Principals' Perceptions of Public Schools' Professional Development Changes during NCLB

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Abstract: This study investigated public school principals' reports of professional development implementation at the school level while working in different state- and local-level contexts (state accountability level, geographic locations, socioeconomic status, demographics, and grade levels). I attempted to measure principals' reported changes in levels of teacher involvement and alignment of professional development with standards, student learning outcomes, school goals, resources, and district goals during No Child Left Behind (NCLB). Using two-level, Hierarchical Generalized Linear Proportional Odds modeling (HGLM-PO), and three pooled waves of a national sample from the Schools and Staffing Survey (National Center for Education Statistics, 2000, 2004, 2007), I implemented a quantitative, repeated cross-sectional, self-report, extant secondary survey analysis design. Principals reported a decrease in teachers' planning and presentation of professional development during NCLB implementation across all settings, indicating a potential reduction in teachers' participation in the professional development process. Principals who worked in urban, elementary, low-SES, and high minority school contexts were more likely to report teachers' participation in the planning and presentation of professional development, but were also more likely to report an increase in the direction and alignment of professional development with school and district goals, standards, student achievement outcomes, and resources. There is evidence that a

school community's location, socioeconomic status, and school demographics plays a role in how schools may interpret accountability environments and implement teachers' professional development. In all settings, school leaders need to purposefully focus on and retain collaborative professional development practices with teachers in the context of continued accountability pressures.
Keywords: Accountability; education policy; hierarchical linear modeling; instructional leadership; professional development; NCLB

Las percepciones de los directores de los cambios de desarrollo profesional en escuelas públicas durante NCLB

Resumen: Este estudio investigó los informes de los directores de escuelas públicas sobre la implementación del desarrollo profesional a nivel escolar mientras se trabaja en diferentes contextos a nivel estatal-y local- (nivel de responsabilidad estatal, ubicaciones geográficas, estatus socioeconómico, demografía, y niveles de grado). Intenté medir los cambios reportados por los directores en los niveles de participación de los profesores y alineamiento del desarrollo profesional con los estándares, resultados del aprendizaje de los estudiantes, objetivos escolares, recursos y metas del distrito durante la implementación de la ley No Child Left Behind o NCLB. Usando el modelo de Probabilidades Proporcionales Lineales Generalizadas Jerárquicas de dos niveles (HGLM-PO por sus siglas en inglés), y tres agrupaciones de muestras tomadas a nivel nacional por la Encuesta de Escuelas y Personal (Centro Nacional para las Estadísticas de Educación, 2000, 2004, 2007), utilicé un diseño de análisis de encuesta secundaria existente, cuantitativa, de sección transversal repetida, auto-reportada. Los directores reportaron una disminución en la planificación y presentación de desarrollo profesional por parte de los profesores durante la implementación de la NLCB a lo largo de todos los escenarios, indicando una reducción potencial en la participación de los docentes en el proceso de desarrollo profesional. Los directores que trabajaron en contextos de escuelas primarias, urbanas, de bajo SES, y alta presencia de minorías fueron más propensos a reportar la participación de los profesores en la planificación y presentación del desarrollo profesional, pero también fueron más propensos a reportar un aumento en la dirección y alineamiento del desarrollo profesional con las metas, estándares, resultados de logros estudiantiles, y recursos escolares y del distrito. Existe evidencia de que la ubicación, estatus socioeconómico y demografía escolar juega un papel en cómo las escuelas pueden interpretar los ambientes de responsabilidad y el desarrollo profesional de los profesores. En todos los escenarios, los líderes escolares necesitan retener y enfocarse a propósito en las prácticas de desarrollo profesional colaborativo con los profesores, en el contexto de una presión de responsabilidad continua.
Palabras-clave: Responsabilidad; política educativa; modelo lineal jerárquico; liderazgo de enseñanza; desarrollo profesional; NCLB

Las percepciones de los directores de los cambios de desarrollo profesional en escuelas públicas durante NCLB

Resumo: Este estudo investigou relatórios de diretores de escolas públicas sobre a implementação de desenvolvimento profissional no nível escolar ao se trabalhar em diferentes contextos estaduais e locais (nível de responsabilidade estadual, localizações geográficas, status socioeconômico, demografia e níveis de escolaridade). Tentou-se medir as mudanças relatadas pelos diretores em níveis de envolvimento dos professores e alinhamento do desenvolvimento profissional com padrões, resultados de aprendizado dos estudantes, metas escolares, recursos e metas distritais durante o programa No Child Left Behind - NCLB. Usando o modelo linear hierárquico generalizado de dois níveis de chances proporcionais (HGLM-PO), e três grupos analisados de uma amostragem nacional da Pesquisa de Escolas e Pessoal (Centro Nacional para Estatísticas da

Educação, 2000, 2004, 2007), usou-se um modelo de análise de pesquisa quantitativa, de seção cruzada repetida, relatório pessoal e de pesquisa secundária existente. Os diretores relataram uma diminuição no planejamento e apresentação dos professores quanto ao desenvolvimento profissional durante a implementação do NCLB através de todos os cenários, indicando uma potencial redução na participação dos professores no processo de desenvolvimento profissional. Os diretores que trabalhavam em contextos urbanos, fundamentais, de baixo status socioeconômico e de escolas de altas minorias tinham uma maior probabilidade de relatar a participação dos professores no planejamento e apresentação do desenvolvimento profissional, mas também tinham maior probabilidade de relatar um aumento na direção e alinhamento do desenvolvimento profissional com as metas, padrões, resultados de conquistas dos estudantes e recursos escolares e distritais. Há evidência de que o local, o status socioeconômico e a demografia de uma comunidade escolar influenciam em como as escolas podem interpretar os ambientes de responsabilidade e implementar o desenvolvimento profissional dos professores. Em todos os cenários, os líderes escolares precisam focar propositadamente e manter práticas de desenvolvimento profissional colaborativas com os professores no contexto das pressões de responsabilidade continuadas.

Palavras-chave: Responsabilidade; política educacional; modelo linear hierárquico; liderança instrucional; desenvolvimento profissional; NCLB

Introduction

In educational leadership and policy research, teachers' professional development, particularly teachers' ability to grow as professionals and change instructional practices, has been identified as an important contributing factor of effective policy implementation fidelity, school improvement, and reform (Hochberg & Desimone, 2010; Scribner, 1999; St. John, Manset-Williamson, Chung, & Michael, 2005). This is also evident in policy-driven environments, where locally developed professional development programs are seen as the most accepted and effective approach to spur changes in teachers' and schools' improvement (Torres, Zellner, & Erlandson, 2008).

While clearly separable from the concept of teachers' professional development processes and effectiveness, principals' professional development leadership is a critical part of school improvement processes (Youngs & King, 2002). The principal does have variable and often inconsistent levels of involvement, both formal and informal, in teachers' professional development (Firestone, Mangin, Martinez, & Polovsky, 2005). Principals' professional development leadership is rooted in their instructional leadership actions, and can vary widely from developing and leading formal teacher training workshops to talking with teachers about their instruction in the hallways (Bredeson, 2000). Yet, as the instructional leader of the school, the principal has the most knowledge of and potential influence on teachers' professional growth and willingness to change instructional practices (Bredeson, 2000; Newmann, King, & Youngs, 2000).

There have been shifts in principals' instructional leadership regarding accountability and approaches to school improvement, particularly an increased focus on student learning, students' needs, and improving instruction (Desimone, 2013). As a result, studies of principals' instructional leadership have shown how principals have worked to build connections between teachers' instructional practice, assessments, and student learning, which align with broader national trends and policy expectations (Coldren & Spillane, 2007; Leithwood, Steinbach, & Jantzi, 2002).

Despite research on the importance of teachers' professional development, principals' instructional leadership, and the effects of accountability on schools and school leaders, few studies have investigated the links between these three areas (Berebitsky, Goddard, & Carlisle, 2014; Stillman, 2011; Youngs & King, 2002). Schools' responses to NCLB can potentially affect how

professional development is developed, implemented, and coordinated among teachers and principals at the school-level, thereby affecting students' educational experiences and levels of success. The purpose of this research study was to determine how public school principals in the United States reported perceived changes in the implementation of teachers' professional development in their schools during NCLB. This study was guided by two main research questions:

> 1) Did public school principals report differences in professional development implementation according to their school contexts, particularly the state accountability policy environment, school level, and school demographics?
> 2) Did public school principals report a change in how professional development was implemented in their schools during the NCLB era, from a period just prior to the implementation of NCLB policies (1999), to the full implementation of NCLB (2007)?

Evidence about effective principal leadership practices does place ultimate responsibility for the direction, culture, and improvement of schools in the hands of principals, and teachers' professional development is a crucial part of principals' role (Knapp & Feldman, 2012; Louis, Leithwood, Wahlsrom, & Anderson, 2010; Louis & Robinson, 2012; Youngs & King, 2002). I positioned principals as responsible for being aware of, facilitating, and engaging with teachers' professional development processes and experiences in their schools (Bredeson, 2000). Using that vantage point, the principals' survey responses can provide insights into how they perceived changes to professional development in their schools during NCLB.

Literature Review

The literature review is organized into three sections that each contributes to the selection of variable constructs and the study analysis. The three sections are: effective principals' professional development leadership, principals' instructional leadership, and the study's conceptual framework, *leadership for learning* (Hallinger & Heck, 2010; Robinson, Lloyd & Rowe, 2008), situated in the context of the standards and accountability era (Hamilton, Stecher, & Yuan, 2008).

The literature review structures principals' professional development leadership separable from, yet clearly related to and embedded within broader instructional leadership practices. I used the framework to analyze principals' reported changes to professional development processes in their schools associated with contextual influences during NCLB.

Principals' Roles in Professional Development Leadership

The research on principals' professional development leadership is embedded within the research on models of instructional leadership (Bredeson, 2000). Here I discuss several characteristics of effective principals' professional development leadership and selected studies that highlight specific actions and structures that have shown to facilitate teachers' growth. Two of the factors that are most relevant to this investigation are professional development program coherence and collaboration with and between teachers.

Characteristics of effective professional development leadership. Scribner (1999) identified key elements for schools to design and implement effective professional development, such as building connections to learning standards, curriculum, assessment, and maintaining a healthy professional community that is focused on student outcomes. A conceptual review of effective teacher professional development by Firestone et al. (2005), asserted that professional development should have a continuous, coherent, and systematic focus on developing teachers'

content knowledge, instructional methods, and ability to reflect and act to develop their professional learning as individuals and growth as a community. In these two models, clear purposes for professional development that are linked to the main elements of instruction are crucial. The responsibility for professional development is a community responsibility, shared by teachers and administrators alike.

In one of the most comprehensive reviews of principals' professional development leadership, Bredeson (2000) identified multiple domains of effective professional development leadership: (1) the principal as an instructional leader and learner; (2) the creation of a learning environment; (3) direct involvement in the design, delivery, and content of professional development; and (4) the assessment of professional development outcomes (p. 398). Among other characteristics within these four main areas, Bredeson discussed particular principal management behaviors that influence teachers' professional learning experiences and opportunities: coordinating professional development activities, making decisions for on resources and school priorities, aligning professional development with school goals and teacher needs, empowering teachers as decision makers, and keeping the focus on student learning. Principals are challenged to design an effective structure and culture around instructional improvement and teacher learning. To effectively coordinate all of these elements, the concept of program coherence is essential for principals' success.

