based practices and student achievement. First, this study examined whether or not the reported use of developmentally based practices in the kindergarten classroom was influenced by a background – courses and certification – in early childhood education. Next, this study explored the role of certification – early childhood, elementary or dual – on kindergarten student achievement in both reading and math. Finally, this study explored the significance of controlling factors, as well as the use of developmentally based practices, on student achievement above and beyond the importance of teacher certification. This chapter summarizes and discusses findings both multilevel regression and hierarchical linear modeling analyses used to examine these issues. This chapter also explores the implications of these findings, what they could mean for teacher education and what limitations might hinder the use of these results.

Question One - Teacher Education and Developmentally Based Practices

This study's first aim was to discover if teachers with a significant background in early childhood education, including courses in early education, courses in child development and certification in early childhood education, reported use of developmentally based practices. Based on the research and the measures used in the base year ECLS-K data, the developmentally based practices selected for use in this study included the use of a

developmentally based environment (eight different centers), child selected activities and formative assessment.

This first question resulted from vast research drawn from the NAEYC's view on Developmentally Appropriate Practices (DAP). Many studies have suggested that teachers who matriculate in early childhood programs have a strong belief in and use of practices that align with DAP (Spodek, 1988; Vartuli, 1999; Smith, 1997; File & Gullo, 2002). From these studies, it is inferred that there is a distinct increase in beliefs and use of developmentally based practices with primary teachers from early childhood programs compared to elementary programs (McMullen, 1999). Additionally, teachers from an early childhood background specifically refer to the use of multiple centers (Van Horn & Ramey, 2004; Smith, 1997; File & Gullo, 2002; Jacobs, 2001), allowing children to select activities (Van Horn & Ramey, 2004; Maxwell et al, 2001; File & Gullo, 2002) and use of formative assessment (Bredekemp & Copple, 1997; File & Gullo, 2002) as important aspects of DAP to include in a primary grade classroom. Because the research was so strong, a hypothesis was formed for all three aspects of developmentally based practices. It was believed that teachers with a background in early childhood education would report using developmentally based practices in the kindergarten classroom

Teacher Education and Developmentally Based Environment

Evidence from this study indicated that an early childhood background is significantly associated with the inclusion of a developmentally based environment in the kindergarten classroom. While courses in early education and child development were both found to be significantly and negatively linked to a developmentally based environment, certification in early childhood education was statistically significant and

positive. This finding indicates that teachers who have taken early childhood coursework are less inclined to use centers in the classroom and that a certificate in early childhood education is important in use of centers in the classroom by teachers. Some studies have indicated that teaching using concrete experiences (including manipulatives and the use of centers) can come from different courses, including but not limited to those in early childhood (Chang, 2007). Results from this study, while not supported by the research on developmentally based practices, suggest that there may be other aspects of a teacher's formal education background that contribute to the use of centers in the kindergarten classroom in addition to certification. This strengthens the need for more research in this area.

Additionally, it is common for teachers in both the pre-service and in-service arenas to have beliefs about developmentally based practices that differ from their reported use of said practices (Vartuli, 1999; Smith, 1997). This could not only impact results of studies such as this one, but it could imply that some teachers are either saying what they think researchers want to hear, while not practicing it, or that they believe in the use of developmentally based practices but cannot implement this in their classroom. Research needs to address what schools are requiring or kindergarten teachers to see why this discrepancy may exist.

Teacher Education and Child Selected Activities

This study indicates that the aspects of an early childhood background which are statistically significant in predicting the use of child selected activities in a kindergarten classroom are certification and early education courses. However, only early education courses were positively correlated with the use of child selected activities. This finding

lends support to the studies that stress the importance of teacher education programs including child selected activities in their curricula for all coursework (File & Gullo, 2002; Buchanan et al, 1998; Smith, 1998). Additionally, the NAEYC position on child decision making is supported by these findings, and teacher education programs should take notice and include this in their curricula.

