

What Should We Consider in Teachers' Professional Development Impact Studies? Based on the Conceptual Framework of Desimone

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Teacher professional development has long been of interest since it affects teachers' learning, the practice of teaching, and student learning. In reality, as substantial resources have been spent on professional development, policy makers increase their search for evidence-based research about its effects on teachers' and students' outcomes. Therefore, it is imperative to use a solid framework evaluating professional development. Specifically, Desimone (2009) provides a comprehensive framework for evaluating the effect of professional development. Specifically, she represents that: 1) core features of effective professional development are content focused, active learning, coherence, duration, and collective participation; 2) the way this effective professional development affect teachers' knowledge, their practice, and finally students' learning; and 3) contextual factors such as student characteristics, teacher characteristics, and school characteristics are related to the effectiveness of professional development. Through this study, Desimone's framework has been supported by both theoretical literature and empirical studies. Furthermore, some implications were provided for policy makers and school leaders as well as for teachers in Korea.

Keywords: Teacher Professional Development; Teacher Education; Teacher Evaluation

Introduction

Teacher professional development has been regarded as one of the most important factors for improving the quality of US schools (Desimone, 2011). Teacher professional development is particularly critical because, if effective, it can influence teachers' learning, the method and practice of teaching, and student learning (Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003). As the investment in professional development has grown, policy makers have increased their search for evidence of its effects on teachers' knowledge, teaching practice, and student learning (Ingvarson, Meiers, & Beavis, 2005). Further, scholars argue that research should use valid methods such as experimental designs to evaluate professional development to determine research-based evidence, and then apply this evidence to real teaching contexts (Wayne, Yoon, Zhu, Cronen, & Garet, 2008). Therefore, in order to evaluate the effect of teachers' professional development on either teachers' or students' outcomes, we need to use a comprehensive framework which not only literature has suggested but also empirical research has supported. Above all, a comprehensive framework for evaluating professional development impact should describe three aspects: First, it should define what the effective professional development is; second, it should explain the path how this effective professional development affect teachers' and

students' outcomes. Third, it should describe what the contextual factors impacting professional development are. In detail, lately conducted literature by Desimone (2009) has provided a comprehensive framework for evaluating professional development representing all three aspects mentioned above. By review of empirical research as well as theoretical literature, we will examine whether Desimone's framework could be justified as a solid theoretical framework for evaluating professional development.

Although empirical research has been conducted for exploring the relationship between professional development and teachers' outcomes in Korea, to the best of my knowledge, there is no literature which comprehensively describes three aspects which were shown above as a solid framework for evaluating professional development. Therefore, if Desimone's (2009) framework is justified by both theoretical literature and empirical research, this framework will help inform further evaluation studies of professional development and the evidence offered through this review of the research will help policy makers implement future professional development initiatives.

Literature Review

Definition of Professional Development

Professional development is defined as the processes and ac-

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tivities designed to improve teachers' knowledge, the practice of instruction, and the learning outcomes of students (Wei, Darling-Hammond, Andree, Richardson, & Orphanos, 2009). Traditional professional development has been identified as discrete activities such as workshops and college courses (Little, 1993). However, this approach is often considered ineffective because these activities are not directly related to individual teacher's classroom teaching (Hawley & Valli, 1999).

Beyond traditional professional development, the situative perspective provides a new approach to define professional development. This perspective was originally used for student learning (Brown, Collins, & Duguid, 1989; Greeno, 1998). Brown et al. (1989) argued that "knowledge is situated, being in part a product of the activity, context, and culture in which it is developed and use." Similarly, arguing that all learning occurs in some situation, Greeno et al. (1998) contended that "the difference between learning in different arrangements is not whether learning is situated or not, but how it is situated." Putnam and Borko (2000) extended the situative perspective on teacher learning. Arguing that cognition is solely an outcome of individuals, they proposed that three concepts that are fundamental to the situative perspective: cognition is 1) situated in specific contexts; 2) social in nature; and 3) distributed across the individual, other persons, and tools. Based on this explanation, they argued that situating learning experiences for acquiring knowledge for teaching could take place not only in the classrooms but also outside the classrooms. As a result, they suggested various activities for teacher learning as part of teachers' professional development. Specifically, they suggested a variety of teacher learning experiences for current teachers and prospective teachers: working with instructional experts, ongoing workshops focusing on instruction, discourse communities among teachers, pairing university-based researchers or staff developers with current teachers; taking a children's literature course, participating in discourse communities through mentoring of for prospective teachers; and taking a case-based teaching course together for both current teacher and prospective teachers.