Program coherence. An additional requirement of strong professional development leadership is program coherence. Program coherence is "the extent to which the school's programs for student and staff learning are coordinated, focused on clear learning goals, and sustained over a period of time" (Newmann et al., 2001, p. 263). Madda, Halverson, and Gomez (2007) identified key features of a coherent instructional program, including: a common instructional framework to guide curriculum, teaching, assessment, and learning climate. They also stressed the important role principals' play to select and manage resources to support new professional development programs that align with school improvement programs. If there is a lack of coherence, there could be a negative impact on professional development effectiveness and student learning (Madda et al., 2007; Newmann et al., 2001).

Newmann et al. (2001) studied nine urban elementary schools to determine how leaders developed school capacity, or potential to implement instructional improvement. They found that across the nine schools, principals who exerted greater emphasis and direction over professional development had higher levels of school-wide implementation of and individual teachers' use of professional development. In addition, principals' leadership also impacted the school's ability to either build, or reduce the school's capacity for professional development and student learning. While principals' influence over professional development does have positive impacts on professional development program fidelity, principals also need to be aware of how to collaborate effectively with teachers.

Collaborative professional development leadership. When teachers are involved in the development of professional development they are more likely to participate, and participation decreases when leaders fail to provide adequate support (Johnson, 2006) or exert more authority over programming (Desimone, Smith, & Phillips, 2007). Generally, principals have more success if they work with teachers in the professional development process and are not autocratic in their approach to staff improvement (Adamson & Yin, 2008; Blase & Blase, 2000; Kelehear, 2005). The most effective professional growth activities are teacher-directed, where teachers lead the process to create, present, and collaborate in professional development activities to improve learning outcomes (Akiba & Liang, 2016; Stillman, 2011; Wilson & Berne, 1999).

Models of professional development that are content focused and involve a *critical mass* of teachers in the building were more successful in changing culture, practices, and lead to deeper conversations and reflections on their own as well as their colleagues' teaching (Dutro, Fisk, Koch, Roop, & Wixson, 2002; Gallucci, 2003). In a study of 25 public, private, and religiously affiliated school principals on the U.S. east coast, Drago-Severson (2007) found that principals who demonstrated exemplary behaviors to encourage teacher growth were highly collaborative, and shared authority over professional development with their teachers. Akiba and Liang (2016) conducted a state-wide analysis of three years' of student achievement data and surveys of middle school math teachers' professional development activities in Missouri. They found an increase in student achievement scores associated with teachers who collaborate and communicate regularly regarding professional development activities.

While leading instructional and assessment changes, the principal should be mindful of shared practices in order to effectively influence or improve teachers' instruction and professional practices (Marks & Nance, 2007; Marks & Printy, 2003; Printy, 2008). When principals share leadership and employ a collaborative approach to teachers' professional development, they foster a more supportive climate in which teachers are more likely to engage in instructional and professional change (Sebastian & Allensworth, 2012; Youngs & King, 2002).

Principals' Instructional Leadership

Coldren and Spillane (2007) defined the concept of instructional leadership as "the practice of making and sustaining connections to the instructional unit (i.e., the interaction of teacher, students, and material) that enable instructional improvement" (p. 371). Complementary to principals' professional development leadership are instructional leadership behaviors that connect to and support professional development and instructional improvement. The daily work of principals across the school and in teachers' classrooms directly informs their professional development leadership.

Aligning instructional programs with school goals. Having clear goals at the school level is especially important during times of curricular, programmatic, instructional, or assessment change (Bauer & Bogotch, 2006; Crum & Sherman, 2008). When a lack of clear vision or mission exists, or is not communicated to the staff, professional disillusion and discontent may result in decreased support among teachers (Margolis & Nagel, 2006; Ng, 2009). Principals who frequently reference the mission of the school and the established school goals while managing policy, instructional, or assessment changes are viewed as more effective instructional leaders (Knapp & Feldman, 2012). Principals exercise significant influence over instructional change, but they should include teachers and stakeholders in the process (Marks & Nance, 2007).

Aligning instructional programs with district goals. District leaders provide broad direction for school improvement and are ultimately responsible for holding principals and teachers accountable (Burch & Spillane, 2005; Floden et al., 1988). The district's goals help the principal and staff set short-term and long-term goals, allocate resources, and create measurements to determine when goals have been met (Krug, 1992). District instructional goals provide a connection between school-, district-, and state-level school improvement and policy goals to improve teaching and student learning (Huffman, Pankake, & Munoz, 2006). Ideally, district-level improvement structures and goals should drive school improvement, professional development, and teacher change in a sustained and coherent way (Firestone et al., 2005).

Aligning instructional programs with state and national standards. Instructional leaders should communicate how local instructional program goals are connected to national

standards and curriculum (Penuel, Fishman, Yamaguchi, & Gallagher, 2007). When standards are consistent and clearly articulated and aligned at the state-, district-, and building-levels, teachers are more willing and able to implement changes into their practice (Dutro et al., 2002). Principals should be aware of and guide teachers how to use standards to set classroom instructional goals, determine scope and sequence, and instructional pacing (Boardman & Woodruff, 2004; Ogawa, Sandholtz, Martinez-Flores, & Scribner, 2003).

Focusing on student learning and evaluating programs for improved student outcomes. Effective instructional leaders create structures that connect assessment of student learning and instruction in observable and measurable ways at the local level (Coldren & Spillane, 2007; Ingram, Louis, & Schroeder, 2004; Young, 2006). These structures help leaders track student learning progress over time and observe trends in specific areas to inform school-level instructional decision making (Spillane, Parise, & Sherer, 2011). Principals should use information from assessment measures in productive and supportive ways to foster locally effective professional development (Fishman, Marx, Best, & Tal, 2003; Knapp & Feldman, 2010; Torres et al., 2008).

Aligning instructional programs with resource support. Instructional leaders should have a competent knowledge of the curriculum, related assessments, and communicate the importance of matching resources to support teaching to learning standards (Johnson, 2006). School leaders who know the curriculum and provide the resources and support for teachers to lead goal-focused instruction are the most effective (Krug, 1992). Leaders should formally observe and evaluate teaching performance, school structures, and efficiency to ensure resources are being used effectively to improve learning (Newmann et al., 2001).

Contextual influences on principals' instructional leadership. There is more recent attention on the effects of contexts on instructional leadership with increasing evidence that contexts can influence principals' practices (Goldring, Huff, May, & Camburn, 2008; Hallinger, 2011a; Louis, Leithwood, et al., 2010; Louis & Robinson, 2012). The school community is a complex environment, and many contextual factors at the state and local levels shape principals' perceptions and actions as leaders. I briefly discuss three contexts that are relevant to this study: policy contexts, school-level, and school demographics.

Policy contexts. Research has shown how accountability measures and the role of external performance expectations have encouraged schools and leaders to better align instruction, assessment, content, standards, and professional development (Marks & Nance, 2007; Ogawa & Scribner, 2002; Roach, Smith, & Boutin, 2011; Spillane et al., 2011). Accountability mandates have been associated with higher-levels of reform implementation and oversight of resources, instruction, and decision-making at the building and classroom levels (de Lima, 2007; Fusarelli, 2002; Louis, Thomas, & Anderson, 2010; Moos, Krejsler, & Kofod, 2008; Prestine, 2005). However, some evidence shows how schools retain control of local instructional improvement practices. Using a national sample, Marks & Nance (2007) measured the perceived effect of accountability on principals' instructional leadership on evaluation, instruction, curriculum, and assessment in low-, moderate-, and high-level accountability states. Their findings indicated low- to moderate- variation between principals' responses between states, and higher levels of local influence on principals' practices in schools.

School-level. While not extensively studied, there is some evidence that school principals have different levels of instructional engagement with teachers depending school level (Volante, Cherubini, & Drake, 2008). In a large-scale study of principals' instructional leadership that included 127 total schools, including elementary-, middle-, and high-schools, Louis, Leithwood et al. (2010), found that middle and secondary school principals were rated in the lowest 20% for supporting

teachers' instructional practices. They also found a similar rating for middle and high schools in the area of professional community. While the particular reasons for the differences were unclear, the authors described how teachers valued principals' levels of intentional communication and support for instruction versus more informal and general levels of leadership visibility in the school.

   School demographics. Accountability measures and the emphasis on test scores have resulted in principals' increased focus on test preparation and low-level skill development which occurs more in low-SES and urban settings (Gardiner, Canfield-Davis, & Anderson, 2009; Hallinger & Murphy, 1986; Ladd & Zelli, 2002; Newton, Tunison, & Viczko, 2010; Volante et al., 2008). Goldring et al. (2008) studied how principals in schools with varying levels of student composition used their time towards instructional leadership. They found a distinct difference between schools with higher levels of minority students and lower-SES than schools with more affluent and higher levels of White students. Principals that worked in the more disadvantaged schools spent more time focusing on instructional leadership and student affairs. Principals in more affluent schools distributed their leadership in different ways and focused less on instructional support and students' needs.

   School location. School principals encounter different sets of challenges depending on their location (Giles, Johnson, Brooks, & Jacobson, 2005; Harmon, Gordanier, Henry, & George, 2007; Knapp & Feldman, 2012). In their study of rural school's implementation of math and science standards, Harmon et al. (2007) found that the school had a lack of resources to fund high quality professional development, and lacked capacity to build sustained and collaborative change. Giles et al. (2005) studied an urban elementary principal who was tasked to improve school performance at a persistently failing site. They found that the principal had to confront not only fiscal and organizational challenges, but community poverty, violence, and professional apathy. Principals' attention on different school and community factors can affect the amount of time they actually focus on instructional leadership (Goldring et al., 2008).

Theoretical Framework

   Derived from the literature review and discussion of the conceptual framework, I selected three main characteristics to frame and analyze principals' perceived changes to schools' professional development leadership: (1) potential contextual influences of leadership (policy environment, school-level, student demographics, school location); (2) professional development and instructional leadership actions to align professional development with school and district goals, standards, student learning outcomes, and resource support in a coherent way; and (3) principals' collaboration and shared leadership with teachers regarding professional development. A conceptual framework of leadership that integrates these selected characteristics of instructional leadership with principals' professional development leadership is *leadership for learning*.

   Leadership for learning. Leadership for learning includes the potential influence of school level context, climate, and other factors on principals' instructional leadership (Glickman, 2002; Hallinger, 2003/2011b; Louis, Leithwood et al., 2010; Male & Palaiologou, 2012; Murphy, Elliot, Goldring, & Porter, 2007). This model focuses on instructional leaders' role to influence or improve instruction while considering the importance of collaborative leadership practices (Macbeath, Frost, & Swaffield, 2008; Reardon, 2011; Waters, Marzano, & McNulty, 2003). Leadership for learning models have not been studied extensively as separate models of instructional leadership (Leithwood & Sun, 2012) and are largely based on the integration of more current reviews of research and meta-analysis of the broader literature (Hallinger, 2003; Leithwood & Sun, 2012; Murphy et al., 2007; Robinson et al., 2008). The framework has multiple interpretations and domain-specific variations that are present in the literature.

