Exploring the Nature of Implementation of Principal Professional Development Programs: What are Mechanisms for School Change?

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This paper explores implementation of a professional development program (PDP) for school principals. Two methods for measuring fidelity of implementation of the PDP are examined: the dose of the intervention that principals received – how many sessions principals attended, and participant awareness and responsiveness – the extent to which principals used what they learned to work with teachers at their individual schools. We examine the relationship between principal attendance at a Professional Development Program (PDP) for school leaders and teacher familiarity with and participation in activities related to the PDP

The knowledge base on developing school leadership capacity is thin. While principal preparation and professional development programs are numerous, and new programs frequently appear on the scene, there is limited empirical evidence about whether and how these programs contribute to improved school leadership practice. We also lack robust empirical evidence about how school leadership practice is connected to teachers' efforts to improve their teaching and to student achievement. To address these critical gaps in knowledge, we conducted a randomized control trial to evaluate a national training model of a district-level strategy for improving student achievement by developing principals' knowledge and skills. The program is designed to develop principals' capacity to lead intensive instructional improvement efforts in their schools.

Ultimately we are interested in the main questions of the effects of school principal program participation on student achievement, and the ways in which student achievement changes in schools led by program participants. However, it is important is to begin to develop a 'theory of action' that explains the mechanisms by which principals' participation in professional development can be infused or diffused into the work of schools. Principals can decide if, when, and how to apply the principles of the PDP curriculum in their own schools.

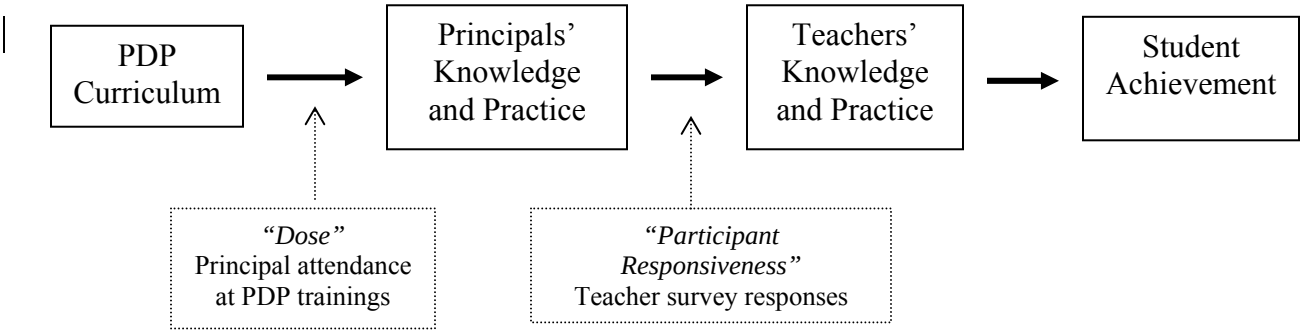
Research on the relationship between school leadership and student learning and achievement indicates that it is typically *not direct*, but rather works through a variety of mediating factors, including the school climate and opportunities for teachers to improve their instructional practices (see Bossert et al., 1982; Goldring & Pasternack, 1994; Hallinger & Heck, 1996). Principals' influence on instruction is indirect through shaping the context within which teachers teach and work. In fact, research has shown that the influence of principal leadership on student achievement is primarily through working with teachers (see Hallinger & Heck, 1996).

The conceptual framework guiding the larger study on which this paper is based posits that principal professional development will affect student achievement by first affecting school principals' knowledge and practice which will then have an impact on teachers' classroom instruction. Our framework posits a relationship between the two mediating variables of principal knowledge and principal practice and teachers' knowledge and practice as presented in Figure 1.

In terms of implementation, we hypothesize that principals who attend more of the PDP sessions, talk to their teachers about the PDP, and have teachers implement

projects related to the PDP curriculum, namely high levels of implementation, will be those principals that over time, will influence teachers' knowledge and practice and their schools will exhibit changes in student achievement.

Figure 1. PDP Theory of Action and Measures of Implementation



In this paper we begin to explore the first stage of the long-linked implementation mechanism. Our goal for this initial, exploratory analysis is to describe and explore the relationship between principal attendance at the professional development program (PDP) sessions and teacher familiarity and participation in PDP projects at the school-level. We use Dane and Schenider's (1998) concepts of dose and participant responsiveness when exploring the implementation of the PDP training program and the extent to which principals took the knowledge learned in PDP sessions and used it in their schools with teachers, respectively. Our goal is to begin to explore notions of implementation diffusion from the principal to teachers. Two main questions guided the inquiry for this study:

1. To what extent did principals attend the PDP? To what extent are teachers aware of the PDP? Do teachers participate in PDP projects? What is the variation in familiarity and participation in PDP activities? Do schools with

high percentages of teachers participating in one type of activity participate in many activities? In other words, are high implementers high in all areas?

2. What is the relationship among teacher leadership status, years of teacher experience, principal's PDP dose and teacher familiarity with and participation in PDP activities?

Concepts of implementation in two literatures contribute to our framing of the current analysis: assessing fidelity of interventions in program evaluation (e.g. Mowbray, Holter, Teague, and Bybee, 2003) and the diffusion of policies in social settings (e.g. Rogers, 2003).

Understanding Implementation

Assessing Fidelity

Five different ways of measuring fidelity in evaluations emerge from a review of the alcohol, tobacco, and other drug (ATOD) prevention research literature by Dane and Schneider (1998): adherence, dose, quality of program delivery, participant responsiveness, and program differentiation. Adherence refers to the degree to which the program provider follows the instructions, guidelines, or requirements of the intervention under study. Dose indicates the number of sessions or lessons completed or presented, including the length and intensity of each of the sessions. In the research lab, dose can be carefully controlled. In real world settings, there is a greater possibility of variation in terms of how much of the program is delivered or in terms of how many sessions a participant actually attends. Third, quality of program delivery refers to the professional skill that the providers (teacher, presenter, and so on) bring to implementing the program with participants. Depending upon the activity, the provider may need to act as a

facilitator or coach, making instantaneous decisions about the amount and type of support to provide to individual or groups of participants. Fourth, participant responsiveness highlights how participants receive the intervention program and what they do with what they have learned. Key concepts of the intervention should be easily recognizable to participants if they are responsive during the instructional time period. Finally, program differentiation refers to the unique components that differentiate one program from another. In order to compare outcomes of a program between a treatment and control group, it is necessary to identify the aspects of the intervention that reliably differentiate it from what participants in the control group are receiving. In this paper we focus on two aspects of Dane and Schneider's conception of implementation: dose and participant responsiveness.