Teacher Education and Formative Assessment

Findings from this study show that none of the aspects of an early childhood background are significantly associated with the use of formative assessment in kindergarten. This implies that, regardless of what courses may teach during the preservice years and how a teacher is certified, the use of formative assessment is not a product of a formal education background. This finding supports recent research that shows how many early teachers are misusing observation, treating it in a summative, rather than formative, manner. Confused by mandates and standards, many teachers fall into a pattern of using different types of assessment as summative rather than formative (McNair et al, 2003), once immersed in their own classrooms. Again, if school administrations are requiring certain types of assessment of their students, teachers may not feel capable or able to perform formative assessment in a correct way. Further, the simple substitution of evaluation based on improvement for formative assessment may not fully target this developmentally based practice. More research should be done to examine other aspects and measures of formative assessment.

Limitations and Future Directions

Although this study anticipated a significant connection between an early childhood teacher education background and the reported use of developmentally based

practices, the findings were mixed. The combination of the above findings might indicate that teachers beliefs about and use of developmentally based practices can be very different (Vartuli, 1999). Furthermore, beliefs tend to be more developmentally based than practices (Charlesworth et al, 1993). Teachers' beliefs during formal education may not align with their practices once they have their own classrooms.

However, it should be noted that not every aspect of DAP, nor every developmentally based practice, was considered in either the ECLS-K or this study. This limits the scope of how a teacher education background might influence beliefs in developmentally based practiced. Additionally, this study did not look at every aspect of teacher education that might influence the development of teaching beliefs and practices. Teacher education programs, then, should carefully consider how to teach developmentally based practices in light of standards and mandates put down by state and federal agencies. It might also be prudent for future research to examine the other aspects of developmentally based practices overlooked by the ECLS-K data and this study, as well as stretching the parameters to include various types of teacher education background, not just early childhood education. There is a great deal more to implementing developmentally based practices than was possible to study here; and it is critical for the future of education that teachers understand what this can mean for their students. Finally, this is an area which would benefit from further studies about coursework undertaken during the licensure process. It is not always possible to align coursework with certification. Because this study did not differentiate between alternative certification programs and university based programs, the number of courses undertaken may differ greatly from teacher to teacher. Coursework requirements vary

from state to state and from university to university. Therefore, teachers with the same certification will likely have taken different numbers of courses. If courses are associated with developmentally based practices, then it is possible that teachers with advanced degrees will already be at an advantage, having possibly taken more courses to achieve this advanced degree. The ECLS-K data provides this information, so further research would be beneficial to the field.

In conclusion, it has been found that coursework has a significant influence on the use of certain developmentally based practices. This stresses the importance of the environmental factor of Social Cognitive Theory. A teacher must have a strong environmental component in the triadic reciprocation model to be her most successful. Research should continue to examine the nature and number of courses required for teachers to enter the field.

Question Two – Teacher Certification Type and Student Achievement

The second goal of this study was to examine whether type of teacher certification is associated with student achievement in kindergarten. This study has parsed student achievement into separate reading and math analyses.

This second question was drawn from research supporting the theory that certification is indeed an indicator of student achievement. Certification in the field being taught has often been shown as significantly and positively correlated with student achievement. Additionally, certification in the field is a more powerful indicator of student achievement scores than most other teacher characteristics (Darling-Hammond, 2000). Studies have also linked certification to student achievement via teacher self-efficacy (Zientek, 2006) with findings that suggest certification in the field lead to higher

efficacy which, in turn, leads to higher student achievement. This study supports certification and links to student achievement in kindergarten, meaning certification type is associated with kindergarten achievement scores. However, a hypothesis was formed specifically addressing early childhood certification, since this type of education is the focus of the study. It was hypothesized that certification in early childhood education would be associated with student achievement in both reading and math for kindergarten students.

Certification Type and Student Achievement in Reading

Findings from this study suggest that, controlling for Fall reading scores, Spring reading scores are not associated with any type of certification. This supports studies and research stating that certification has little, if any, influence on student achievement (Storch & Whitehurst, 2001; Whitehurst, 2002). Reviews of multilevel studies suggest that only 20% of student achievement can be attributed to teacher characteristics. Of this 20%, though, certification is not a statistically significant factor (Whitehurst, 2002). However, these findings contradict more recent findings that certification has a strong effect on reading student achievement throughout schooling (Myrberg, 2007). Perhaps states differ in requirements for certification, or more recent changes in teacher education programs have begun to address the 2002 findings and improve their curricula. It is possible that the distinction between licensure and certification could be at play here, and more research should be carried out to examine this possibility. Additionally, it would be interesting to see if the acquisition of certification has an influence on student achievement. Whether or not a teacher gains certification through state exams and

licensure or an alternative route may be associated differently with reading student achievement.