Hallinger (2011b) organized his leadership for learning model into four domains of integrated leadership behaviors: values leadership, leadership focus, contexts for leadership, and sources of leadership. Murphy et al. (2007) developed an eight-domain leadership for learning model with multiple, overlapping sub-units or tasks: vision for learning, instructional program, curricular program, assessment program, communities of learning, resource acquisition and use, organizational culture, and social advocacy. Of the few empirical studies to test leadership for learning as an integrated model of instructional leadership, Marks and Printy's (2003) results indicated how instructional leadership should not be top-down, and should be an integrative leadership approach drawing on elements of transformational leadership to improve outcomes. Their model contains several domains of effective integrated instructional leadership: intellectual leadership, supportive and encouraging leadership, innovation and idea generation, influence on restructuring, and sharing of power.

Hallinger and Heck (2010) conducted a large-sample, longitudinal, panel study testing the leadership for learning domains of collaborative leadership and school academic capacity, defined as: standards emphasis and implementation, focused and sustained improvement, student support, professional capacity; and each of the constructs' effects on students' reading achievement outcomes. The study found collaborative instructional leadership had positive impacts on school capacity, and in turn, resulted in students' reading achievement gains.

These integrated models have also been under analytic scrutiny. For example, Robinson et al. (2008) published a meta-analysis of transformational, instructional, and integrated leadership models. They identified five key dimensions of integrated leadership for learning: establishing goals and expectations, resourcing strategically, evaluating and coordinating teaching and curriculum, promoting and participating in teacher learning and development, and ensuring an orderly and supportive environment. In their analysis, core instructional leadership behaviors remain the most effective means to improve instruction and student learning. Specifically, they cited collaborative goal setting and teachers' professional learning alongside principals as each having the greatest positive effects on instructional change and student learning. They argued how collaborative skills are important to principals' work, but concluded that principals must provide direction and impart instructional leadership influence to be truly effective. Aligning with the conceptual framework, I used an antecedent direct-effects model to measure relationships between selected contextual variables and principals' perceptions of professional development at the local level.

Antecedent direct-effects model. This study employed a hierarchical, antecedent direct-effects theoretical model to analyze principals' perceived changes in professional development processes in their schools (Bossert, Dwyer, Rowan, & Lee, 1982; Knoeppel & Rinehart, 2008). This model structured potential external or environmental influences on professional development implementation at the school level, such as state-, district-, or federal-policy context, school context, and school characteristics. In this study I modeled principals' responses to the survey questions regarding professional development processes in their schools as part of their integrated role as professional development leaders and instructional leaders. Principals' survey responses were collected in a multi-level, nested structure at the school- and state-levels, therefore I used a hierarchical antecedent direct-effects model in this study.

Methods

Drawing on previous research on principals' instructional leadership and professional development leadership behaviors this study utilized and is reported following Hierarchical Generalized Linear Proportional Odds Modeling, or HGLM-PO (Hox, 2010; O'Connell, Goldstein,

Rogers, & Peng, 2008; Raudenbush & Bryk, 2002; Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2011) to measure principals' reported differences in professional development implementation in their schools. Using a HGLM-PO analysis of ordinal response variables allows a linear analysis of outcome variables that are not continuous, and are constrained response category variables with non-normal distributions (Hox, 2010; O'Connell et al., 2008). The assumptions of normality are violated in the measurement of ordinal outcome variables, and measurements of skewness and kurtosis do not apply.

In this study, each of the outcome variables was measured on a five point Likert scale: 1- *never*, 2- *rarely*, 3- *sometimes*, 4- *frequently*, and 5- *always*. For any ordinal survey question there are an infinite number of possible responses and influences underlying a respondent's choice. These are considered latent variables of interest in the analysis. But, an ordinal category variable restricts a participant response to one of several categories, subject to interpretation. How individual principals interpret and respond to a "never" versus a "rarely", or a "rarely" versus a "sometimes", and so on, is difficult to measure and can bias the model estimates and interpretation of results. The use of HGLM-PO properly estimates variance and error components, and proper specification of model effects. It provides a more accurate and rigorous estimate of principal responses, measuring the overall likelihood ratio or probability range of principals' responses to each category and across categories presented in a survey question depending on their group identification, contextual influences, and the latent variables predicted in the analysis (O'Connell et al., 2008; Raudenbush & Bryk, 2002). This is different from other analysis methods that measure survey responses by comparing mean-level responses alone. The calculated regression probability models document an empirical response pattern for principals working in different contexts by accounting for an underlying latent variable influencing principals' choices over time (Hox, 2010; O'Connell et al., 2008). The literature does have conflicting views about which analysis method is preferred (Norman, 2010), but leaders in the field of multi-level modeling of ordinal response variables recommend HGLM-PO (O'Connell et al., 2008; Raudenbush & Bryk, 2002), which has been used in published educational policy literature (Becker, 2006).

Outcomes were measured and compared across the three independent waves using a pooled cross-sectional design (Firebaugh, 1997) to measure principals' perceptions regarding how schools implemented professional development activities at the local level. The dependent variable measures explain principals' reports about professional development processes in their schools within differing state levels of accountability (Marks & Nance, 2007) in a variety of school-level contexts (Pitner, 1988). The study utilized two levels of statistical contextual controls for initial, pre-NCLB state-level accountability levels (Marks & Nance, 2007), comparing these trends within each of the waves in different school-level contexts over an eight year span of NCLB implementation from 1999-2000 to 2007-2008.

Sample and Instrumentation

This study used three waves from two linked, national, extant data sets collected through the National Center for Education Statistics (NCES); the Public-School Principal Questionnaire contained in the Schools and Staffing Survey, or (SASS) (NCES, 2000, 2004, 2007), and the Common Core of Data or (CCD) (NCES, 1998, 2002, 2006) Public School Universe Survey and State Aggregate Fiscal Data Survey. The SASS survey waves are administered at intervals of every four years, and the coded, linked data sets use common NCES district- and school-level code number identifiers for the selected waves of 1999-2000, 2003-2004, and 2007-2008. The SASS has been used in previous research on instructional leadership (see Boyce & Bowers, 2013, for an exhaustive review). The SASS survey is limited in some ways. The survey is not connected to student achievement data or specific measures of policy pressure or context. The survey is cross-sectional

and administered every four years, therefore it is possible respondent schools are repeated across these three waves of data. Across all three waves, the surveys contain approximately 21,000 principal responses. In the model analysis, the weighted, pooled sample at level-1 across all three waves was approximately 250,000 principals. The case weights are calculated by the inverse proportion to the probability of selection of principals in the population (Raudenbush et al., 2011). The HLM software adjusted the weighted sample by dividing each sample weight by the mean of all the weights (Raudenbush & Bryk, 2002; Stapleton & Thomas, 2008) resulting in a more accurate estimate of the grand population analysis. The actual sample (*n*) and the weighted sample (Weighted *n*) are included in the descriptive tables for each wave. The sample sizes were rounded to the nearest ten as per IES guidelines. Descriptive statistics for the samples and all variables are included in Tables A1-A3 in the Appendix.

Variables and Model Analysis

Using the antecedent effects model, and HGLM-PO analysis, I operationalized nested, contextual independent variables to measure principals' reported changes in schools' professional development practices within three national surveys administered during NCLB. This assignment process was based on the research questions, underlying theory, supporting empirical research, nature of the sampled population at each level, and model review prior to completing the statistical analysis (O'Connell et al., 2008). This study compared differences between principals working in schools with pre-determined characteristics or group assignments. The independent variables are hierarchical, antecedent controls selected from the literature which require more investigation and have been found to potentially influence principals' practices, namely state accountability policy conditions (LOW, MODERATE, HIGH), demographics of the school district (RURAL, SUBURBAN, URBAN), school level (ELEMENTARY, MIDDLE, HIGH), demographics (LOW/HIGH MINORITY and LOW/HIGH SES), and year as a time function to measure professional development processes reported by principals across the country at three separate time periods (1999, 2003, 2007).

Identifier variables. The SASS non-public, restricted access survey gathered linked data from the CCD, especially for variables concerning census, racial, and socioeconomic variables from state- and district- data. Therefore, for each survey instrument, there are unique identifiers that will trace a school-level respondent (principal), to school-level data and responses, to district-level identifiers and variables, to state-level identifiers and variables, back to census data, to ensure a hierarchical path linking variables to each nested level. Identifier variables were utilized in this study at each level: state identification (state ID code); district (district control number, CCD identification code, state ID code); school (school control number, district control number, and school sector); and principal respondent (principal control number, school control number). These identifiers linked an item response to a public school principal respondent, principal respondent to a school, the school to a district, and the district to a state, aligning with the proposed hierarchical model analysis. The level-2 units were grouped according to state identification code (STATE ID) in the model and entered as the key identification variable in HLM 7. There are a total of 51 level-2 units, including the District of Columbia as a state-level unit.

State accountability independent variables (antecedent). State-level accountability policies potentially affect district-level and school-level administrators' instructional leadership behaviors, and levels of accountability vary across states- particularly prior to and at the outset of the implementation of NCLB (Marks & Nance, 2007).

In response to the hierarchical structure of the educational system, and the development of accountability systems across states over time, this study builds upon the work of Marks and Nance

(2007), whose study used 1999 SASS responses to divide states into three separate groups based on their respective, initial accountability levels and policy settings: low accountability influence, moderate accountability influence, and high accountability influence. In their study Marks and Nance (2007) established the three different category groups by measuring principals' responses to questions on the 1999 survey regarding principals' perceptions of state influence on various aspects of instructional policy (establishing curriculum, determining the content of professional development, setting performance standards for students). They measured principals' responses at the state and school-levels, and designated responses that were more than one standard deviation below the mean as "low," responses that were between one deviation below to up to one deviation above the mean as "medium," and responses that were more than one standard deviation above the mean as "high". Their method reflects and is aligned with data from related research literature that identifies curriculum, instruction, professional development, and assessment mechanisms as primary concerns among teachers and principals.

In their study, the states were divided into the following categories, and were used as a metric in this study as low-, moderate-, and high-accountability groups. The state control groupings are listed in Table E-1 in the Appendix. This results in 51 total level-2 state groups. At the aggregate level, and for control purposes, these are adequate level-2 units for multi-level modeling.

These three state-level groups established a baseline control-level of accountability, taking into account the experiences of principals in 1999 pre-NCLB that may have experienced sudden policy and programmatic changes in states that had little previous state oversight, compared to principals that worked within states with established oversight and stronger policy conditions. This grouping strategy builds on previous empirical literature, and also utilized a measure originating in the survey instrument with the population under investigation. This study extends previous work by determining the effects of state- and federal-level accountability on professional development practices over time, controlling for NCLB implementation and existing state-level conditions. These groups were carried forward through each of the three waves of data analysis, and were coded and clustered together as three separate control group samples of principals within each of the state-level groupings. In the model analysis, the variable is labeled "ACCT," where a three level dummy variable was created in SPSS with the reference group variable name heading as MODERATE= 0, and comparative groups were entered into the model as LOW= 1, and HIGH= 1.