Policy Implementation and Diffusion

Implementation is one stage in the process of program diffusion. Once a program is developed, transferring it into real world settings and sustaining it is a long-term process that requires effectively diffusing the program in complex, successive phases of dissemination, adoption, implementation, and sustainability (Durlak and DuPre, 2008). For a program to be successful, diffusion must be successful at each stage of the process.

In regard to dissemination, information does not reach all intended participants, and when it does, not everyone is motivated to adopt a new approach (adoption). Implementation involves changes in materials, structure, role/behavior, knowledge and understanding, and value internalization (Fullan and Pomfret, 1977), so it is not surprising that a host of implementation problems can emerge. Finally, maintaining the

initial efforts of the program can often be quite difficult, limiting sustainability (Rogers, 2003).

Policy diffusion in state governments can be helpful for thinking about program implementation and diffusion in education settings. Policy diffusion is generally described by two explanatory models that are not mutually exclusive: an "internal determinants model" and a "regional diffusion model" (Jensen, 2004). The internal determinants model hypothesizes that policy adoption occurs as a result of political, social or economic variables, while the regional or spatial explanation of diffusion hypothesizes that policy diffusion occurs according to spatial boundaries, and that proximity (Brown, 1981) and time (Jensen, 2004) determine adoptions.

The spatial diffusion model may be informative when considering principals' efforts (or non-efforts) to share what they had learned at the PDP with teachers in their schools. According to this model, interpersonal interaction and proximity lead to communication and learning. In state government, one theory about diffusion posits that it is dependent on the populations of the geographic regions and the distance between those regions (Clark, 1984); this concept can easily be applied to teachers within schools. – the population of the geographic region can refer to the nature of the interactions amongst teachers in a school and the beliefs, knowledge, and expertise of different teachers within a school, and the distance between those teachers – both physically and metaphorically – may contribute to the amount of diffusion that takes place around a specific program.

The contribution of time when considering diffusion is also relevant to educational contexts. Diffusion occurs over a period of time. Therefore, longer periods

of time can lead to greater diffusion – a small spatial area of diffusion can become a larger spatial area of diffusion with an increasing number of adopters (Jensen, 2004).

In this paper we conceptualize the percentage of teachers who report participating in PDP projects at each school as a measure of the principal's efforts to diffuse the knowledge and practices emphasized in the PDP training institutes. In this way, the principal's diffusion efforts are indicative of their participant responsiveness -- how they are taking what has been learned in the PDP training institutes and applying it to their school context. We are interested not only in how many or what percentage of teachers are aware of the PDP or participate in PDP-related projects at their school, but who those teachers are, and what status they hold in the school in terms of years of experience and leadership status. We are interested in how new knowledge is diffused throughout the entire school organization as a result of principal participation in – and responsiveness to – the PDP training sessions. Therefore, both concepts of measuring fidelity of implementation and the diffusion process inform our thinking and analysis.

Whether implementation is conceptualized as fidelity or as a phase in the diffusion process, measuring implementation is important for a variety of reasons. First, when there is a failure to implement the program as planned, there is the potential to incorrectly conclude that the observed findings can be attributed to the intervention (Dobson & Cook, 1980). This is commonly known as a Type III error. Second, studying fidelity of implementation helps to explain *why* interventions succeed or fail. Data can be collected about three aspects of the program: the theory, the design, and the practice. Although there always may be some variation between design and implementation, larger differences between these aspects may contribute to different degrees of implementation

fidelity (Fullan and Pomfret, 1977). Third, assessing fidelity of implementation allows researchers to identify what has been modified in the program, and speculate how that change impacts outcomes. Finally, fidelity of implementation reveals important information about the feasibility of using an intervention. According to Dusenbury, Brannigan, Falco, et al. (2003), if it is difficult to achieve fidelity of implementation in practice, then the program has low feasibility. Likewise, if the program is implemented with high fidelity but fails to produce the desired effects, it may be truly ineffective and need to be redesigned. Gathering data on implementation is the only way to make decisions about the "feasibility" of the program.

Methods

Context of the Study

This paper is part of an ongoing research project of a professional development program (PDP) for school principals. The program is a district-level strategy that is designed to improve student achievement by arming principals with the knowledge and skills needed to lead instructional improvement efforts in their schools. The PDP model posits that as a result of attending the PDP institutes and engaging in learning activities, principals gain knowledge and expertise, and as a result, implement new strategies and programs in their schools. Teachers benefit from the principal's new knowledge and expertise, and as a result, create better opportunities for student learning.

Sample

The entire sample includes 50 principals and 2027 teachers nested within those 50 schools, which represents all of the principals in the district. A sub-sample includes 28

principals with 1155 teachers nested within those 28 schools where the principal was the same for the year of the PDP intervention (2005-06) and the year that the teacher-level survey was administered (2006-07).

As can be seen in Table 1, even though all schools were located in the same urban district, there was substantial variation in their demographic characteristics. The average student enrollment for the schools was 644, though the standard deviation of 301 indicated a substantial range across schools. On average, the schools of principals had an African-American enrollment of 67 percent, although the standard deviation of 26 percent indicates a broad range of student ethnicity in schools.

Table 1: Characteristics of the Schools

Demographic Characteristic	*Mean*	*sd*
School Size	644	301
Percent Black	67 %	26 %
Percent Hispanic	3 %	4 %
Percent Free/Reduced Lunch	59 %	21 %

Data Sources

Two sources of data were utilized for this study. First, attendance data was collected for each of the eleven PDP institutes that were offered between June 2005 and March 2006. The number of institutes that principals attended, or the "dose" of the intervention that they received ranged from a minimum of 0 sessions to a maximum of 11 sessions. Principals who were members of the district-level leadership team and were trained by the PDP developers to be principal trainers attended all 11 sessions, and although their knowledge-based was likely greater than those principals who received a dose of 11, to be conservative, these principals were also assigned a dose of 11. The

second data source was a survey administered to teachers at all schools in the district in the Spring of 2007 (n = 2027; 78 percent response rate). Nine questions on this comprehensive survey were relevant to the research questions for this study, and asked about teacher familiarity and participation in projects or discussions related to specific aspects of the PDP. Table 2 presents the text of the nine questions along with their variable names.

Table 2. Variables and descriptions

Variable	*Question as it appeared in the Spring 2007 questionnaire*
AWARE	Are you aware of the Professional Development Program (PDP)?
TALK	How many times has your principal talked to you about the PDP? (collapsed into binary 0 = never, 1 = one or more times)
DOMATH	Did your principal ask you to participate in any projects or discussions related to mathematics?
DORDG	Did your principal ask you to participate in any projects or discussions related to reading?
DODBD	Did your principal ask you to participate in any projects or discussions related to data-based decision making?
DOPLC	Did your principal ask you to participate in any projects or discussions related professional learning communities?
DOACTPLN	Did your principal ask you to participate in any projects or discussions related to action planning?
DOSBR	Did your principal ask you to participate in any projects or discussions related to standards based reform?
DOCOACH	Did your principal ask you to participate in any projects or discussions related to coaching?