Certification Type and Student Achievement in Math

Evidence from this study indicates that, controlling for Fall math scores, only certification in elementary education was associated with spring math scores, though this was found to be a negative association. While Whitehurst (2002) suggests that certification does not influence student achievement at all, Uri Treisman (2004) suggests that teachers who are certified in math have higher student achievement than teachers not math certified. Other studies demonstrated that student achievement is influenced by teacher certification when that certification is in a field which emphasizes the importance of math instruction (Creemers & de Jong, 2002). On the other hand, some studies have found no conclusion about the importance of having a degree or coursework in elementary education (Wayne & Youngs, 2003). Findings from this study support previous conclusions that a meaningful focus and instruction in math in a teacher education program is the best way to increase math student achievement (Leinwand & Fleischman, 2004). If, then, early childhood teacher education programs provide minimal training on math instruction (Graham et al, 1997) and, therefore, may not be associated with higher math scores, early childhood teacher education should adapt to include more math instruction. Additionally, findings from this study suggest that an elementary certification, while possibly more focused on content knowledge, does not positively correlate with student math achievement scores in kindergarten. This might indicate that there are other aspects of an elementary based education that would positively influence student math achievement in kindergarten. It might also indicate a

need for kindergarten to remain a learn and play grade in schooling, and that early childhood education should focus on allowing the child to guide his own learning through play and manipulatives rather than by the strict academic route than many elementary education programs advocate.

Limitations and Future Directions

It was hypothesized that certification in early childhood education would be linked to student achievement in kindergarten for reading and math. However, the results did not support this hypothesis. While prominent researchers like Grover Whitehurst and Linda Darling-Hammond disagree as to the importance of certification and teacher characteristics to student achievement scores, it is important to explore other recent individual studies to see what they have to offer. Chang (2007) suggests that teacher educators must be mindful of state mandates, especially when teaching for instruction in early math. This study supports the need to continue examination of student achievement scores in association with certification. Further research should be done using the ECLS-K data to explore certification and student achievement beyond the kindergarten year. A caveat of the study is that it does not examine different levels of certification as indicative of student achievement scores. This is another area that future research should address.

Additionally, there is still a distinction in many states, and an argument amongst educators, between certification and licensure. While this study uses the terms interchangeably, this is not always the case. Research needs to be done to examine if these differences are, in fact, influencing student scores.

Future research should also be conducted to examine why the association between an elementary certification and Spring math scores is negative. It is important to know if

the elementary education programs are missing a crucial aspect of math education or if the teachers in this study were also lacking another characteristic that influenced the math scores. Finally, the differences that exist for dual certified teachers need to be explored beyond the simple connection to elementary certification. This research might find that a combination certification has unique influences on student achievement, providing deeper insight for teacher education programs and licensure boards.

Question Three - Developmentally Based Practices and Student Achievement

The final aim of this study was to examine the association between developmentally based practices and student achievement beyond teacher certification. This question was tested using hierarchical linear modeling, one analysis each for reading and math. Support for this question was derived from multiple studies on developmentally based practices and student achievement throughout school grades. Some studies have found that student achievement in later elementary school is connected to use of reform based teaching as opposed to traditional teaching practices (Riordan & Noyce, 2001). Evidence also suggests that when using developmentally based practices, children show higher gains in cognitive and intellectual development (Coplan et al, 1999). In contrast with this research, though, is that which finds no evidence linking developmentally based practices to cognitive or academic outcomes (Van Horn et al, 2005). In this study, certification was associated only, and negatively, to student achievement for elementary certification and math.