School-level independent variables (antecedent). School and district level antecedents are derived from the literature review that identified the potential effects of context on principals' leadership, particularly policy, demographics and school location. Using a pooled-cross sectional design, this study measured principals' national-level responses at three points in time during NCLB. The three survey waves, 1999-2000, 2003-2004, and 2007-2008, are represented by the variable term at level-1, YEAR, in the model analysis. These variables represent 1999-2000 as a policy environment prior-to NCLB, 2003-2004 as a policy environment just after NCLB implementation, and 2007-2008 as a policy environment during full NCLB implementation. Reference and comparative group years were into the model with dummy coding labeled in SPSS as variable headings, reference year 1999 as YEAR 1 = 0, and 2003 as Year 2= 1, and 2007 as Year 3 = 1.

School and district location, or the variable labeled by NCES as "urbanicity," is a categorical variable described by NCES as: large or mid-sized city; urban fringe of large or mid-sized city; small town/rural. These variables analyzed responses from three different groups of principals, who are from urban, suburban, and rural area schools. In the model analysis, the variable is labeled "GEO," where a multilevel dummy variable was created in SPSS and labeled with the reference group as SUBURBAN=0, and each comparative group entered into the model as URBAN=1, and RURAL= 1.

School level emerged from the literature review as a context of influence with the need for additional study of secondary settings and comparisons between levels. The variable school level is provided with three possible choices: elementary (K-6 only), secondary (7-12 only), and combined (all other variations of a K-12 setting). SASS sampling did not permit a separate analysis of middle school grades without grade level overlap and is a noted limitation of the study. This variable remained categorical variable in the model, which structured a comparative analysis of principals who work in elementary, secondary, or combined variations of K-12 grade settings, with the primary comparison of interest to be elementary versus secondary settings. In the model analysis this variable is labeled "LVL," where a multilevel dummy variable was created in SPSS labeled with the reference group as COMBINED=0, and each comparative group entered into the model as SECONDARY=1, ELEMENTARY=1.

The next two variables operationalized the influence of student demographics on principals' leadership practices, specifically students' racial composition and socioeconomic measures. Students' racial composition at the school level is measured by one continuous variable which asked respondents to provide the number of minority students enrolled in the school. In the model analysis this variable is labeled "MINOR," where this variable was collapsed into a dichotomous dummy variable using a median split (Pallant, 2010) across the three waves of the population. The median number of minority students per school across the three waves of data is approximately 20 students per school (rounded as per IES guidelines). The use of a comparative median split analyzed school settings with respect to the number of minority students that attend the school to measure if there is a difference among schools, not to measure the effect size of race. A dichotomous dummy variable was created in SPSS with variable label headings for the reference group as less than or equal to 22 = 0, ($\leq$ 22=0), and greater than or equal to 23= 1, ($\geq$ 23=1).

Students' socioeconomic status (SES) was measured by one variable, measuring the number of students in the school that were approved for free and reduced lunch (FRL). The FRL variable is a continuous variable that measured how many students were approved for FRL per school. In the analysis this variable is labeled "POVERTY," where this variable was used as a proxy measure of student and school-level socioeconomic status as defined by federal guidelines. This continuous variable was collapsed into a dichotomous dummy variable using a median split across all three waves of the sample population. The median number of students approved for FRL across the three waves of data is 160 students per school. The dichotomous dummy variable was created in SPSS with labels for the reference group as less than or equal to 160 = 0 ($\leq$ 160=0), and greater than or equal to 161= 1 ($\geq$161=1).

The outcome dependent variables listed in Table D-1 in the Appendix were analyzed as seven independent ordinal response variables, with 5-point Likert scales ranging from 1- *never* to 5- *always*, regarding how professional development supports: school-goal setting (PD_SSG), district goal-setting (PD_SDG), standards implementation (PD_SS), evaluation of student achievement (PD_ESA), resources support and allocation (PD_SWR), collaborative professional development planned by teachers (PD_PLT), and collaborative professional development presented by teachers (PD_PRT). The final two-level HGLM-PO model was employed as shown in Equation 1.

In the model shown in equation 1, the reference intercept or control group for the analysis (β_{0j}) also generated the first threshold level (δ_1) for category response 1 in the model, for the principal group with the following attributes: responses from 1999 (just before NCLB); working in suburban schools, in combined grade level schools, with a student body containing less than 160 students approved for free and reduced lunch, with less than 22 minority students in the student population, working in states with a moderate level of perceived accountability. By adding the slope effects of the comparison groups, β_{ij}, (year, level, SES, geography, demographics) and the level-2

changes to the common intercepts for each organizational level predictor at level-2, γ_j, (state accountability level), separate probability ratios are calculated and compared to measure the effects of group assignment and the effects of time on principals' responses, for each of the response categories δ_{c-2}. These δ_{c-2} threshold coefficients can be used to generate a proportional representation of the number of participants that responded in each of the survey's Likert response categories 1-5 depending on their group identification. Initial data cleaning was completed in SPSS 21 and the final analysis was completed using HLM 7.

LEVEL (1)

$$n_{1ij=} \beta_{0j} + \beta_{1j}(2003_{ij}) + \beta_{2j}(2007_{ij}) + \beta_{3j}(Urban_{ij}) + \beta_{4j}(Rural_{ij}) +$$
$$\beta_{5j}(Elementary_{ij}) + \beta_{6j}(Secondary_{ij}) + \beta_{7j}(POVERTY_{ij})$$
$$+\beta_{8j}(MINOR_{ij}) + \delta_{2j} + \delta_{3j} + \delta_{4j}$$

LEVEL (2)

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(LOW_j) + \gamma_{02}(HIGH_j) + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$
$$\beta_{2j} = \gamma_{20}$$
$$\beta_{3j} = \gamma_{30}$$
$$\beta_{4j} = \gamma_{40}$$
$$\beta_{5j} = \gamma_{50}$$
$$u_{0j} \sim N(0, \tau_{00}) \tag{1}$$

Probability odds ratios (OR) were calculated using the reference groups in each modeled equation (total odds for the reference group coded as = 0) against the groups that are entered into the model (total odds for the predictor group coded as= 1) at each level of the equation. This equation can be used to produce an OR which can be interpreted as, compared to the reference group, this group (β_{ij}) has a higher/lower likelihood to respond at or below a given category level (O'Connell et al., 2008). Meaning, a logit coefficient expressed as a negative (-) describes a decreased odds that the principal group will respond at lower levels of the outcome variable categories, and an increased likelihood they will respond at higher levels of the outcome variable categories. A logit coefficient expressed as a positive (+) describes increased odds that the principal group will respond at lower levels of the outcome variable categories, and a decreased likelihood they will respond at higher levels of the outcome variable categories. The resultant OR were calculated and expressed as a percentage deviation from 1.00, where 1.00 indicated no difference in odds between groups. An odds ratio at >1.00 indicated a net percentage increase in odds the predictor group will respond at lower category response levels compared to the reference group. An odds ratio of <1.00 indicates a net percentage decrease in odds the predictor group will respond at lower category levels compared to the reference group.

In total, the complete analysis comprises three multilevel regression models for each of the seven outcome variables (null, level-1 only, and full model with level-1 and level-2 predictors), for a total of 21 models. The reporting of HGLM-PO findings follows the protocols and examples described by (O'Connell et al., 2008) and will report the following for each model: measurement of each null model, the coefficient (logit) for each variable at level-1 and level-2, the threshold

coefficient for each category response outcome, the OR for each predictor in the full model, and the variance and intra-class coefficients (ICC) for each of the models (including chi-square and *t*-test statistics as per normal regression analysis), and a calculated model change variance analysis. HLM 7 uses full penalized quasi-likelihood estimation strategies (PQL) with robust standard errors estimates to generate variance estimates for HGLM ordinal outcome models (Raudenbush et al., 2011). The HLM 7 software uses PQL estimates to measure both fixed and random parts of the model and does not generate a deviance statistic (Raudenbush et al., 2011). In this study, each of the final models reached calculated convergence in HLM 7 between 8-11 iterations, suggesting good model fit.

Data were prepared and weighted according to NCES sampling guidelines. The NCES data sets provided a final principal-level sampling weight for each survey wave, a variable labeled as "AFNLWGHT" in each of the data sets. This weight was applied to the level-1 principal sample only and not to the level-2 units. The level of interest is principal responses at level-1, and the level-2 units (states) were grouped according to research and by individuals' survey measures by proxy in this study and therefore, there is no applicable weight to apply at level-2 in this study. In HLM, the software adjusted the sampling weights and rescaled the respondents to appropriate relative levels in the population. The case weights were calculated by the inverse proportion to the probability of selection of principals in the population (Raudenbush et al., 2011). The software adjusted the weighted sample by dividing each sample weight by the mean of all the weights (Raudenbush & Bryk, 2002; Stapleton & Thomas, 2008) resulting in a more accurate estimate of the grand population analysis. Each final sampling weight descriptive analysis (Weighted *n*) is included in the descriptive tables for each year. Final sample sizes were rounded to the nearest ten for each variable category and the final sample size is therefore estimated according to IES publication clearance protocols.

The HGLM-PO data analysis in HLM 7 produced a variable reliability estimate for each ordinal outcome variable. The HLM 7 reliability estimates for each variable are as follows: professional development supports school goals (PD_SSG) = .94; professional development supports district goals (PD_SDG) = .89; professional development supports standards (PD_SS) = .92; professional development evaluated for student achievement effects (PD_ESA) = .95; professional development planned by teachers (PD_PLT) = .88; professional development presented by teachers (PD_PRT) = .89; and professional development supported with resources (PD_SWR) = .88. These results indicated a high degree of reliability in each of the variables' measures. Bivariate correlation analysis was completed and included in Tables B6-B8 in the Appendix. The 21 total model output tables, three models for each of the seven outcome variables, are included and labeled in Tables C1-C7 in the Appendix. Model one is an unconditional model, model two includes level-1 variable in the model, and model three is a full model with level-2 variables included in the model. A summary table of all final model probability odds ratio changes for each outcome variable, cross-listed for each predictor group at level-1 and level-2, is displayed in Table 1 in the findings section.

Findings

This study sought to measure if principals reported changes to school-level professional development practices during NCLB implementation. This study found principals reported increased levels of alignment between teaching, curriculum, assessment, standards, evaluation, resources, and related professional development activities during the period of 1999-2000 to 2007-2008. The study also found there are measurable differences in principals' responses according to their school's demographic and geographic contexts. It is important to note that across all of the

outcome variables the ICC values were negligible across the level-2 units (1.5% to 3.6%). Even though the level-2 ICC values were extremely small, I completed HGLM analysis because the data is nested within states and I established theoretical reasons to do so. The majority of the variation in the models is at level-1.