Aligned with the situative perspective by Putnam and Borko (2000), scholars also have suggested various ways to engage in effective teacher learning opportunities such as coaching, mentoring, study groups, action research, observation of teachers' in-class practices, involvement in the development or improvement process, and enactment of curriculum in the classroom (Guskey, 2000; Loucks-Horsley et al., 2003).

Theoretical Framework for Evaluating Professional Development

About a decade ago, Supovitz (2001) suggested that a logic behind professional development is that high-quality professional development will change teaching in classrooms, which will, in turn, increase student achievement. In addition, some scholars (Guskey & Sparks, 2002; Loucks-Horsley & Matsumoto, 1999) have suggested including teachers' knowledge as a new mediating variable between professional development and student learning in the framework since effective professional development shapes not only teaching practice but also teachers' knowledge. Moreover, recent literature has claimed that teachers' knowledge gained from professional development influences teaching practice (Blank & Alas, 2008; Yoon, Duncan, Lee, Scarloss, & Shapley, 2007). Desimone (2009) in-

cluded teachers' knowledge as well as attitudes and beliefs as critical factors affecting teaching practice.

Considering the current literature, the comprehensive theoretical framework synthesized by Desimone (2009) is convincing since it contains that: 1) explanation of effective professional development; 2) all the path from effective professional development to student achievement and; 3) contextual factors. We figure out how both theoretical literature and empirical studies will support Desimone's framework. **Figure 1** represents Desimone's core conceptual framework for studying the effect of professional development on teachers and students.

Critical Features of Effective Professional Development

Even though scholars have suggested diverse characteristics of effective professional development, recently conducted research commonly has described five characteristics as core features of effective professional development: content focus; active learning; coherence; duration; and collective participation (Blank, de las Alas, & Smith, 2007; Corcoran, 2007; Desimone, 2011; Wayne et al., 2008). These characteristics are explained in greater detail below along with the empirical research that serves as evidence of the impacts of each of the five characteristics.

Content Focus

Content refers to what teachers learn through professional development (Garet, Porter, Desimone, Birman, & Yoon, 2001). Specifically, content in professional development is divided into two main categories: knowledge of the subject matter, and the knowledge of how students learn that content (Kennedy, 1998). Shulman (1986) calls the second type pedagogical content knowledge. It is considered the most important feature of effective professional development (Desimone, 2009).

Empirical research suggests that content-focused professional development can influence teachers' knowledge, teaching practice, or student learning (Carpenter et al., 1989; Cohen & Hill, 2000; Garet et al., 2001; Ingvarson et al., 2005; Smith, Desimone, & Ueno, 2005). Over 20 years ago, Carpenter et al. (1989) used an experimental design to examine the effect of teachers' learning of Cognitive Guided Instruction (CGI) on teachers' knowledge, teaching practice, and student learning. For the experiment, twenty first-grade teachers who were assigned to a treatment group participated in a month-long workshop to learn about children's development of problem solving

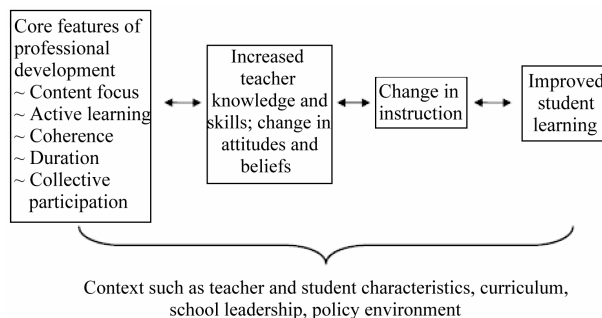


Figure 1. Desimone's (2009) conceptual framework for studying the effect of professional development on teachers and students.

skills in addition and subtraction. Teachers in the control group participated in two 2-hour workshops that did not provide any discussion about how children think as they solve problems, nor was any specific framework given for how to understand children's cognition. The results revealed that the teachers in treatment group who learned about pedagogical content knowledge about children's mathematical thinking not only had a better understanding of the students' problem solving processes but also used better problem solving strategies than the teachers in the control group. In addition, in terms of the knowledge of number facts and problem solving, students who learned from the teachers in the experimental group performed better than students taught by teachers in the control group.