In the analyses described here, we focus on two ways of measuring implementation of the PDP program – dose and participant responsiveness (Dane and Schneider, 1998) – while also considering implementation as a phase in the diffusion process (Rogers, 2003). We define dose as the number of PDP sessions attended by principals during the course of a 10-month period when 11 sessions were offered, and

participant responsiveness as the way in which principals convey the information that they learned during the PDP sessions to the teachers at their school.

Participant responsiveness is measured by teacher survey responses organized in three increasing levels of engagement: first, teacher awareness about the PDP, second, whether the principal had talked with teachers about the PDP, and third, teacher participation in projects or discussions related to seven key aspects of the PDP curriculum (mathematics instruction, reading instruction, data-based decision making, professional learning communities, action planning, professional learning communities, and coaching). We consider the diffusion process in terms of which teachers in the schools indicated that they were aware, had talked about, or had participated in PDP activities. We believe that both conceptualizations of implementation are relevant and necessary to take into account when evaluating the success of an intervention that is designed to provide participants with the knowledge and skills to take what has been learned and apply it in an organizational context.

Analytic Approach

To answer the research questions described above, we conducted descriptive analyses and employed hierarchical linear modeling (HLM) methods of analysis (Bryk and Raudenbush, 1992). Specific models, procedures, and results are described in detail in the next section.

For the HLM analyses we reduced the original dataset to only include data from schools that had the same principal from the 2005-06 to 2006-07 school year. Although teacher and principal-level baseline data was collected in Spring 2005, the professional development intervention was not delivered until June 2005. The teacher survey was

administered in Spring 2007. Therefore, to examine any relationship between principal PDP participation and teacher PDP familiarity or participation in projects, including only those principals who were at the same school for the two years of data collection was necessary. We also examined whether any schools had a change in principals within our sample where principals had varying dose levels (for example, one principal one year had a dose of 0 and then another principal the second year had a dose of 3) so that different principal attendance rates may have contributed to teacher responses. There were no such instances in our data, so cross classified models were not necessary. The final sample for the non-descriptive analyses was reduced from 2027 teachers nested within 50 schools to 1155 teachers nested within 28 schools.

Results

The first question regarding program implementation is a question of dose—in other words, how many sessions did the principals attend?. Principals, on average, did not attend many of the professional development sessions. Simply in terms of dose, we note the low attendance rates and the relatively large standard deviations for both samples used for the analyses. The descriptive statistics are presented in Table 3.

Table 3. Descriptive statistics for the attendance variable: "DOSE" for the full sample and sub-sample

Sample	*n*	*Mean*	*sd*	*Minimum*	*Maximum*
Full Sample	50	3.16	4.49	0	11
Sub-Sample	28	4.18	4.88	0	11

More specifically, for the full sample, 30 principals attended 0 PDP training sessions, 1 principal attended 1-2 sessions, 5 attended 3-5 sessions, 3 attended 6-8 sessions, 3 attended 9-10 sessions, and 8 attended 11 sessions. In the sub-sample of 28 principals,

15 principals attended 0 PDP sessions, 0 attended 1-2 sessions, 2 attended 3-5 sessions, 3 attended 6-8 sessions, 2 attended 9-10 sessions, and 6 attended 11 sessions.

As mentioned previously, we are interested in exploring the relationship between implementation of the professional development program (PDP) and teacher familiarity and participation in PDP activities at the school-level. Because one of the goals of the PDP was for principals to take what they had learned back to their schools and implement activities with teachers, we used responses from the teacher survey and principal attendance data at PDP sessions for this analysis. The fist question we explored is to what extent were teachers in the district aware of the PDP. On average, 29% of all teachers were aware of the PDP, while 17% of teachers had a principal who had talked with them about the PDP. Furthermore, only 4-14% of teachers had participated in a project related to a specific PDP curriculum area, ranging from 4% working on or discussing coaching to 14% working on or discussing professional learning communities. These projects relate to the key curriculum strands of the PDP. Descriptive statistics for all of the individual level teacher results are presented in Table 4.

Table 4. Descriptive Statistics for Individual Teacher Results

Variable	*n*	*Mean*	*sd*	*Minimum*	*Maximum*
AWARE	2004	0.29	0.45	0	1
TALK	1945	0.17	0.37	0	1
DOMATH	2027	0.05	0.20	0	1
DORDG	2027	0.05	0.24	0	1
DODBD	2027	0.11	0.32	0	1
DOPLC	2027	0.14	0.35	0	1
DOACTPLN	2027	0.08	0.28	0	1
DOSBR	2027	0.10	0.30	0	1
DOCOACH	2027	0.04	0.22	0	1

We note that the highest percentage of teachers were aware of PDP, followed by the percentage of teachers who indicated their principal had spoken with them about PDP. Teachers participated in implementation projects related to professional learning communities, data-based decision making, and standards-based reform more than other curriculum areas. Interestingly, of those teachers who reported they were aware of PDP, only 47% also indicated their principals had talked to them about the PDP. It seems therefore, that teachers became aware of PDP from other sources, beyond the principal, such as district officials, other principals beyond their own principal, and other educators or teachers.

Because the theory of action suggests that principals work with their teachers in their schools, we were primarily interested in school-level implementation; individual level responses to teachers would not indicate whether implementation was occurring at the school level. In other words, we do not know from the simple percentages if the teachers who are aware of the PDP program are from a very small number of schools or spread out across schools in the district. To that end, we aggregated responses calculating the percentage of teachers in each school to understand whether they were engaged with PDP. While we would expect that widespread diffusion would mean that large numbers of teachers in a school would be aware of PDP, we certainly do not believe that all teachers would be involved in PDP project implementation. We found that the average school had 30% of their teachers responding that they were aware of PDP, while 16% of teachers reported that the principal had talked with them about PDP, and a range of 5%-15% of teachers reporting participating in PDP projects. These results of aggregating responses to the school level appear in Table 5 below.