Correlation Analysis

Referencing the tables in Appendix B, there are come correlated variables to note in the analysis within the three waves. There is moderate to high correlation between low, moderate, and high accountability states. In the analysis, there is little indication there are significant differences among state policy contexts. There is moderate correlation between rural, suburban, and urban school settings, which indicates there may be limited differences among principals reporting from different school levels. There are moderate correlations between minority and poverty levels, indicating similar association between these variables. Among the dependent variables, there is moderate correlation between school and district goals, indicating similarity in principals' responses to these two variables. There is also moderate correlation between how professional development was aligned with standards, and district and school goals. Teachers' participation in the planning and presentation of professional development are also moderately correlated, indicating that these activities may occur in conjunction with one another. These correlated variables should be taken into consideration when interpreting the results of this analysis.

HGLM-PO Analysis

I included data summaries in Table 1 that displays the final calculated OR for each dependent variable in the study that is also cross-referenced for each independent variable in the model. The summary table displays the final analysis results for each variable in the model to provide a synthesized visual summary, to compare trends across the study data, and discuss the results for all dependent variables.

Table 1
Net Probability Odds Ratio Percentage Differences- Principals' Reports of Professional Development Processes in their Schools

Variable	PD_SSG	PD_SDG	PD_SS	PD_ESA	PD_PLT	PD_PRT	PD_SWR
2003	-.07	.07	.03	-.04	**.38*****	**.28*****	-.03
2007	**-.12***	**.10***	**.17***	**-.22*****	**.69*****	**.31****	**-.20*****
URBAN	**-.18*****	**-.11***	-.07	**-.22*****	-.10	**-.16***	-.09
RURAL	**.40*****	**.14***	-.02	**.20*****	**.29*****	**.95*****	**.20*****
SEC.	-.09	-.07	-.01	.02	-.06	**-.13***	**.17***
ELEM.	**-.39*****	**-.38*****	**-.31*****	**-.27*****	**-.19****	**-.26*****	-.03
POVERTY	**-.24*****	**-.22*****	**-.29*****	**-.15*****	-.08	**-.19*****	**-.11***
MINOR.	**-.15****	**-.13***	**-.18****	**-.26*****	-.01	**-.13****	**-.17***
HIGH	.03	**-.07***	**-.21****	-.17	.09	-.03	-.10
LOW	-.03	-.05	**.26***	.15	-.03	.05	.14

Note a. ***p<.05; **p< .01; *** p<.001**.
Note b. **PD_SSG**= professional development supports school goals; **PD_SDG**= professional development supports district goals; **PD_SS**= professional development supports standards; **PD_ESA=** professional development evaluated for effects on student achievement; **PD_PLT=** professional development planned by teachers; **PD_PRT=** professional development presented by teachers; **PD_SWR=** professional development supported with resources.

The six major findings of the study are interpreted and summarized below by corresponding research question. The findings are also displayed in Table 2 (addresses research question one), and Table 3 (addresses research question two).

Table 2

Contextual Effects Summary of Principals' Reports of Professional Development in Schools

Contextual variable	*Areas of change to professional development practices*
LOW	Lower reported levels of alignment with standards.
MODERATE*	---
HIGH	Higher reported levels of alignment with district goals and standards.
RURAL	Lower reported levels of alignment with school goals, district goals, student achievement, and resource support. Lower reported levels of teachers' planning and presentation of professional development.
SUBURBAN*	---
URBAN	Higher reported levels of alignment with school goals, district goals, and student achievement. Higher reported levels of teachers' presentation of professional development.
ELEMENTARY	Higher reported levels of alignment with school goals, district goals, standards, and student achievement. Higher reported levels of teachers' planning and presentation of professional development.
COMBINED*	---
SECONDARY	Higher reported levels of teachers' presentation of professional development. Lower reported levels of resource support.
POVERTY	Higher reported levels of alignment with school goals, district goals, standards, student achievement, and resource support. Higher reported levels of teachers' presentation of professional development.
MINORITY	Higher reported levels of alignment with school goals, district goals, standards, student achievement, and resource support. Higher reported levels of teachers' presentation of professional development

Note. * = control or reference group in the model.

Professional development and contexts. In response to research question one, "Did public school principals report differences in professional development implementation according to their school contexts, particularly the state accountability policy environment, school level, and school demographics?", the study found evidence that principals' responses differed according to

their local school context. A summary of principals' reports according to their context are shown in Table 2.

 School location. Among school principals working in different geographic locations, rural schools appeared to manage their professional development processes much differently than other peers, where they reported less alignment of teachers' professional development and goal-setting, student achievement, and resource allocation. Rural principals reported decreased levels of participation among their teachers in the planning and presentation of professional development. As a group they may be revealing challenges to their schools' professional development practices. Not only did they report lower levels of alignment among the technical indicators of professional development processes, they also reported lower levels of teachers' participation in professional development. Referencing the literature on successful professional development and instructional leadership, they could be struggling to provide aligned, coherent, and teacher-led professional development in their settings (Newmann et al., 2001; Drago-Severson, 2007). This could be due to contextual challenges reported in previous studies, where principals are constrained by time, resources, and structures to provide adequate professional development (Harmon et al., 2007).

 School level. Among principals working in different school levels, the elementary group reported higher levels of alignment among professional development and standards, goals, and student achievement. Elementary principals reported higher levels of teachers' planning and presenting professional development. Secondary principals and combined-grade level principals were very similar in their reports of professional development processes. Secondary principals' reported lower levels of professional development alignment with resource support, but did report higher levels of teachers' presentation of professional development. Among principals from different levels, elementary principals reported more alignment of the technical aspects and direction of professional development, but also reported higher levels of teachers' participation of implementing professional development. Similar to the results of Louis et al. (2010), elementary principals reported more attention in their schools as to how professional development was implemented across all technical areas, with higher reported levels of support for teachers' participation. From this data and previous studies, elementary schools appeared to be more attuned to how professional development processes connected to national, state, and local initiatives in their settings. However, we do not have evidence as to why these differences occurred among school-levels.

 School demographics. Among principals working in varied school demographics, there is evidence that principals who worked in high-needs urban schools with lower-SES and higher levels of minority students reported different professional development practices than their counterparts. Principals in these schools reported more alignment of professional development with school goals, school district goals, standards, student outcomes, and resources. They also reported higher levels of teachers' planning professional development. As reported in the literature, schools that have more at-risk students do focus more on testing, and have greater accountability to improve student achievement outcomes. These principals' reported professional development processes seem to align more in these ways. These data are very similar to the findings of Goldring et al. (2008), where principals with higher levels of minority and disadvantaged students spent more time on instructional leadership behaviors than their counterparts. Newmann et al. (2001) also identified how more successful urban schools had comprehensive and locally generated professional development programs.

 Policy contexts. There is some limited evidence that principals who worked in different state-level accountability policy contexts reported varied professional development processes at the school level. Principals from high-accountability states were more likely to report higher levels of alignment of professional development, district goals, and standards. Principals from high-

accountability states were not any more or less likely to report significant differences in professional development processes in all other technical areas, including the extent to which teachers are involved in the planning and presentation of professional development. It is possible that the schools in high-accountability states received policy indicators about standards more frequently, or were emphasized more at the state and local levels.

Principals from low-accountability states only reported one significant difference in their professional development processes compared to their peers in other states. They were less likely to report alignment of their professional development with standards. In this case, the policy expectations seemed to align well with how schools implemented and principals reported professional development and standards alignment in their schools.

Changes in professional development reported during NCLB. In response to research question two, "Did public school principals report a change in how professional development was implemented in their schools during the NCLB era, from a period just prior to the implementation of NCLB policies (1999), to the full implementation of NCLB (2007)?", there is evidence that principals' reported changes to how professional development was implemented across the country during NCLB. A summary of the results for 2003 and 2007 waves are shown in Table 3.

Changes to professional development reported in 2003. Findings show that in the 2003 survey wave, principals across the country reported lower levels of participation of teachers in the planning and presentation of professional development. Among the national population, principals did not report significant levels of change to the alignment of professional development processes compared to the 1999 wave. The limited differences in the technical side of professional development processes may indicate how schools were still trying to learn what NCLB meant for them at the local levels. Although it is speculative, teachers' levels of planning and participation may indicate how schools were hiring and working with external consultants and professional development facilitators in order to learn more about new accountability expectations.

Table 3
Summary of Principals' Reported Changes to Professional Development during NCLB - National Level Sample Reporting

Time variable	Areas of change to professional development practices
1999*	---
2003	Lower reported levels of teachers' planning and presentation of professional development.
2007	Higher reported levels of alignment with school goals, student achievement, and resource support. Lower reported levels alignment with district goals, standards. Lower reported levels of teachers' planning and presentation of professional development.

Note. * = control or reference group in the model.

Changes to professional development reported in 2007. In 2007, principals reported more changes to professional development processes than in 2003. Principals reported higher levels of alignment between professional development and supporting school goals, student outcomes, and resource support. Interestingly, principals also reported lower levels of alignment with district goals and standards. In addition, principals also reported lower levels of teachers' participation teachers' planning and presentation of professional development. This may demonstrate a decrease in within-

school, teacher-lead professional development collaborative practices during NCLB implementation. A potential explanation is that by 2007, schools were considering ways in how professional development matched school-level goals and achievement outcomes, and were not as concerned with broader state policies, standards, or district-level influences. These other stakeholders' concerns may have been too far removed from schools' local school improvement and performance initiatives.

Discussion

The impacts of school context on principals' practice and the effects of school community characteristics on leadership is not a fully-developed line of research inquiry, but one that is gaining more attention in the more recent literature . This study found significant differences among schools' professional development practices, especially as reported by elementary principals and principals working in high-needs, urban school settings. Elementary and urban school principals reported higher levels of professional development alignment with school goals, district goals, and student outcomes than their counterparts. Schools with low-SES and higher levels of enrolled minority students reported more focus on local, building-level goal-setting. The literature has shown how local-level leaders often deflect the influence and control of top-down policies, choosing to focus more on local school and community concerns and student data (Alsbury & Whitaker, 2007; Malen, 2003; Miller, 2010; Mintrop, 2012; Sherman, 2008).

Principals in elementary, urban, high-needs settings are more likely to report higher levels of support for professional development with resources, and also to include teachers in the development and implementation of professional development in collaborative ways. It is possible they utilized local capital resources, human resources, and talent to improve instruction and school outcomes (Goldstein, 2007; Honig & Hatch, 2004; Huffman et al., 2006; Rorrer & Skrla, 2005; Sherman, 2008). This evidence creates a possible scenario of cultural balance that schools are trying to achieve in these settings. While these types of schools are mindful of the technical sides of professional development and instructional improvement, including goals, student outcomes, and resources, they also collaborated with and engaged teachers more in their own professional growth. This is one of the key features to build school-level capacity for professional growth and learning (Newmann et al., 2001; Youngs & King, 2002). This is not the case for all school settings, where a local rural context seemed to affect their schools' professional development practices in a completely opposite manner.