In another study, *Garet et al.* (2001) used a national probability sample of 1027 mathematics and science teachers participating in the Eisenhower Professional Development Program aimed at developing the knowledge and skills of classroom teachers. The purpose of the study was to investigate the impact of content-based professional development on teachers' knowledge. To measure the content focus, teachers were asked to indicate how much emphasis the activities in which they participated put on strengthening content knowledge in mathematics and science. Using path analysis, the study suggested that a focus on content knowledge is positively related to enhanced teachers' knowledge.

In another study, the Australian Government Quality Teacher Program (AGQTP) had four projects aimed at improving teaching skills. Using self-reported data from 3250 teachers who had participated in those projects, *Ingvarson et al.* (2005) studied the effect of content-based professional development on teachers' knowledge, practice, and efficacy. To measure the content focus, the scholars also used teachers' self-reported survey responses. The teachers indicated the extent to which professional development focused on the four aspects: content or subject knowledge, knowledge of how students learn content, knowledge of teaching content, and models to illustrate the methods to teach that content. Using block-wise regression, the scholars found that the extent to which the program focused on content was significantly associated with increased teachers' knowledge.

Reform of mathematics instruction in California also led to the implementation of content-focused professional development. *Cohen and Hill* (2000) examined the effect of this implementation on teachers' practice and student achievement. For this purpose, they used teachers' survey data from California's elementary schools and student math scores from the California Learning Assessment System (CLAS). The scholars then measured the content focus asking teachers the extent to which they participated in workshops to understand the math curriculum. Using regression analysis, they found that the number of teachers participating in workshops to learn about the math curriculum was positively related to both teachers' reform-oriented practice and students' math scores.

Smith et al. (2005) also investigated the relationship between content-focused professional development and the use of reform-oriented instruction in mathematics using 2000 National Assessment of Educational Progress (NAEP) data, which was a stratified national probability sample of eighth-grade students and their mathematics teachers. Although the NAEP sample was not designed to estimate the attributes of the US teacher population, they examined it by aggregating the student data to the teacher level. Specifically, they defined the content of pro-

fessional development as the number of hours teachers had spent in workshops for mathematics or mathematics education during the prior year. By using a Hierarchical Linear Model (HLM), they found that teachers who participated more in workshops for mathematics or mathematics education were more likely to emphasize conceptual learning goals and use conceptual teaching strategies.

Researchers have also documented the impact of content-focused professional development on student achievement through systematic literature reviews (*Kennedy, 1998; Yoon et al., 2007*). *Kennedy* (1998) reviewed studies of in-service programs meant to enhance the teaching of mathematics and science. The review revealed that the programs that focused on teachers' subject knowledge, on the curriculum, or on how students learn the subject were more likely to have positive effects on student learning than the programs that focused primarily on teachers' behavior. More recently, *Yoon and colleagues* (2007) conducted a review of the evidence of the effects of professional development on student achievement in reading, mathematics, and science. Through a comprehensive review, they found that only nine studies out of more than 1300 studies met What Works Clearinghouse (WWC) evidence standards. Moreover, all the interventions that were analyzed in these nine studies focused on enhancing teachers' subject knowledge and their pedagogical content knowledge. Four of the nine studies focused on student achievement in reading and English/language arts, two studies focused on mathematics, two on mathematics and reading and English/language arts, one on science, and one on mathematics, science, and reading and English/language arts. The results of the nine studies indicate show that providing professional development to teachers had a moderate effect on student achievement across the nine studies.

In summary, a substantial number of studies using various research methods, including correlational studies (*Cohen & Hill, 2000; Garet et al., 2001; Ingvarson et al., 2005; Smith et al., 2005*), meta-analyses (*Kennedy, 1998; Yoon et al., 2007*), and experimental studies (*Carpenter et al., 1989*) have commonly shown that content-focused professional development enhances teachers' knowledge, reforms teaching practice, or improves student learning.