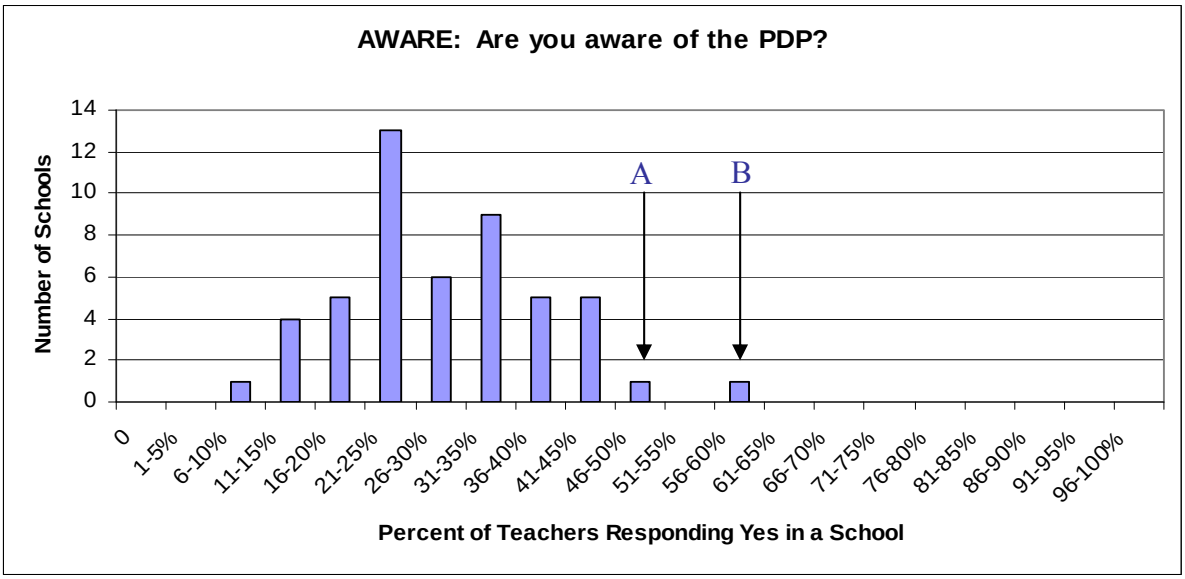
Table 5. Percentage of teachers at each school responding yes to each of nine implementation questions

Variable	*n*	*Mean*	*sd*	*Minimum*	*Maximum*
AWAREpctyes	50	0.30	0.12	0.10	0.84
TALKpctyes	50	0.16	0.12	0	0.53
DOMATHpctyes	50	0.05	0.04	0	0.22
DORDGpctyes	50	0.06	0.04	0	0.19
DODBDpctyes	50	0.12	0.06	0	0.29
DOPLCpctyes	50	0.15	0.07	0	0.36
DOACTPLNpctyes	50	0.09	0.06	0	0.31
DOSBRpctyes	50	0.11	0.06	0	0.32
DOCOACHpctyes	50	0.05	0.05	0	0.17

The large variation in teacher awareness and participation in PDP across schools is of interest. While we would expect large numbers of teachers to be aware of the PDP and have principals who have to talked to them about it, if implementation is being diffused, it is unclear what numbers of teachers would be expected to work on projects—what is a threshold of implementation diffusion within a school? Would a principal work with a small number of key teacher leaders first to try out new things? At this point we are merely describing patterns, without making judgments regarding amount and level of implementation

The following nine bar graphs (Figures 2-10) present the distribution of school level teacher responses, and identify schools that have a high percentage of teachers who report they are both aware of and engaged in PDP projects (see Table in the Appendix as well).

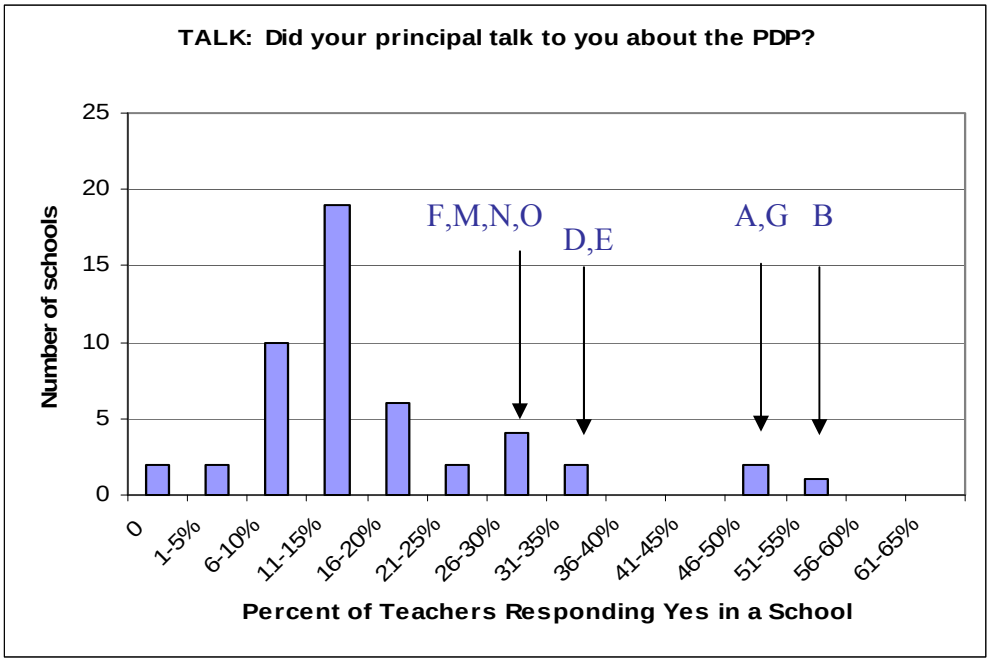
Figure 2. Distribution of school percentage of teachers responding yes to AWARE



We note from Figure 2 that two schools: A and B have a very high percentage of teachers aware of PDP. Obviously, teachers can be aware of PDP not from their principals but from districts sources, other teachers, announcements, as mentioned above.

In the next figure we present the percentage of teachers indicating their principals have talked to them about PDP. We note that in addition to school A and B, whose teachers said their principals talked with them about PDP *and* had high percentages of teachers said they were aware of PDP, another nine schools had large percentages of teachers indicate their principals had spoken with them about PDP.

Figure 3. Distribution of school percentage of teachers responding yes to TALK



However, as indicated in the next set or figures, being aware of PDP and talking with their principals about PDP does not necessarily mean that teachers are working on projects related to PDP. Schools A and B consistently have many teachers who are working on a number of project areas related to the PDP curriculum, while other schools, such as J are working on projects in two areas, and L and M and school K have high percentages of teachers working on one project area.

Figure 4. Distribution of school percentage of teachers responding yes to DOMATH.