While the literature does not include extensive research on rural schools, particularly rural school principals' professional development practices and accountability, this study raises some interesting questions about rural schools' professional development practices. In rural schools the principals reported significantly lower levels of alignment with the technical side of professional development, including school goals, district goals, and student achievement outcomes, compared to suburban and urban peers. There is literature that supports a looser instructional climate or school improvement atmosphere, which potentially allows for more flexibility, less conflict, resilience, and more creativity (de Lima, 2007; Pajak & Green, 2003) but also reduced cohesion and collegiality (Young, 2006). In these rural settings, principals reported how their schools implemented much different management processes for professional development, possibly resulting in a reduction in collaboration and cohesion. This seems to reveal a need for closer investigation about how these findings may manifest in rural leadership practices, and how these professional development practices are experienced and interpreted by teachers in rural schools.

This present study extended Marks and Nance's (2007) work by investigating several related domains of schools' professional development practices within low- to high- accountability states as

a control variable. Compared to their findings, the resultant patterns of variation and significance among principals at the local- and state-levels are similar in nature to this study. This study found similar outcome patterns at the local level, with minimal, relatively insignificant variation among principals' responses analyzed at the state-level. In this study, the existing local contextual effects on schools' professional development practices were also the most significant predictors in the models, controlling for pre-existing state accountability environments. Despite the lack of variation among states, the national sample analysis in 2003 and 2007 indicated some significant changes in professional development practices.

In the era of accountability there may be an association between NCLB and schools' professional development practices. Principals reported higher levels of alignment with school goals, standards, student achievement, and resources. Surprisingly, the results indicated lower levels of alignment between professional development, standards, and district-level goals among principals in 2007. This is interesting given the evidence that school district leaders should emphasize greater the alignment between professional development, state learning standards, and district-level goals to improve student achievement results (Firestone et al., 2005).

This study may have detected a decrease in teachers' ability to design and implement their own professional development. The data show lower levels of teachers' planning and presentation of their own school-level professional development within each of the 2003 and 2007 waves. This could signal a significant reduction in collaborative school leadership practices with teachers' regarding their professional development practices during NCLB. The most recent research on instructional leadership, leadership for learning, has shown significant benefits to collaborative, distributed leadership approaches on school outcomes (Hallinger & Heck, 2010; Leithwood & Sun, 2012; Marks & Printy, 2003; Reardon, 2011). The results of this study conflict with the established research on the success of collaborative and distributed leadership practices. School leaders should be mindful of and purposefully include teachers in the planning and implementation of professional development.

Study Limitations

The findings and conclusions of the study must be considered in light of empirical limitations. The findings are limited by the measurement of seven dependent variables. Future analyses should include more variables of interest at the person- and school-levels, using confirmatory analysis to identify additional latent factors that may exist in the data. Also, while the cross-sectional design allowed comparisons across three waves of data, it did not track responses from the same principal panel cohort. These types of designs only provide information about the aggregate net change only in a given population or sub sample population, and cannot determine individual levels of change or correlations (Hagenaars, 1990). The three principal populations under investigation between 1999 and 2007 in this study are not truly the same in a statistical sense, and must be acknowledged as a design weakness (Hagenaars, 1990). Researchers emphasize the importance of clear, precise analysis, and caution against making significant empirical, causal inference claims using a repeated cross-sectional design (Menard, 1991). The inherent measurement error that exists within each wave of these data sets is acknowledged and managed by appropriate statistical modeling and methods of analysis. The use of hierarchical modeling, specifically HGLM-PO is important because of its rigor and statistical ability to tease out differences between and within groups, and for its ability to measure error with greater precision within and between the waves of data. The use of HGLM-PO is also a weakness due to high mathematical threshold to produce statistically significant results (Bickel, 2007). This study cannot make a claim that the principal responses are a direct effect of NCLB implementation, and the conclusions are drawn as a result of statistical and contextual associations. Despite these limitations, the study does reveal some

significant indicators regarding how principals have reported changes to schools' professional development practices in their schools during NCLB, and how schools enacted professional development according to different local contexts.

Conclusions and Implications

Research on principals' professional development leadership and leadership for learning shows how aligned, coherent, focused, and collaborative principal leadership is the most effective way to spur teachers' growth, and in turn, student achievement. The evidence from this study provides a mixed picture regarding how school leaders implemented professional development in their schools, particularly during NCLB.

Across the national sample in 2003, principals reported soon after implementation how their teachers' involvement in the planning and presentation of professional development was lower than before. These levels continued to decline into the 2007 wave. While this study cannot determine the sources of schools' use or facilitation of professional development programming, it is possible that schools sought out additional, external supports for instructional improvement and professional development (Cooley & Shen, 2003). This could be indicated by principals' reported higher levels of resource support for professional development in schools 2007. From the data, the most significant finding during NCLB implementation is the association between lower levels of teachers' planning and presentation of professional development and higher levels of resource support. It could be argued that schools are not building local capacity and drawing on teachers' expertise as much as they should be in order to build lasting professional development cultures.

In high-needs urban schools with higher levels of low-SES and minority students especially, principals reported leadership practices that appeared to be in sync with research-based practices. Schools in these contexts reported higher levels of alignment between professional development and the key technical areas of standards, student learning, resources and local goals. In schools that need the most supports and organization to improve student learning, while overcoming significant challenges in their schools, the principals' reported a focus on effective professional development practices. This is also evident in elementary settings, where previous research indicated how elementary settings are more collaborative and focused on instructional improvement. Providing strong professional development supports for teachers and students in the early years provides a foundation for later academic success. This study shows how schools in these settings reported more focus on building capacity for growth that is more locally-driven and collaborative.

The outlier group in the study are the rural principals, where even lower levels of alignment and much lower levels of teachers' participation in professional development were reported. In the sample, the bulk of rural schools are likely located in the low-accountability states. There could be multiple, converging internal and external elements that could explain rural principals' responses. In the literature, rural schools have limited capacity, limited resources, and if they are situated in low-accountability state policy cultures, there may be a lack of external incentives to align or design professional development programs. If rural schools are constrained by resources and structures at the local levels, leaders in rural areas should consider using their teachers to build more capacity for sustained professional development and instructional improvement. Further study of rural schools' professional development practices is definitely needed.

Implications. This study of NCLB-style professional development implementation in schools raises more questions regarding professional development implementation across school settings as we look forward to the "post-NCLB era." Research could focus more attention on professional development in context, particularly how schools approach professional development

when constrained by different levels of funding, local capacity (e.g. numbers of teachers, or school sizes), and levels of collaboration. Previous studies identified capacity building and collaboration as two of the most effective means for long-term professional development improvement. If schools outsource their professional development, what does that do to culture? What are the impacts on teachers' practices and how leaders develop their teachers' potential to lead in their buildings?

State or federal policies generally do not include specific guidelines for schools' implementation of professional development, as it is largely a locally determined program or initiative. Policymakers could consider additional funding for high-quality, locally-designed programs that could model effective practices for other schools to learn from and implement. I did not locate research that specifically examined states' use of professional development funding and connections to teachers' change or student outcomes. This could be a new line of inquiry for researchers or an alternative approach for state-level or district leaders to consider in support of local school innovation and professional development practices.

For leaders' professional development practices, this study highlights how teachers' roles in professional development have reportedly diminished during NCLB. In principal and superintendent preparation and practice, there should be more critical analysis of how leaders can cultivate school capacity for improvement. The greatest resource schools have is their teachers and their experiences, their passion, and their desire to collaborate for the benefit of student learning. School leaders should evaluate their professional development programs, structures, resources, and personnel to determine if they utilize professional development not only to improve instruction, but to foster healthy and sustained professional learning cultures.

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Appendix A

Table A-1
Descriptive Statistics; (1999)

Variable	N	Range	Min.	Max.	M	SD
1999	9100	0	0	0	1.00	.00
Low	1340	1	0	1	.15	.35
Medium	5050	0	0	0	.55	.49
High	2050	1	0	1	.23	.42
Urban	1870	1	0	1	.22	.41
Suburban	3300	0	0	0	.39	.48
Rural	3350	1	0	1	.39	.49
POVERTY	7830	1	0	1	.55	.49
MINOR.	8490	1	0	1	.54	.49
ELEM	4140	1	0	1	.49	.50
HS	3600	1	0	1	.42	.49
COMB	780	0	0	0	.09	.29
PD_SSG	8520	4	1	5	4.16	.69
PD_SDG	8520	4	1	5	4.09	.71
PD_SS	8520	4	1	5	3.99	.75
PD_ESA	8520	4	1	5	3.60	.97
PD_PLT	8520	4	1	5	3.68	.87
PD_PRT	8520	4	1	5	3.46	.79
PD_SWR	8520	4	1	5	3.47	.87
AFNLWGHT	8520	95.48	.84	96.32	9.71	10.10
Valid *n*	7340					
Weighted *n (est.)*	82800					

Table A-2
Descriptive Statistics; (2003)

Variable	N	Range	Min.	Max.	M	SD
2003	8400	0	1	1	1	.00
Low	1330	1	0	1	.16	.37
Medium	5070	0	0	0	.24	.42
High	1740	1	0	1	.21	.41
Urban	1920	1	0	1	.24	.42
Suburban	3420	0	0	0	.42	.49
Rural	2810	1	0	1	.34	.48
POVERTY	7620	1	0	1	.49	.50
MINOR.	8130	1	0	1	.49	.50
ELEM	4040	1	0	1	.50	.50
HS	3210	1	0	1	.39	.49
COMB	900	0	0	0	.11	.32
PD_SSG	8140	4	1	5	4.19	.70
PD_SDG	8140	4	1	5	4.06	.74
PD_SS	8140	4	1	5	3.96	.75
PD_ESA	8140	4	1	5	3.65	.91
PD_PLT	8140	4	1	5	3.54	.85
PD_PRT	8140	4	1	5	3.39	.73
PD_SWR	8140	4	1	5	3.50	.79
AFNLWGHT	8140	235.58	.90	236.48	10.76	12.52
Valid *n*	7390					
Weighted *n (est.)*	87620					

Table A-3

Descriptive Statistics; (2007)

Variable	N	Range	Min.	Max.	M	SD
2007	7850	0	1	1	1.00	.00
Low	1240	1	0	1	.16	.36
Medium	4180	0	0	0	.60	.49
High	1510	1	0	1	.19	.39
Urban	1670	1	0	1	.22	.41
Suburban	3220	0	0	0	.43	.49
Rural	2570	1	0	1	.34	.47
POVERTY	7270	1	0	1	.46	.49
MINOR.	7460	1	0	1	.47	.49
ELEM	3670	1	0	1	.49	.50
HS	2860	1	0	1	.38	.49
COMB	930	0	0	0	.12	.33
PD_SSG	7460	4	1	5	4.22	.69
PD_SDG	7460	4	1	5	4.05	.76
PD_SS	7460	4	1	5	3.93	.76
PD_ESA	7460	4	1	5	3.77	.89
PD_PLT	7460	4	1	5	3.47	.85
PD_PRT	7460	4	1	5	3.39	.75
PD_SWR	7460	4	1	5	3.60	.76
AFNLWGHT	7460	164	1	165	12.13	13.94
Valid *n*	6900					
Weighted *n (est.)*	90470					