Active Learning

Active learning refers to the extent to which professional development provides opportunities for teachers to be engaged in the analysis of teaching and learning (*Garet et al., 2001*). Researchers have suggested a variety of ways to promote active learning, such as observing expert teachers or being observed, reviewing students' work or thinking, scoring assessments, leading discussions, developing and presenting lessons, coaching and mentoring, or interacting with teachers to discuss steps for improving teaching practice (*Blank et al., 2008; Corcoran, 2007; Desimone, 2009; Loucks-Horsley et al., 2003*). Three correlational studies show a positive relationship between active learning through professional development and teachers' knowledge or teaching practice (*Desimone, Porter, Garet, Yoon, & Birman, 2002; Ingvarson et al., 2005*). Two studies measured the specific activities performed by the teachers as active learning (*Desimone et al., 2002; Garet et al., 2001*).

In their evaluation of the Eisenhower Professional Development Program, *Garet et al.* (2001) measured four dimensions of active learning: observing and being observed during teaching;

planning for classroom implementation; reviewing student work; and presenting, leading, and writing. The results of a path analysis showed that the extent of active learning opportunities for teachers was positively related to enhanced knowledge and skills. In addition, using a purposefully selected sample of 207 teachers in 30 schools located in 10 districts across five states, Desimone et al. (2002) examined the relationships between the features of professional development and changes in teaching practice in mathematics and science. They adapted the items that Garet et al. (2001) had used to measure active learning. By using a hierarchical linear model (HLM), they found that active learning opportunities for teachers were positively associated with teachers' technology use and higher order instruction.

The third study is different from the previous studies. In an evaluation study of AGQTP, Ingvarson et al. (2005) measured active learning by asking teachers directly whether a program in which they participated actively engaged them in reflecting on their teaching practice, in identifying specific areas of their practice that they needed to develop, and whether it gave them opportunities to test new teaching practices. Using block-wise regression, they found that active learning for teachers was positively associated with both their knowledge and teaching practice.

Coherence

Coherence refers to the extent to which professional development is consistent with other teacher learning opportunities, with teachers' knowledge and beliefs, and with school, district, and state reforms and policies (Desimone, 2011). Two empirical studies have evaluated how coherence is related to teachers' knowledge or teaching practice (Garet et al., 2001; Penuel, Fishman, Yamaguchi, & Gallagher, 2007). First, Garet et al. (2001) measured coherence by asking about three dimensions of teachers: the extent to which professional development were consistent with the teachers' goals, the degree to which these activities were aligned with state and district standards and assessments, and the extent to which the professional development promoted communication among teachers about their work. They found coherence was substantially positively related to changes in teaching practice. In addition, using a sample of 454 teachers and 28 professional development providers engaged in the GLOBE Program, which is an earth science education program, Penuel et al. (2007) examined the relationships between different characteristics of professional development and teachers' knowledge and their ability to implement the science program. They measured coherence by asking teachers the following question: How well did professional development match with both the teachers' goals for professional development and the existing reform ideas within the school? They also asked whether professional development was followed up with activities that built on what had already been learned. By using a HLM, they found that perceived coherence was positively associated with two aspects of curriculum implementation: protocol use and preparation for student inquiry.

Duration

Duration is defined as "both the number of contact hours of professional development, and the length of time over which engagement in the activity spans" (Hochberg & Desimone, 2010). Three empirical studies determined that the total number

of contact hours of professional development had a positive association with teachers' outcomes, such as attitude, preparedness, and teaching practice (Banilower, Heck, & Weiss, 2007; Heck, Banilower, Weiss, & Rosenberg, 2008; Supovitz & Turner, 2000). These three studies analyzed the Local Systemic Change (LSC) initiative, which National Science Foundation (NSF) supported teacher enhancement effort to improve instruction in science, mathematics, and technology (Banilower et al., 2007). Supovitz and Turner (2000) analyzed cross sectional data from 24 LSC science projects. They divided the total participation hours of a professional development into five time periods: 1 - 19 hours, 20 - 39 hours, 40 - 79 hours, 80 - 159 hours, and more than 160 hours. By using a HLM, they found that teachers' total participation hours in professional development was strongly linked with both inquiry-based teaching practices and an investigative classroom culture.

Unlike Supovitz and Turner (2000), the other two studies analyzed longitudinal data from 42 LSC science projects (Banilower et al., 2007) and 48 LSC math projects (Heck et al., 2008), which were implemented over a span of seven years. These studies used total participation hours in professional development. By using a HLM, both studies found that the total participation number of hours in LSC projects was positively related to teachers' attitudes, both content and pedagogical preparedness, and their classroom practices.