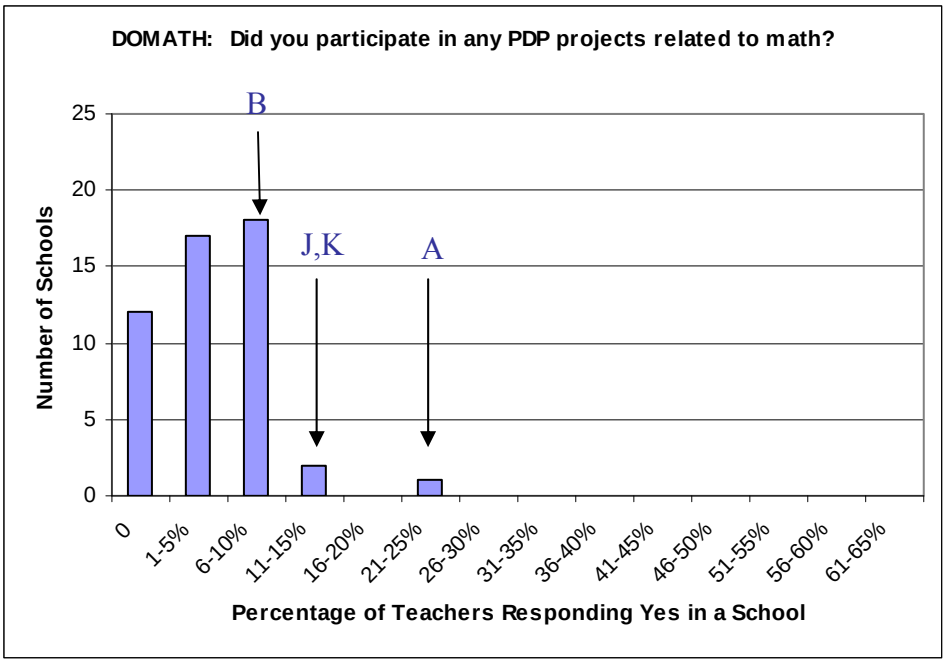


Figure 5. Distribution of school percentage of teachers responding yes to DORDG.

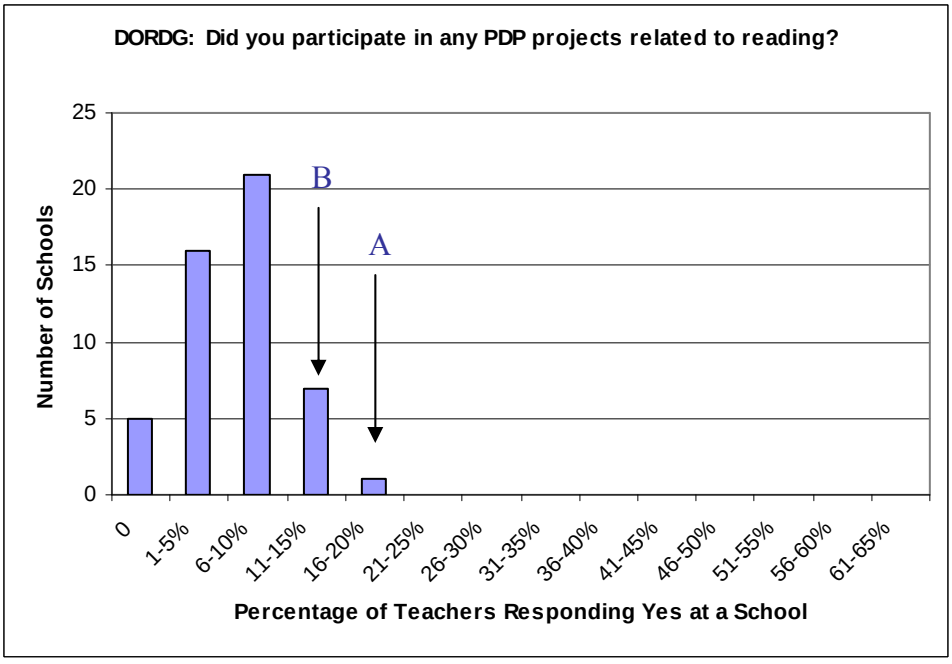


Figure 6. Distribution of school percentage of teachers responding yes to DODBD.

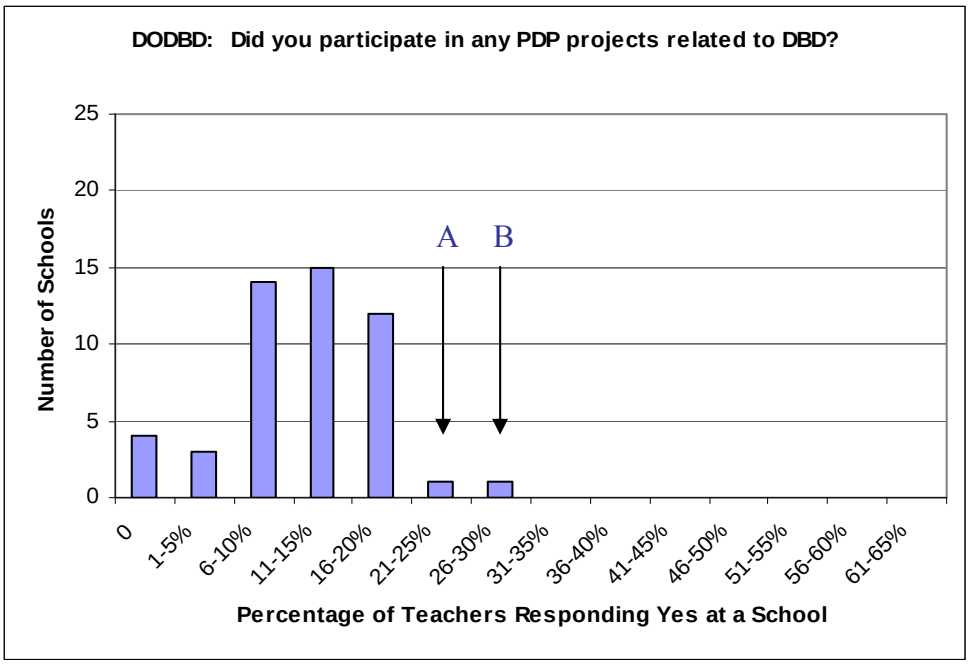


Figure 7. Distribution of school percentage of teachers responding yes to DOPLC.