Appendix B

Table B-1
Bivariate Correlation Statistics; (1999)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. High	1	-.69*	-.25*	-.04*	-.02	-.02	-.07*	-.003	.13*	-.16*	-.14*	.04*	.04*	.13*	.12*	-.01	.01	.04*
2. Moderate		1	-.53*	.00	.11*	-.11*	.05*	.02*	.06*	.00	-.06*	.02	.00	.00	-.02	.04*	.03	.01
3. Low			1	-.06*	-.12	.16*	.02	.02*	-.07	.18	.24*	-.07*	-.05*	-.15*	-.11*	-.04*	-.05	-.05*
4. Urban				1	-.41*	-.43*	.06*	-.05*	-.01	-.24*	-.31*	.08*	.04*	.01	.09*	.03*	.12*	.00
5. Suburban					1	-.64*	.02	.02	-.07*	.08	.06	.04*	.01	.00	-.02	.04*	.07*	.02
6. Rural						1	-.07*	.03	.08	.12*	.20*	-.11*	-.05*	-.02	-.06*	-.07*	-.18*	-.02
7. ELEM							1	-.84	-.30*	-.05*	-.04*	.10*	.09*	.08*	.09*	.06*	.05*	.04*
8. HS								1	-.25*	.01	.07*	.09*	-.07*	-.08*	-.08*	-.03*	-.02*	-.04*
9. COMB									1	.05*	-.04*	-.03*	-.04*	-.01	-.01	-.05*	-.05*	.00
10. POVERT.										1	.44*	-.10*	-.08*	-.11*	-.11*	-.04*	-.10*	-.05*
11. MINOR.											1	-.10*	-.08*	-.11*	-.16*	-.03*	-.06*	-.06*
12. PD_SSG												1	.66*	.46*	.42*	.35*	.31*	.35*
13. PD_SDG													1	.57*	.38*	.24*	.24*	.28*
14. PD_SS														1	.36*	.18*	.19*	.24*
15. PD_ESA															1	.31*	.29*	.39*
16. PD_PLT																1	.56*	.38*
17. PD_PRT																	1	.38*
18. PD_SWA																		1

*Note. *p* <.01 (two-tailed).

Table B-2
Bivariate Correlation Statistics; (2003)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. High	1	-.67*	-.24*	.02	.00	-.02	-.04*	.04	-.01	-.12*	-.11*	.00	.02	.07	.08	-.05*	.01	.04
2. Moderate		1	-.56*	.01	.07*	-.09*	.04	-.02	-.03	-.04*	-.08*	.03*	-.01	-.01	-.02	.06*	.04*	.00
3. Low			1	-.04*	-.10*	.14*	-.01	-.16	.04*	.19*	.23*	-.04*	-.01	-.07*	-.06*	-.03*	-.06*	-.05*
4. Urban				1	-.47*	-.40*	.09*	-.04*	-.08*	-.21*	-.32*	.12*	.06*	.03*	.10*	.06*	.12*	.05*
5. Suburban					1	-.63*	.04*	.03*	-.12*	.08*	.09*	.03*	.01	.00	.00	.05*	.09*	.02
6. Rural						1	-.12*	.00	.20*	.10*	.19*	-.13*	-.07*	-.03*	-.09*	-.11*	-.20*	-.07*
7. ELEM							1	-.81*	-.35*	.01	-.06*	.13	.11	.08*	.08*	.08*	.07*	.08*
8. HS								1	-.27*	-.08*	.04	-.09*	-.08*	-.05*	-.05*	-.04*	.00	-.06*
9. COMB									1	.12*	.04*	-.08*	-.06*	-.05*	-.05*	-.06*	-.09*	-.03*
10. POVERT.										1	.40*	-.10*	-.07*	-.10*	-.12*	-.03*	-.10*	-.05*
11. MINOR.											1	-.11*	-.08*	-.09*	-.15*	-.06*	-.09*	-.09*
12. PD_SSG												1	.65*	.49*	.47*	.37*	.32*	.41*
13. PD_SDG													1	.56*	.40*	.29*	.28*	.34*
14. PD_SS														1	.39*	.25*	.24*	.30*
15. PD_ESA															1	.35*	.33*	.43*
16. PD_PLT																1	.57*	.39*
17. PD_PRT																	1	.41*
18. PD_SWA																		1

*Note. *p* <.01 (two-tailed).

Table B-3
Bivariate Correlation Statistics; (2007)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. High	1	-.66*	-.23*	.01	-.01	.00	-.02*	.04*	-.03*	-.12*	-.09*	.02	.03*	.08*	.06*	-.04*	.01	.03*
2. Moderate		1	-.59*	.02*	.09*	-.11*	.02	-.01	-.01	-.06*	-.11*	.04*	-.01	.03	.02	.04*	.04*	.01
3. Low			1	-.04*	-.11*	.15*	-.01	-.03	.05*	.20*	.24*	-.07*	-.02	-.12*	-.09*	-.01	-.06*	-.05*
4. Urban				1	-.46*	-.39*	.08*	-.02	-.09*	-.18*	-.31*	.09*	.04*	.06*	.09*	.07*	.13*	.05*
5. Suburban					1	-.64*	.04*	.04*	-.12*	.03*	.07*	.04*	.03	.00	.01	.06*	.08*	.04*
6. Rural						1	-.12*	-.02	.20*	.12*	.20*	-.13*	-.06*	-.05*	-.09*	-.12*	-.19*	-.09*
7. ELEM							1	-.79*	-.37*	.00	-.08*	.12*	.10*	.12*	.11*	.04*	.07*	.08*
8. HS								1	-.28*	-.10*	.05*	-.06*	-.06*	-.08*	-.09*	-.02	-.01	-.07*
9. COMB									1	.15*	.05*	-.10*	-.07*	-.06*	-.04*	-.04*	-.09*	-.02
10. POVERT.										1	.36*	-.12*	-.07*	-.12*	-.10*	-.06*	-.10*	-.06*
11. MINOR.											1	-.09*	-.02	-.11*	-.12*	-.03	-.06*	-.07*
12. PD_SSG												1	.64*	.52*	.46*	.33*	.31*	.41*
13. PD_SDG													1	.55*	.38*	.25*	.24*	.32*
14. PD_SS														1	.43*	.24*	.23*	.32*
15. PD_ESA															1	.32*	.31*	.40*
16. PD_PLT																1	.58*	.41*
17. PD_PRT																	1	.42*
18. PD_SWA																		1

Note. $*p < .01$ (two-tailed).

Appendix C

Table C-1
Model Analysis of Professional Development Supports School Goals (PD_SSG)

Parameter	Unconditional Model- Model 1 *Null model* B	se	t-ratio	Conditional Model- Model 2 *Level 1 only* B	se	t-ratio	Full Model- Model 3 *Levels 1 & 2* B	se	t- ratio	OR	CI
Fixed effects											
Level 1											
Intercept (β_0)	-7.06***	.26	-27.42	-7.03***	.25	-28.32	-7.03***	.25	-21.21	.00	(.001,.001)
Slopes (γ_{10}-γ_{80})											
2003				-.08	.06	-1.22	-.07	.06	-1.52	.93	(.82,1.05)
2007				-.13*	.06	-1.96	-.13*	.06	-2.54	.88	(.78,1.00)
URBAN				-.20***	.05	-4.02	-.20***	.05	-3.27	.82	(.75,.90)
RURAL				.34***	.05	6.41	.34***	.05	6.21	1.40	(1.27,1.56)
SEC.				-.09	.08	-1.16	-.09	.08	-.91	.91	(.77,1.07)
ELEM.				-.49***	.09	-5.16	-.49***	.09	-6.61	.61	(.51, .74)
POVERTY				-.29***	.04	-5.99	-.29***	.04	-8.45	.76	(.67,.83)
MINOR				-.16**	.05	-3.09	-.16**	.05	-3.32	.85	(.77,.94)
Level 2											
Intercepts											
HIGH(γ_{01})							.03	.11	.30	1.03	(.83,1.28)
LOW(γ_{02})							-.02	.15	-.13	.97	(.71,1.35)
Thresholds											
δ_2	2.42***			2.42***			2.42***				
δ_3	5.06***			5.08***			5.07***				
δ_4	7.61***			7.70***			7.63***				
Random effects											
Var.(τ_{00})	.15			.12			.12				
Chi (x^2)	838.12(*50*)***			705.29(*50*)***			705.77(*48*)***				
ICC (ρ)	.044			.036			.036				

Note. *p<.05; **p< .01; *** p<.001.

Table C-2

Model Analysis of Professional Development Supports District Goals (PD_SDG)

Parameter	Unconditional Model- Model 1 *Null model* B	se	t-ratio	Conditional Model- Model 2 *Level 1 only* B	se	t-ratio	Full Model- Model 3 *Levels 1 & 2* B	se	t- ratio	OR	CI
Fixed effects											
Level 1											
Intercept(β_0)	-5.69***	.19	-30.41	-5.65***	.17	-29.52	-5.65***	.19	-29.85	.01	(.002,.005)
Slopes(γ_{10}-γ_{80})											
2003				.06	.05	1.40	.07	.05	1.40	1.07	(.98,1.17)
2007				.10*	.05	1.96	.10*	.05	1.97	1.10	(1.00,1.21)
URBAN				-.12*	.05	-2.28	-.12*	.05	-2.28	.89	(.80,.98)
RURAL				.13*	.05	2.14	.14*	.06	2.16	1.14	(1.01,1.30)
SEC.				-.08	.07	-.97	-.08	.08	-.97	.93	(.78,1.09)
ELEM.				-.48***	.07	-4.95	-.49***	.09	-4.96	.62	(.51,.74)
POVERTY				-.24***	.04	-3.71	-.24***	.06	-3.70	.78	(.69,.89)
MINOR				-.13*	.05	-2.30	-.13*	.06	-2.30	.87	(.78,.98)
Level 2											
Intercepts											
HIGH(γ_{01})							-.13*	.05	-1.02	.93	(.80,1.08)
LOW(γ_{02})							-.07	.05	-.34	.95	(.68,1.32)
Thresholds											
δ_2	1.61***			1.60***			1.61***				
δ_3	4.04***			4.06***			4.05***				
δ_4	6.53***			6.59***			6.55***				
Random effects											
Var.(τ_{00})	.08			.08			.07				
Chi (x^2)	490.82(*50*)***			506.59(*50*)***			491.01(*48*)***				
ICC (ρ)	.024			.024			.021				

Note. *p<.05; **p< .01; *** p<.001.