By analyzing the nine rigorous studies identified from the systematic review of professional development impact studies, Yoon and colleagues (2007) found that there was also a duration effect of professional development on student learning: Out of the six studies that provided sufficient contact hours of professional development, the range of 30 to 100 hours depicted a statistically significant and positive effect on student achievement gains. In contrast, the remaining three studies that provided a more limited period of time for professional development, ranging from 5 to 14 hours, showed no statistically significant effect on student learning.

Collective Participation

Collective participation refers to the extent to which multiple teachers from the same school participate in the same learning opportunities (Hochberg & Desimone, 2010). Two correlational studies found a positive association between collective participation and teaching practice (Desimone et al., 2002; Penuel et al., 2007). Desimone et al. (2002) found that professional development was more effective in changing teachers' classroom practices when it involved collective participation of teachers from the same school, department, or grade. Penuel et al. (2007) also found that teachers reported more change when participants in the professional activities engaged all teachers in the department or grade groupings, or all teachers in the school or set of schools.

Another recent review (Blank et al., 2008) analyzing the findings from 41 evaluation studies conducted on 25 professional development initiatives undertaken between 2004 and 2007 across 14 states, also found that these five features of professional development are positively associated with teaching practice and student achievement: 1) focus of content and pedagogical content knowledge on math and science; 2) active learning opportunities by coaching and mentoring through master teachers, and the use of the lesson study method for learning among teachers; 3) alignment with the school cur-

riculum; 4) long durations of 45 to 300 hours; and 5) activities with grade-level teacher teams. The results revealed that the five characteristics of effective professional development that were commonly found in all eight interventions had a measurable relationship with teaching practice and student achievement.

Relationships among Four Steps in a Synthesized Theoretical Framework

Desimone's (2009) comprehensive theoretical framework focused on four steps: 1) teachers need to experience high-quality professional development; 2) professional development increases teachers' knowledge and changes their attitudes or beliefs; 3) teachers' new knowledge, attitudes, and beliefs can change teaching practice; and 4) instructional changes increase student learning. The relationships are explained in greater detail below along with the empirical research that serves as evidence of each of the relationships.

Professional Development and Teachers' Knowledge, Attitudes, or Efficacy

Research shows a positive relationship between professional development and teachers' knowledge, attitudes, or efficacy (BaniLower et al., 2007; Borman & Rachuba, 1999; Heck et al., 2008; Penuel et al., 2007). To elaborate on the argument, two studies using LSC projects (BaniLower et al., 2007; Heck et al., 2008) investigated the relationships between professional development and teachers' attitudes and teachers' knowledge. They used teachers' self-reported survey data to measure the relations. By using a HLM, the scholars found that the total number of hours the teachers spent participating in LSC projects directly related to their attitudes towards both standards-based teaching and their perceptions of pedagogical and content preparedness. In addition, Penuel et al. (2007) examined the relationship between professional development and teachers' knowledge. They defined teachers' knowledge as teachers' knowledge of pedagogy, which includes both content knowledge and pedagogical content knowledge. They also used teachers' self-reported survey data to measure this knowledge. By using a HLM, the results indicated that teachers' perceived coherence of earth science education programs had a positive relationship with teachers' knowledge of pedagogy. Moreover, by analyzing the Prospects data, Borman and Rachuba (1999) considered teacher efficacy as teachers' outcomes of professional development. From an ANalysis of COVariance (ANCOVA), they found teachers with more professional growth opportunities had better efficacy than those with fewer professional growth opportunities.