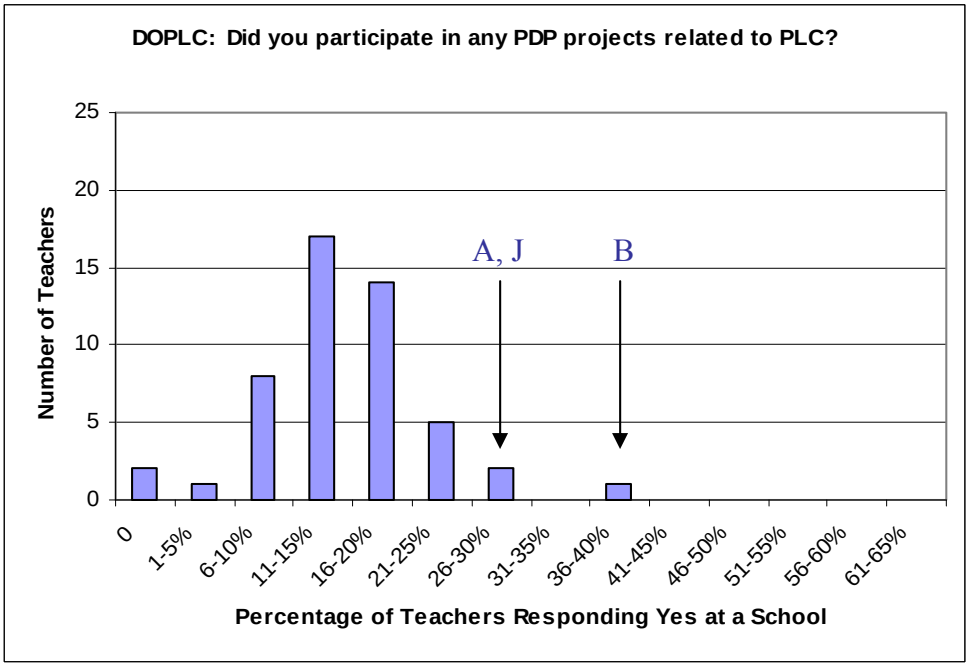


Figure 8. Distribution of school percentage of teachers responding yes to DOACTPLN.

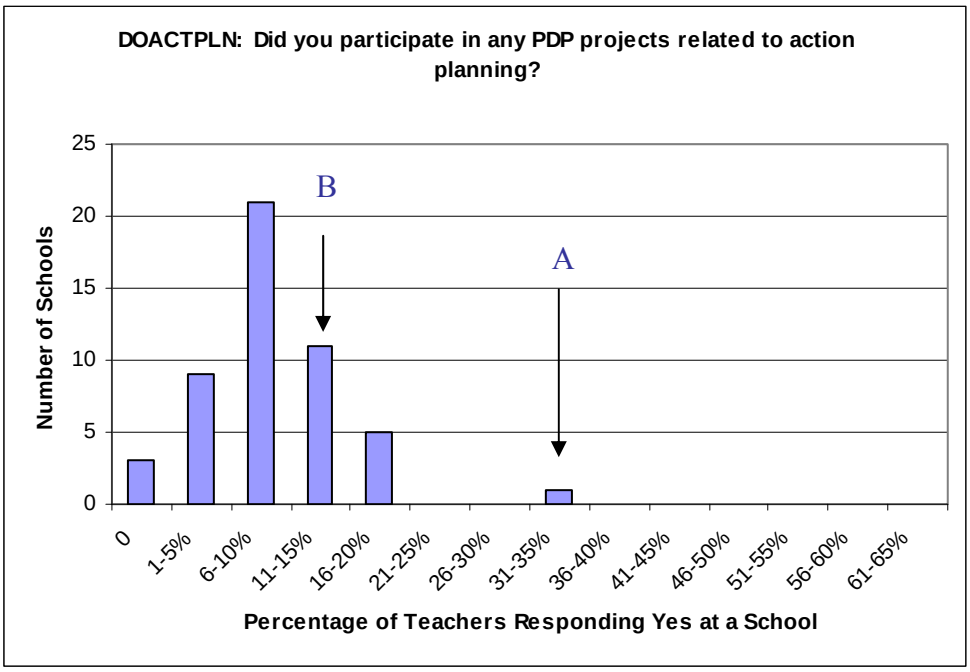


Figure 9. Distribution of school percentage of teachers responding yes to DOSBR.

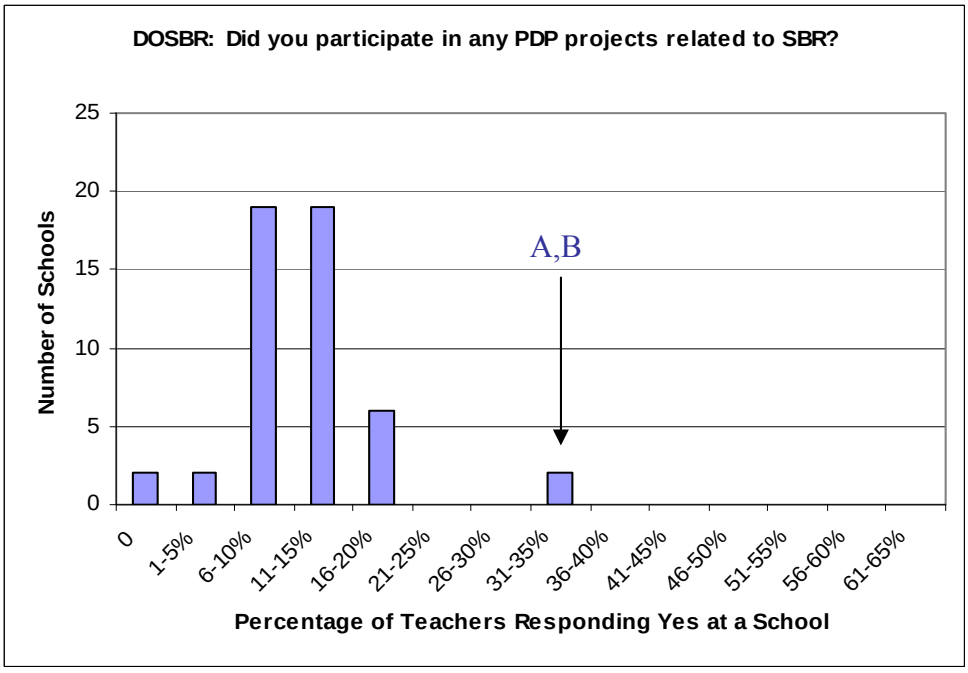
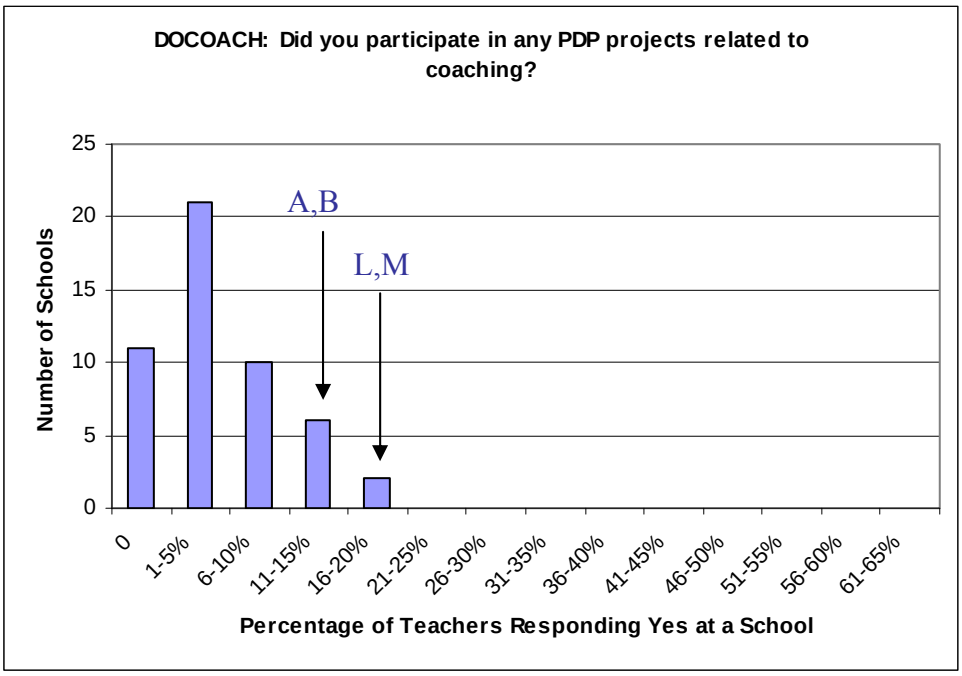