Student/Family Characteristics and Student Achievement

In this study, student and family characteristics were the most predictive of student achievement scores. For math, fall scores were the most predictive of spring

student achievement. For reading, family SES and fall scores predicted spring student achievement. There is research that supports this finding. Family background consistently has a greater effect on student achievement than any school or teacher characteristic (Haskins & Loeb, 2007). Further studies have indicated a significant link between parent characteristics and student achievement (Storch & Whitehurst, 2001). In the review of multilevel studies, Whitehurst suggests that 60% of variance in student achievement can be attributed to race and SES (2002). With regard to math, specifically, children from low income families are more likely to have lower achievement scores than children from other families (Jordan et al, 2009). However, results from this study show no significant association between student race and either reading or math scores. With regard to reading, children from white, higher SES families enter kindergarten with more skills and show higher spring achievement scores than other children (Kainz and Vernon-Feagans, 2007). Findings from this study support this. Increasing a student's SES predicts an increase in spring scores. This is highly important for schools and teachers to consider when looking at their student population.

At least one study suggests that high quality teaching can overcome differences between low income and high income families (Myrberg, 2007). A study that examined pre-school influence on kindergarten student achievement found that both reading and math scores increased for those students who attended a state funded pre-school (Hardy, 2006). Families from disadvantaged groups might fare better academically in kindergarten if they attend pre-school.

Teacher Characteristics and Student Achievement

This study indicated that very few teacher characteristics were associated with student achievement in kindergarten. Certification in elementary education predicted math scores only. For both reading and math, instructional time (on the specific subject matter) best predicted student achievement in kindergarten. Most states have instructional time requirements for reading and math in kindergarten, and many states have gone to a full day kindergarten to meet these needs. Students in full day kindergarten programs have higher achievement in reading in their spring assessments (Kainz & Vernon-Feagans, 2007) This finding supports previous findings of both Darling-Hammond (2003) and Andrew & Schwab (1995) that found great significance to teacher characteristics. However, there is also research that continually lessens the importance of teacher characteristics. Of the teacher characteristics believed to be 20% associated with student achievement, subject matter knowledge in math seems to be significant, but not in reading (Whitehurst, 2002). Whitehurst also suggests that most of this 20% is actually attributed to teacher verbal and cognitive ability, but not certification or experience (2002). Darling-Hammond has also suggested that years experience lessens in association with student achievement beyond 5 years, and that teachers with less than 3 years experience are less efficient in attaining high student achievement (2003).

Finally, it is again necessary to remember the importance of instructional time in creating a teacher's sense of self-efficacy. While this study has attempted to connect instructional time with self-efficacy, it has found that instructional time is critical to a student's achievement in both math and reading. For the teacher, this reinforces the Social Cognitive Theory's inclusion of self-efficacy in the personal realm of the triadic

reciprocation model. A teacher with a strong sense of self-efficacy, possibly displayed by higher instructional time, will have students with higher achievement scores.

Developmentally Based Practices and Student Achievement

The final finding from this study indicated no significant connection between the use of developmentally based practices and student achievement, regardless of previous characteristics. While this part of the model was not strongly based in research, some studies found a connection between primary grade use of developmentally based practices and student achievement scores (Coplan et al, 1999; Griesemer, 1997). However, other studies contradict those findings and indicate no connection at all between developmentally based practices and student achievement (Van Horn et al, 2005; Van Horn & Ramey, 2003). Without an observation component, though, this study could not fully explore the use of developmentally based practices. Further research should include an observation component in conjunction with teacher report.

While developmentally based practices were not directly associated with spring achievement scores, one of the developmentally based practices indirectly influenced scores via an impact on another variable. Formative assessment was found to decrease the influence of fall reading scores on spring scores. This could indicate that teachers using formative assessment have lower achievement scores in reading. However, as teachers use a mixture of assessment types and may not be completely aware of how each type might benefit students, it is not unlikely for scores to be effected (McNair et al, 2003).