Professional Development and Teaching Practice

Considerable research has also found a positive relationship between professional development and teaching practice (BaniLower et al., 2007; Borman & Rachuba, 1999; Desimone et al., 2002; Heck et al., 2008; Penuel et al., 2007; Smith et al., 2005; Supovitz & Turner, 2000). Using LSC projects, three studies have found that the quantity of the projects in which teachers participate is positively linked with both inquiry-based teaching practice and investigative classroom culture in math and science (BaniLower et al., 2007; Heck et al., 2008; Supovitz & Turner, 2000). In addition, using data from the 2000 National

Assessment of Educational Progress (NAEP), Smith et al. (2005) found that participation in workshops, seminars, and college classes in mathematics or mathematics education were positively related to the use of reform-oriented instruction among middle school mathematics teachers. Furthermore, using a purposefully selected sample of 207 teachers in 30 schools, Desimone et al. (2002) found that some features of teachers' professional development had an influence on teaching practice in mathematics and science. Specifically, collective participation was positively related to the use of technology; active learning was positively related to the use of both technology and higher order instructional methods, and coherence had a positive influence on the use of alternative assessments. Using the GLOBE Program data, Penuel et al. (2007) also found that two other aspects of professional development, coherence and collective participation, had a positive association with changes in teachers' instruction. Moreover, using teacher data from the congressionally mandated Prospects study of educational growth and opportunity, Borman and Rachuba (1999) found that teachers with more professional growth opportunities were more likely to implement reformed instruction. Methodologically, the empirical studies reviewed in their study also revealed a relationship between professional development and teaching practice by using a HLM (BaniLower et al., 2007; Desimone et al., 2002; Heck et al., 2008; Penuel et al., 2007; Smith et al., 2005; Supovitz & Turner, 2000) or an ANCOVA (Borman & Rachuba, 1999).

Three empirical studies investigated the paths that connect professional development, teachers' knowledge or attitudes, and teaching practice (BaniLower et al., 2007; Garet et al., 2001; Heck et al., 2008). Using path analysis, Garet et al. (2001) found that core features of the Eisenhower Professional Development Program including content focus, active learning, and coherence had a positive relationship with teachers' knowledge and skills. In addition, teachers' knowledge and skills showed a significant association with changes in teaching practice. Using a Structural Equation Model (SEM), BaniLower et al. (2007) and Heck et al. (2008) also found teacher knowledge, which was measured by perceptions of pedagogical and content preparedness, was a significant mediating variable between the extent of participation in LSC projects and reform-oriented teaching practice. Finally, these two studies found that teachers' attitudes toward standards-based teaching were important for mediating the relationship between professional development and investigative teaching practice.

Professional Development and Student Achievement

Two correlational studies (Cohen & Hill, 2000; Ingvarson et al., 2005) examined the association between professional development and student learning. Using cross sectional data from a California elementary school teachers' survey and California Learning Assessment System (CLAS) student math scores, Cohen and Hill (2000) investigated the association between teachers' participation in student curriculum workshops and changes in teachers' practice and student achievement. Using regression analysis, they found that the teachers participating in student curriculum workshops had a positive relationship with both using reform-oriented practice in class and their students' math scores. In addition, using cross sectional teachers' self-reported data from AGQTP, Ingvarson et al. (2005) examined the relationship among process aspects of

professional development, teachers' knowledge, teachers' practice, and student learning. Using a block-wise regression analysis, they found that all of the paths among the comprehensive theoretical framework were statistically significant: professional development, teachers' knowledge, teaching practice, and student achievement. However, their study was limited in measuring student achievement since student learning was only indirectly measured by teachers' self-reported survey data. Furthermore, one experimental study (Carpenter et al., 1989) also found that participation in a month-long workshop of Cognitive Guided Instruction (CGI) had positive influences on teachers' knowledge, teaching practice, and student learning. In brief, results of the empirical research have consistently supported the theoretical framework linking professional development, teachers' knowledge and attitudes, teaching practice, and student achievement either partially or comprehensively.

Contextual Factors Impacting Professional Development

Diverse contexts such as schools, districts, and communities that teachers work in can affect the result of implementation of professional development. Therefore these should also be considered when evaluating the effects of professional development (Stein, Smith, & Silver, 1999). In this regard, this study next seeks to document how the literature describes the context variables affecting the effectiveness of professional development and how empirical research has investigated the effects of contextual factors. A body of literature has described the diverse critical context factors affecting the effectiveness of professional development: 1) student characteristics (Desimone, 2009; Hochberg & Desimone, 2010); 2) teacher characteristics (Desimone, 2009; Hochberg & Desimone, 2010); 3) principal leadership (Corcoran, 2007; Guskey & Sparks, 2002; Hochberg & Desimone, 2010; Loucks-Horsley & Matsumoto, 1999); 4) school culture (Loucks-Horsley & Matsumoto, 1999; Supovitz, 2001); 5) policy related to curriculum and assessment system (Hochberg & Desimone, 2010; Loucks-Horsley & Matsumoto, 1999; Yoon et al., 2007).