Figure 10. Distribution of school percentage of teachers responding yes to DOCOACH.



In sum, we note variability in the district in regards to implementation; many schools are not aware of nor working on any project related to PDP, while two schools are highly engaged in PDP activities. Five schools seemed to pick certain project areas. We cannot say whether 6-10% of teachers participating in projects indicates 'good' implementation levels or not. Perhaps having a few teachers engage and learn is a very efficient and effective way of piloting and trying out new leanings and new ideas.[1]

Relationship between Dose and Responsiveness

To extend the analyses further, we examined the relationship between the number of sessions each principal attended (dose) and teacher responsiveness and participation in PDP projects. First, we were curious about the characteristics of principals at schools A

[1] Subsequent analyses will begin to explore the relationships between these levels of project engagement and school outcomes, such as changes in teaching and learning.

and B reporting higher percentages of participation. The principal at School A was a trainer, and the principal at School B attended 11 sessions of the PDP institutes.

Teachers are nested within schools, so hierarchical linear modeling was required to explore the nature of the relationships between dose and responsiveness. We considered nine outcome variables, representing the nine different questions teachers responded to on the Spring 2007 teacher questionnaire (described in Table 3), along with two other variables of interest. We hypothesized that principals would be more likely to work with teacher leaders and more experienced teachers as a mechanism to begin to implement what they were learning in PDP. Thus we analyzed two variables: LEADER (1 if formally assigned to a leadership role in the school; 0 if not) and YRSEXP (continuous variable indicating the number of years of overall teaching experience). Thirty-one percent of the teachers in our sample were assigned to a formal school-level leadership role, and the average number of years of experience was 14 years. One school-level (level-2) variable was included – the number of professional development sessions that the principal attended (DOSE). The maximum number of sessions was 11. Principals who were trained to be session trainers rather than participants were assigned a dose of 11. All others were assigned a dose that corresponded to the number of sessions attended. The full set of descriptive statistics for the data set used for the HLM analyses are presented in Table 6. Note in these analyses we used the sub sample of schools where the principal was the same for the year of the PDP intervention (2005-06) and the year that the teacher-level survey was administered (2006-07).

Table 6. Descriptive Statistics for Reduced Sample (Same Principal 05-06 to 06-07)

Level- 1 Descriptive Statistics					
Variable Name	*n*	*Mean*	*sd*	*Minimum*	*Maximum*
Outcome Variables:					
AWARE	1155	0.32	0.46	0	1
TALK	1107	0.19	0.39	0	1
DOMATH	1155	0.06	0.23	0	1
DORDG	1155	0.07	0.26	0	1
DODBD	1155	0.12	0.32	0	1
DOPLC	1155	0.15	0.36	0	1
DOACTPLN	1155	0.09	0.28	0	1
DOSBR	1155	0.11	0.32	0	1
DOCOACH	1155	0.05	0.21	0	1
Level-1 Predictors:					
LEADER	1131	0.31	0.46	0	1
YRSEXP	1119	14.03	9.73	0	44
Level-2 Descriptive Statistics					
Variable Name	*n*	*Mean*	*sd*	*Minimum*	*Maximum*
DOSE	28	4.18	4.88	0	11

Unconditional Models

To gauge the magnitude of variation between schools for each of the outcome variables, we began by estimating a model with no predictors at either level. Given a Bernoulli sampling model (outcome data are in the form 0,1) and a logit link function, the level-1 model is:

$$\eta_{ij} = \beta_{0j}$$

and the level-2 model is

$$\beta_{0j} = \gamma_{00} + \mu_{0j}, \;\; \mu_{0j} \sim N(0, \tau_{00})$$

Here, γ_{00} is the average log-odds of responding yes on the outcome variable, while τ_{00} is the variance between schools in school-average log-odds of responding yes on the

outcome variable. For the first outcome variable AWARE, the estimated results are γ_{00} = -0.76 (se = 0.08), τ_{00} = 0.23 (se = 0.05). Thus, for a school with a "typical" level of awareness (random effect $u_{0j} = 0$), the expected log-odds of being aware of PDP is -0.76, which corresponds to an odds of exp{-0.76} = 0.468. This corresponds to a probability of 1/(1 + exp-{-0.76}) = 0.32 to answer yes to the outcome variable AWARE.

This "typical" probability, associated with a school-level random effect of 0, is considerably larger than the population average of 32% responding yes. This difference is due to the nonlinear relationship between η_{ij} , the log-odds of answering yes, and φ_{ij}, the probability of answering yes. The upper and lower limits of the 95% prediction interval for η_{ij} are symmetric around the mean of -0.76, but the corresponding interval for the probability is not symmetric around the corresponding value of $\varphi = 0.468$ (Raudenbush and Bryk, 2002).

Assuming the schools' log-odds of answering AWARE positively, β_{0j}, to be approximately normally distributed with mean -0.76 and variance τ_{00} = 0.05, we would expect about 95% of the schools in our sample to have values of β_{0j} between $-0.76 \pm 1.96 * \sqrt{0.23} = (-1.24, -0.28)$. Converting these log-odds to probabilities, 95% of schools lie between (0.15, 0.55) with respect to the probability of answering yes to being aware of the PDP program. Full results of the unconditional model for the outcome AWARE and the other outcome variables are reported in Table 7 below.