Limitations and Future Directions

The study, while examining a wide range of possible influences on student achievement in kindergarten, did not explore the specifics of some of these associations. More research needs to be performed, using the same ECLS-K data, to explore aspects of the family and the teacher that were not tackled in this study. Further research should also be performed to explore the associations between all of the above family, student and teacher characteristics on student achievement beyond the kindergarten year. It is thought that these associations might change with more time, with achievement showing different gains from kindergarten to first grade and beyond. The more time a student spends in formal education, the more time these characteristics have to influence his achievement.

General Limitations and Future Directions

This study was predicated on the assumption that teacher characteristics derived during the formal teacher education period were associated with student achievement scores beyond child and family characteristics, including race, SES, and previous scores. Some research has supported the theory that student achievement scores can be influenced by that which occurs in the classroom as well as before a teacher enters the classroom (Creemers & de Jong, 2002; Krol et al, 2002; Tosun, 2000; Leinwand & Fleischman, 2004; Myrberg, 2007). However, there is also a large body of research that suggests that student achievement in the early grades of elementary school is influenced by little other than family and child characteristics (Storch & Whitehurst, 2001; Whitehurst, 2002; Haskins & Loeb, 2007; Jordan et al, 2009) especially for literacy development (Kainz and Vernon Feagans, 2007). Kindergarten student achievement scores in Spring seem to be mostly influenced by race, SES and Fall scores.

The findings from this study, although not always aligned with the proposed hypotheses, support previous findings that teacher characteristics have little association with student achievement. However, it must be considered that the only student achievement scores considered for this study were those taken during the kindergarten year. It would be prudent for further research to include scores that students obtained throughout the rest of the ECLS-K data collection period.

This study did find that a certification in elementary education is negatively associated with student achievement in math. This finding could support research on teacher self-efficacy and its link to an elementary education background. Elementary education majors are likely to develop a stronger sense of self-efficacy which should, in turn, increase student achievement (Tosun, 2000; Tucker et al, 2005). However, as these teachers are not certified in early childhood education, this self-efficacy could, in fact, be a hindrance to kindergarten math achievement. At the same time, math achievement scores are found to be higher when the teacher is certified in mathematics (Triesman, 2004). Further research should be performed using the ECLS-K data to examine more characteristics of teachers that are linked to teacher self-efficacy. If, in fact, student achievement is linked to teacher self-efficacy, then more research should also be undertaken to explore how and why teachers develop specific aspects of efficacy during the teacher education process.

The final findings from this study pertain to using developmentally based practices in the kindergarten classroom. An early childhood background associated in different ways to the 3 developmentally based practices selected for exploration: developmentally based environments, child selected activities and formative assessment.

This supports research on DAP (NAEYC, Bredekemp & Copple, 2007) being associated with early childhood teacher education programs (Smith, 1997; Maxwell et al, 2001; File & Gullo, 2002). However, the use of these developmentally based practices was not found to directly influence student achievement. This means that more research needs to be performed on additional developmentally based practices as well as how these practices might influence achievement in other elementary school grades.

Additionally, this study must take into account the time the ECLS-K data were collected. When the study began, the No Child Left Behind Act was being written into law, and when data were collected, the law had been activated in schools across the nation. This meant that uniform standards and tests were being used to assess how well students learned at each grade level (Hyun, 2003). While these standards were set to ensure learning for all students, the call for accountability and the narrowing of alternative assessment practices meant that teachers were not necessarily able to use such things as formative assessment in their classrooms (Hyun, 2003). Additionally, the NCLBA coincided with the prevalence of pre-packaged curriculum, which often left Early Childhood teachers feeling the need to use more teacher-selected activities and whole group instruction, rather than using the practices advised by the NAEYC (Hyun, 2003).

The limitations of this study argue for future research investigating further each of the research questions examined in this study. Additionally, these limitations stress the importance of a continued look at family and student characteristics and how they affect student achievement in kindergarten and beyond.