Student Characteristics

Student characteristics include achievement level, ethnicity, whether a student is eligible for free reduced-price lunch, and whether the student is classified as limited English proficient (Desimone, Smith, & Ueno, 2006; Heck et al., 2008). Two empirical studies found that the percentage of students on free or reduced-price lunch was negatively related to both teachers' professional growth opportunities (Borman & Rachuba, 1999) and inquiry-based teaching practice (Supovitz & Turner, 2000). First of all, using data from the congressionally mandated Prospects study of educational growth and opportunity, Borman and Rachuba (1999) divided the percent of students eligible for free or reduced-price lunches in a school into three groups: low poverty (0% - 33%), medium poverty (34% - 66%), and high poverty (67% - 100%). Using Multivariate analyses of variance (MANOVAs), they found that the teachers from high poverty elementary schools had fewer professional growth opportunities such as participation in professional development than the teachers from low poverty elementary schools. In addition, using data from the 24 LSC initiative projects Supovitz and Turner (2000) also defined percentage of students on free or

reduced lunch as one of the context variables. By using a HLM, the researchers found schools having higher percentage of students on free or reduced lunch had a negative influence on inquiry-based teaching practice.

Teacher Characteristics

Teacher characteristics include prior experience, content knowledge, beliefs, and attitudes (Desimone, 2009). Using teachers' survey data from the 2000 NAEP, Desimone, Smith, and Ueno (2006) found the extent of teachers' content knowledge in mathematics had an influence on content-focused and sustained professional development participation. They defined the extent of teachers' content knowledge by type of degree in mathematics and mathematics education. Using multinomial logit analysis, they found that teachers who majored in mathematics or mathematics education were more likely to participate in sustained content-focused professional development than teachers who did not major in either mathematics or mathematics education.

Principal Leadership

Even though principals typically do not influence students' learning directly, their knowledge and practices indirectly affect students in their interactions with the teachers through professional support, which then help teachers use new knowledge and practice (Corcoran, 2007; Guskey & Sparks, 2002). Three empirical studies using LSC projects investigated the effect of principals' support on reform-based practice in math (Heck et al., 2008) and science (Banilower et al., 2007; Supovitz & Turner, 2000). All three studies measured teachers' perceptions of principals' support through teachers' self-reported survey responses. By using a HLM, they found that the teachers' perception of principals' support is an important predictor of reform-based teaching practice. In addition, two studies (Banilower et al., 2007; Heck et al., 2008) found that teachers' perception of principals' support had a positive influence on teachers' attitude toward standards-based teaching, perceptions of preparedness of content, and perceptions of pedagogy.

School Culture

School culture can also affect teachers' learning (Loucks-Horsley & Matsumoto, 1999). For example, in an evaluation study of AGQTP, Ingvarson et al. (2005) defined professional learning community as one of the school cultures and examined the role of it. By using a regression analysis, researchers determined that professional learning community was a critical mediating variable between professional developments and teachers' enhanced knowledge.

Curriculum or Assessment System

Curriculum is also one of the factors affecting the effectiveness of professional development (Hochberg & Desimone, 2010). Two empirical studies using LSC projects support it (Banilower et al., 2007; Heck et al., 2008). By using a SEM, both studies showed that the frequency with which the professional development program employed instructional materials that were coherent with the local curriculum was positively related to teachers' investigative practice.

Literature also suggests the case of an assessment system as a

context variable influencing the effect of professional development (Loucks-Horsley & Matsumoto, 1999; Yoon et al., 2007). In examining the potential influence of content-based professional development on students' achievement, Cohen and Hill (2000) included the California Learning Assessment System (CLAS) as a context variable. By regression analysis, the result indicated that the assessment system which was aligned with a state reform policy positively affected both teachers' reform-based practice and students' performance.

Conclusion and Implication

Based on the review of literature, the implications for researchers, policy makers and school leaders in Korea are five-fold.