Table C-3
Model Analysis of Professional Development Supports Standards (PD_SS)

Parameter	Unconditional Model- Model 1 Null model			Conditional Model- Model 2 Level 1 only			Full Model- Model 3 Levels 1 & 2				
	B	se	t-ratio	B	se	t-ratio	B	se	t-ratio	OR	CI
Fixed effects											
Level 1											
Intercept(β_0)	-5.79***	.14	-40.55	-5.76***	.14	-42.11	-5.74***	.13	-43.03	.00	(.002,.004)
Slopes(γ_{10}-γ_{80})											
2003				.03	.06	.48	.03	.06	.48	1.03	(.92,1.16)
2007				.16*	.07	2.28	.16*	.07	2.28	1.17	(1.02,1.34)
URBAN				-.10	.06	-1.72	-.10	.06	-1.74	.93	(.81,1.01)
RURAL				-.02	.04	-.49	-.02	.04	-.55	.98	(.90,1.06)
SEC.				-.002	.08	.03	-.002	.08	.02	.99	(.86,1.16)
ELEM.				-.38***	.10	-3.89	-.38***	.10	-3.89	.69	(.57,.83)
POVERTY				-.29***	.05	-5.51	-.29***	.05	-5.46	.71	(.67,.83)
MINOR.				-.17**	.06	-3.04	-.16**	.05	-3.03	.82	(.76,.94)
Level 2											
Intercepts											
HIGH(γ_{01})							-.24**	.05	-3.33	.79	(.68,.91)
LOW(γ_{02})							.26*	.05	1.99	1.26	(.99,1.68)
Thresholds											
δ_2	1.91***			1.91***			1.91***				
δ_3	4.44***			4.45***			4.45***				
δ_4	6.89***			6.95***			6.95***				
Random effects											
Var. (τ_{00})	.12			.08			.06				
Chi (x^2)	692.62(*50*)***			491.32(*50*)***			370.83(*48*)***				
ICC (ρ)	.034			.023			.018				

Note. *p<.05; **p< .01; *** p<.001.

Table C-4

Model Analysis of Professional Development Evaluated for Effects on Student Achievement (PD_ESA)

Parameter	Unconditional Model- Model 1 *Null model*			Conditional Model- Model 2 *Level 1 only*			Full Model- Model 3 *Levels 1 & 2*				
	B	se	t-ratio	B	se	t-ratio	B	se	t-ratio	OR	CI
Fixed effects											
Level 1											
Intercept(β_0)	-4.45***	.09	-46.82	-4.41***	.11	-41.14	-4.40***	.08	-53.26	.01	(.01,.02)
Slopes(γ_{10}-γ_{80})											
2003				-.04	.05	-.97	-.04	.06	-.80	.96	(.86,1.07)
2007				-.25***	.05	-5.39	-.25***	.07	-3.41	.78	(.67,.90)
URBAN				-.25***	.05	-4.73	-.25***	.06	-4.36	.78	(.69,.87)
RURAL				.18***	.04	3.80	.18***	.04	4.11	1.20	(1.10,1.31)
SEC.				.02	.07	.32	.02	.05	.47	1.02	(.93,1.12)
ELEM.				-.30***	.07	-4.46	-.30***	.06	-4.82	.73	(.65,.84)
POVERTY				-.17***	.04	-3.78	-.17***	.05	-4.38	.85	(.79,.91)
MINOR.				-.30***	.05	-6.03	-.30***	.04	-5.05	.74	(.66,.83)
Level 2											
Intercepts											
HIGH(γ_{01})							-.19	.05	-1.29	.83	(.62,1.11)
LOW(γ_{02})							.14	.05	1.38	1.15	(.94,1.42)
Thresholds											
δ_2	2.11***			2.11***			2.11***				
δ_3	3.90***			3.93***			3.93***				
δ_4	5.86***			5.95***			5.95***				
Random effects											
Var. (τ_{00})	.17			.12			.11				
Chi (x^2)	1088.54(*50*)***			788.29(*50*)***			702.81(*48*)***				
ICC (ρ)	.049			.035			.032				

*Note. *p<.05; **p< .01; *** p<.001.*

Table C-5

Model Analysis of Professional Development Planned by Teachers (PD_PLT)

Parameter	Unconditional Model- Model 1 Null model			Conditional Model- Model 2 Level 1 only			Full Model- Model 3 Levels 1 & 2				
	B	se	t-ratio	B	se	t-ratio	B	se	t-ratio	OR	CI
Fixed effects											
Level 1											
Intercept(β_0)	-4.46***	.09	-46.80	-4.46***	.09	-46.79	-4.47***	.09	-45.58	.01	(.009,.014)
Slopes(γ_{10}-γ_{80})											
2003				.32***	.07	4.58	.32***	.07	4.58	1.38	(1.20,1.59)
2007				.52***	.06	8.06	.52***	.06	8.07	1.69	(1.49,1.92)
URBAN				-.10	.07	-1.42	-.10	.07	-1.41	.90	(.78,1.04)
RURAL				.26***	.06	4.28	.26***	.06	4.27	1.29	(1.15,1.46)
SEC.				-.06	.06	-.96	-.06	.06	-.95	.94	(.83,1.07)
ELEM.				-.20**	.07	-2.90	-.20**	.07	-2.89	.81	(.71,.94)
POVERTY				-.08	.07	-1.07	-.08	.07	-1.09	.92	(.80,1.07)
MINOR.				-.01	.06	-.11	-.01	.06	-.14	.99	(.87,1.13)
Level 2											
Intercepts											
HIGH(γ_{01})							.09	.09	1.03	1.09	(.92,1.32)
LOW(γ_{02})							-.04	.11	-.38	.97	(.76,1.21)
Thresholds											
δ_2	2.13***			2.13***			2.13***				
δ_3	4.26***			4.29***			4.26***				
δ_4	6.40***			6.47***			6.41***				
Random effects											
Var. (τ_{00})	.07			.07			.069				
Chi (x^2)	458.90(*50*)***			456.03(*50*)***			456.73(*48*)***				
ICC (ρ)	.021			.021			.020				

Note. *p<.05; **p< .01; *** p<.001.

Table C-6

Model Analysis of Professional Development Presented by Teachers (PD_PRT)

Parameter	Unconditional Model-Model 1 *Null model*			Conditional Model-Model 2 *Level 1 only*			Full Model-Model 3 *Levels 1 & 2*				
	B	se	t-ratio	B	se	t-ratio	B	se	t-ratio	OR	CI
Fixed effects											
Level 1											
Intercept(β_0)	-4.69***	.12	-37.70	-4.71***	.13	-37.50	-4.70***	.13	-37.06	.01	(.007,.012)
Slopes(γ_{10}-γ_{80})											
2003				.25***	.05	4.72	.25***	.05	4.72	1.28	(1.16,1.41)
2007				.27**	.09	3.15	.27**	.09	3.15	1.31	(1.11,1.56)
URBAN				-.17*	.08	-2.18	-.17*	.08	-2.18	.84	(.72,.98)
RURAL				.67***	.06	10.41	.67***	.06	10.37	1.95	(1.72,2.22)
SEC.				-.14*	.07	-2.03	-.14*	.07	-2.02	.87	(.76,.99)
ELEM.				-.30***	.07	-4.03	-.30***	.07	-4.02	.74	(.64,.86)
POVERTY				-.21***	.07	-3.29	-.21***	.07	-3.25	.81	(.71,.92)
MINOR.				-.14**	.06	-2.40	-.14**	.06	-2.37	.87	(.78,.98)
Level 2											
Intercepts											
HIGH(γ_{01})							-.03	.09	-.35	.97	(.81,1.16)
LOW(γ_{02})							.05	.09	.56	1.05	(.87,.128)
Thresholds											
δ_2	2.32***			2.34***			2.34***				
δ_3	4.80***			4.90***			4.90***				
δ_4	7.71***			7.86***			7.86***				
Random effects											
Var. (τ_{00})	.08			.06			.06				
Chi (x^2)	483.27(*50*)***			369.06(*50*)***			367.67(*48*)***				
ICC (ρ)	.023			.018			.018				

Note. *p<.05; **p< .01; *** p<.001.

Table C-7

Model Analysis of Professional Development Supported with Resources (PD_SWR)

Parameter	Unconditional Model- Model 1 *Null model*			Conditional Model- Model 2 *Level 1 only*			Full Model- Model 3 *Levels 1 & 2*				
	B	*se*	t-ratio	*B*	*se*	t-ratio	*B*	*se*	t- ratio	OR	CI
Fixed effects											
Level 1											
Intercept(β_0)	-4.92***	.13	-38.48	-4.89***	.13	-38.04	-4.88***	.12	-39.78	.01	(.006,.010)
Slopes(γ_{10}-γ_{80})											
2003				-.03	.07	-.46	-.03	.07	-.39	.97	(.85,1.11)
2007				-.22***	.06	-4.54	-.22***	.06	-3.56	.80	(.71,.91)
URBAN				-.10	.06	-1.20	-.10	.06	-1.58	.91	(.81,1.02)
RURAL				.18***	.05	3.89	.18***	.05	3.48	1.20	(1.08,1.33)
SEC.				.16*	.06	2.26	.16*	.06	2.39	1.17	(1.03,1.33)
ELEM.				-.03	.08	-.44	-.03	.08	-.40	.97	(.82,1.14)
POVERTY				-.16*	.06	-3.34	-.15*	.06	-1.93	.89	(.80,1.01)
MINOR.				-.11*	.08	-4.74	-.11*	.08	-2.32	.83	(.72,.97)
Level 2											
Intercepts											
HIGH(γ_{01})							-.10	-.08	-.99	.90	(.77,1.06)
LOW(γ_{02})							.13	.09	1.20	1.14	(.94,1.39)
Thresholds											
δ_2	2.44***			2.44***			2.44***				
δ_3	4.75***			4.74***			4.77***				
δ_4	7.10***			7.14***			7.14***				
Random effects											
Var. (τ_{00})	.07			.06			.051				
Chi (x^2)	481.11(*50*)***			363.78(*50*)***			330.29(*48*)***				
ICC (ρ)	.022			.016			.015				

Note. *p<.05; **p< .01; *** p<.001.

Appendix D

Table D-1
Dependent Variable Survey Questions and Variables

Variable Code	Variable description	Survey Question
PD_SSG	Professional development support school goals	How often is professional development for teachers at this school designed or chosen to support the school's improvement goals?
PD_SDG	Professional development support district goals	How often is professional development for teachers at this school designed or chosen to support the district's improvement goals?
PD_SS	Professional development support state and local standards	How often is professional development for teachers at this school designed or chosen to support the implementation of state or local standards?
PD_ESA	Professional development Evaluated for effects on student achievement	How often is professional development for teachers at this school evaluated for evidence of effects on student achievement?
PD_PLT	Professional development planned by teachers	How often is professional development at this school planned by teachers in the school or district?
PD_PRT	Professional development presented by teachers	How often is professional development for teachers at this school presented by teachers at this school or district?
PD_SWR	Professional development supported with resources	How often is professional development for teachers at this school accompanied by the resources that teachers need (ex. time and materials) to make changes in the classroom?

Appendix E

Table E-1
State Accountability Level Groups in the Model

State Variable Code	States in control grouping
LOW	Colorado, Idaho, Iowa, Montana, Nebraska, New Hampshire, North Dakota, Vermont, Washington
MODERATE	Alaska, Arizona, California, Connecticut, Delaware, District of Columbia, Florida, Georgia, Hawaii, Illinois, Indiana, Kansas, Kentucky, Maine, Maryland, Michigan, Minnesota, Missouri, Nevada, New Jersey, New Mexico, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Wisconsin, Wyoming
HIGH	Alabama, Arkansas, Louisiana, Massachusetts, Mississippi, New York, North Carolina, Texas, Virginia, West Virginia.

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