Practical Implications

Although it was not the purpose of this study to directly address teacher education programs and their practices, there are implications brought forth by the findings. First, the importance of undertaking a variety of different courses, both early education and elementary based, seems to be of importance. While early education courses are shown to be associated with the use of developmentally based practices (Hudson, 2003), elementary based and methods courses may be linked to teacher self-efficacy (Shaw & Dvorak, 2007) and, thus, to student achievement. Teachers who are aiming to teach in kindergarten are likely to benefit from taking a mixture of courses as well as getting certified in both early childhood and elementary education, based on the results of this study. Teacher education programs have a real opportunity to address a possible *overlap gap,* where both early childhood and elementary education practices are needed to teach primary grades, including kindergarten. Future educators can take advantage of both sets of knowledge by carefully selecting which teacher education program to attend, or by taking courses and gaining pre-service experience from both elementary and early childhood programs. Faculty at teacher education programs across the country should open a dialogue amongst and between Early Childhood, Elementary and secondary programs. It is not only important for teachers to understand the children at the age in which they teach them, but where the children came from and where they will go to best influence what the students get out of education.

Second, although findings do not suggest that the use of developmentally based practices is associated with student achievement, it is still important that teacher education programs preparing teachers for work in kindergarten ensure that teachers

leave with domain-specific knowledge as well as the ability to use research-proven practices, such as DAP (Lewis, 2009). This would be a step towards guaranteeing that all children are prepared academically (Ryan & Grieshaber, 2005; Bowman et al, 2001). Specifically, this author supports continuing to treat kindergarten as an early childhood grade level with necessary elementary influences, without going too academic and removing parts of an early childhood curriculum, such as play. Elementary pre-service teachers would benefit immensely from taking some of the child development and early education courses offered at their own universities. The programs should allow this crossover and ensure that it occurs.

Finally, and possibly most crucially, teacher education programs should not overlook the impact that family and child characteristics have on student achievement (Coleman, 1966). Programs should explore ways to ensure that teachers are teaching to individual student strengths and weaknesses, which may be based on family characteristics. Furthermore, teacher education programs should ensure that their teachers are being given a broad variety of research, strategies and field experiences in order to prepare them to teach students from a variety of races and SES backgrounds, including exploration of different family and community cultures that impact a student's experiences. Teacher education programs should be required to offer courses on family characteristics so that future teachers are presented with the most current information about how these characteristics, such as race and SES, will influence the level of achievement their future students can reach. If, as this study and many others have proven, family characteristics are the most critical influence of the achievement scores of

young students, then it is the duty of the university to address this in their teacher education programs.

During the collection of ECLS-K data, the nation was focused on raising standards for university based teacher education programs (Roth & Swail, 2000). However, results from this study have shown that the nation needs to return to these goals and examine what aspects of teacher education programs need to be strengthened and which need to be pruned.

Conclusion

While examining the associations between teacher characteristics and student achievement, this study supported previous research indicating that family and child characteristics are more important in predicting student achievement than any teacher characteristic.

Elementary certification of teachers is negatively correlated with student achievement in math. Additionally, teacher characteristics that have previously been found to be correlated with student achievement (i.e. methods courses and years of experience) were not associated beyond the family and child characteristics. Only instructional time was significant in predicting spring achievement scores.

Taken as a whole, the findings of this study contribute new knowledge concerning the influence of teacher education and teacher characteristics on student achievement in kindergarten. By continuing to expand this study into first grade and beyond, and by studying additional teacher characteristics, the research base can better understand how teachers should be trained to best meet the needs of student across grade levels as well as those standards and mandates set by local, state and federal authorities.

APPENDIX A

Definition of Terms

Teacher self-efficacy – a teacher's perceptions about her own capabilities to foster students' learning and engagement

Developmentally based practices – practices considered appropriate for use in kindergarten

Formal teacher education background – types of coursework and type of certification which teachers undergo to become a teacher

Student achievement – assessment scores attained by students in math and reading

APPENDIX B

Items in Formal teacher Education Background

1) Early Childhood certification
2) Elementary certification
3) Early Childhood courses
4) Child Development courses
5) Math methods courses
6) Reading methods courses

APPENDIX C

Items in Developmentally Based Practices

1) Child selected activities
2) Formative Assessment/evaluation of students based on improvement and growth
3) Developmentally based environment/use of various learning centers in classroom
    a. Reading area
    b. Listening center
    c. Writing center
    d. Science area
    e. Art area
    f. Computer area
    g. Drama area
    h. Math area

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