First, we need to consider three ways for evaluating professional development. There were three ways for studying the potential effect of professional development. Considerable empirical research looked into the correlation between features of professional development and teachers' or students' outcomes for evaluating the effectiveness of specific programs for teacher learning (Banilower et al., 2007; Cohen & Hill, 2000; Garet et al., 2001; Heck et al., 2008; Ingvarson et al., 2005; Penuel et al., 2007; Supovitz & Turner, 2000). Carpenter et al. (1989) used experimental designs for evaluating the effectiveness of specific interventions. Some studies looked into the relationship between the features of effective professional development and teachers' outcomes using teachers' survey data from national probability samples that were designed primarily for student-level analysis (Borman & Rachuba, 1999; Smith et al., 2005) or using purposefully selected samples of teachers (Desimone et al., 2002).

Second, we need more empirical studies that investigate the relationships among professional development, teachers' knowledge, attitudes or beliefs, and teaching practice. A comprehensive theoretical framework by Desimone (2009) describes that increased teachers' knowledge or changes in their attitudes and beliefs by professional development can cause change in teaching practice. As mentioned above, considerable research has shown a relationship between professional development and teaching practice. In addition, some empirical research suggested a relationship between professional development and teachers' knowledge (Penuel et al., 2007) or efficacy (Borman & Rachuba, 1999). However, only a few empirical research studies looked into the overall path across professional development, teachers' knowledge or attitudes, and teaching practice (Banilower et al., 2007; Garet et al., 2001; Heck et al., 2008). Therefore, future research should figure out how mediating variables such as teachers' knowledge, attitude, belief, satisfaction, or efficacy work between professional development and teaching practice as mediators.

Third, context variables should be considered for professional development impact studies. Most empirical studies only included teachers' characteristics such as gender, race, teaching experience and school characteristics (such as percentage of free reduced lunch, location and size as context variables). Only a few empirical studies included additional context variables such as principals' support and curriculum materials (Banilower et al., 2007; Heck et al., 2008), the assessment system (Cohen & Hill, 2000), professional learning community (Ingvarson et al., 2005) and found their associations with outcomes. As a result, future research should include context variables

suggested by the literature and look into their impact on effectiveness of professional development. In addition, we need to study whether these core features and frameworks were effective or not in various nations that have different contexts. For example, Ingvarson et al. (2005) found core features and frameworks for evaluating professional development were also effective in Australia.

Fourth, we need to use more rigorous methodology such as randomized experimental design in professional development impact studies. For about a decade, most empirical studies for studying the effect of professional development were correlational studies (Cohen & Hill, 2000; Desimone et al., 2002; Garet et al., 2001; Ingvarson et al., 2005; Penuel et al., 2007; Smith et al., 2005; Supovitz & Turner, 2000). Correlational studies are meaningful because they explain the relationship between professional development and teachers' or students' outcomes. However, they have limitations since they do not determine a true causal effect. In this regard, experimental studies that can demonstrate causal effects are considered rigorous methodologies (Wayne et al., 2008).

Fifth, we should be careful when measuring the variables of interest. First of all, a considerable number of studies used teacher self-reported survey data for measuring teachers' knowledge (Banilower et al., 2007; Garet et al., 2001; Heck et al., 2008; Ingvarson et al., 2005; Penuel et al., 2007; Supovitz & Turner, 2000). However, it has limitations for measuring teachers' knowledge accurately because it mainly relies on teachers' perceptions. Therefore, we need to develop test instruments for measuring teachers' knowledge for future studies. Furthermore, Cohen and Hill (2000) have used standardized test scores for measuring students' achievement. However, Ingvarson et al. (2005) used teachers' reported survey responses as a proxy measure of student learning or achievement. They asked teachers whether, as a result of the professional development program, their students experienced enhanced learning. Even though the results indicated that the professional development program had a positive influence on student learning, it is less convincing because student learning was measured by teachers' perceptions. More sensitive and appropriate forms of assessment capable of capturing the types of learning the professional development program seek to promote are needed to improve research in the field.

In summary, as a practical point, policy makers and school leaders need to consider these five characteristics whether professional development reflects all these five features before implementing it. In addition, some contextual factors that have been suggested by the literature also have been supported by empirical studies as indirect factors impacting professional development. As a result, school leaders and policy makers need to regard these contextual factors for successful implementation of professional development. Moreover, policy makers and school leaders should allocate funds for teacher professional development impact studies using this comprehensive framework. Then, based on the evidence of empirical research, policy makers need to determine the implementation of professional development initiatives.

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