Table 7. Results of unconditional models

	Average log odds (γ_{00})	Variance (τ_{00})	Odds ratio for "typical" school	Probability of answering yes for typical school	Lower Bound (prob)	Upper Bound (prob)
Outcome						
AWARE	-0.76	0.23	0.468	0.319	0.154	0.545
	(0.08)	(0.05)				
TALK	-1.3	0.68	0.273	0.214	0.051	0.578
	(0.15)	(0.46)				
DOMATH	-2.89	0.53	0.056	0.053	0.013	0.188
	(0.16)	(0.29)				
DORDG	-2.58	0.27	0.076	0.070	0.027	0.173
	(0.12)	(0.08)				
DODBD	-2.01	0.35	0.134	0.118	0.040	0.299
	(0.11)	(0.12)				
DOPLC	-1.77	0.35	0.170	0.146	0.051	0.352
	(0.11)	(0.13)				
DOACTPLN	-2.37	0.45	0.093	0.085	0.024	0.258
	(0.13)	(0.20)				
DOSBR	-2.08	0.4	0.125	0.111	0.035	0.301
	(0.12)	(0.17)				
DOCOACH	-3.07	0.57	0.046	0.044	0.010	0.169
	(0.18)	(0.33)				

Table 7 shows that although the highest confidence intervals for probabilities for answering yes are for the questions asking about PDP awareness (AWARE: 0.15, 0.55) and whether your principal talked with you about PDP (TALK: 0.05, 0.58), there are also variations between schools for the remaining seven questions that focused on doing a project related to different aspects of the PDP curriculum. 95% of schools lie between (0.01, 0.19) for probability of doing a project related to math, between (0.03, 0.17) for reading, between (0.04, 0.30) for data-based decision making, between (0.05, 0.35) for professional learning communities, between (0.02, 0.26) for action planning, between (0.04, 0.30) for standards-based reform, and between (0.01, 0.17) for coaching.

Conditional Models

We hypothesized that higher probability of participating in PDP projects would be associated at level-1 with the teacher's number of years of experience teaching and the teacher's status as a school-level leader, and at level-2 with the amount of "dose" of the professional development intervention that the principal received. We predicted that leaders and teachers with more years of experience would have higher probabilities of familiarity and participation with PDP, and that higher levels of principal attendance at PDP sessions would also predict higher rates of PDP familiarity and project participation for teachers. The level-1 structured model is:

$$\eta_{ij} = \beta_{0j} + \beta_{1j}\,(\text{LEADER})_{ij} + \beta_{2j}\,(\text{YRSEXP})_{ij}\,,$$

where YRSEXP is grand-mean centered and LEADER remains in its dummy variable matrix. At level-2, we model β_{0j} as a function of the level-2 predictor DOSE left uncentered, since interpreting a dose of 0 is of interest to the analysis. We viewed the other level-1 coefficients as fixed, that is, the effect of being a leader and years of experience would be the same across schools:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\,(\text{DOSE}) + \mu_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}\,.$$

Table 8 displays the results of the unit-specific HLM model in log-odds.

Table 8. Results for each of the nine outcomes, reported in log-odds

	Outcomes (Unit-specific model with robust standard errors, reported in log-odds)								
	Model 1: AWARE	*Model 2: TALK*	*Model 3: DOMATH*	*Model 4: DORDG*	*Model 5: DODBD*	*Model 6: DOPLC*	*Model 7: DOACTPLN*	*Model 8: DOSBR*	*Model 9: DOCOACH*
Fixed effects									
INTERCEPT, β_{0j}									
INTERCEPT, γ_{00}	-1.17***	-1.90***	-3.44***	-3.04***	-2.39***	-2.04***	-2.80***	-2.48***	-3.80***
	(0.13)	(0.19)	(0.27)	(0.21)	(0.17)	(0.16)	(0.16)	(0.13)	(0.29)
DOSE, γ_{01}	0.03	0.06*	0.05	0.04	0.03	0.02	0.03	0.03	0.03
	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
LEADER, β_{1j}									
INTERCEPT, γ_{10}	0.71***	0.31	0.80**	0.58*	0.56*	0.41*	0.57*	0.42	1.04*
	(0.14)	(0.24)	(0.27)	(0.24)	(0.22)	(0.18)	(0.28)	(0.33)	(0.40)
YRSEXP, β_{2j}									
INTERCEPT, γ_{20}	0.04***	0.02	0.02	0.03**	0.02	0.03**	0.03**	0.05***	0.04**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Variance component									
τ	0.26*	0.55***	0.49	0.23	0.37*	0.36*	0.45*	0.39*	0.55
	(0.07)	(0.36)	(0.24)	(0.05)	(0.14)	(0.13)	(0.21)	(0.15)	(0.30)

*Indicates p <0.05, ** Indicates p <0.01, *** Indicates p < 0.001.

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Nine different models have been estimated and reported in Table 8. In each of the nine models, the level-1 and level-2 predictors have remained the same, and appear in the far left column. The remaining 9 columns report the coefficients for each of the fixed effects in the model for each of the 9 different outcomes.

Aware: For the first model with the outcome variable AWARE, for example, we see an intercept of – 1.17 log odds, which calculates to a probability of 0.24 (1/(1+exp{-log odds ratio}). Thus, the predicted probability of answering yes to the question "Are you aware of PDP?" for a participant at an average school with the average number of years of experience, who is not a school-wide leader (LEADER = 0) and whose principal did not attend any PDP training sessions (DOSE = 0) is 0.24. In other words, on average, a teacher completing the survey at a "typical" school who is not a leader and whose principal did not attend any PDP sessions with 14 years of experience (the grand mean for the sample) has a 0.24 probability of answering yes to the question: Are you aware of the professional development program for principals?

The level-2 predictor of DOSE is not significant in the model regarding teacher awareness of PDP. There is no relationship between the number of sessions that principals in this sample attended and whether or not their teachers were aware of the PDP program. However, being a school-level leader is associated with an increase in awareness in the log-odds ratio: -1.17 + 0.71 = -0.46, which corresponds to a probability of 0.39. That is, on average, if the teacher completing the survey at a "typical" school has 14 years of experience and the principal did not attend any PDP sessions, but was a leader at her school, the probability of answering yes to AWARE increases from 0.24 to 0.39. Model 1 also suggests that the number of years of experience is associated with an

increase in teachers reporting awareness of the PDP. On average, controlling for leadership status, dose, and the random effect of school, a one year increase in years of experience is associated with a 0.06 log-odds (or approximately 0.01) increase in probability of responding yes to AWARE.

Talk: In terms of whether principals talked to teachers about PDP, the estimated intercept is -1.90 log odds, or a probability of xx of answering yes for a non school-level leader with the average number of years of experience and DOSE = 0. In this model, after controlling for predictors and the random effect of school, leadership status nor years of experience changes the probability of answering yes to the question of whether principals talked to teachers about PDP.

In model 2, principal attendance at PDP sessions (DOSE), has a significant relationship with whether or not the principal talked to teachers about PDP. The effect of a one-unit change in dose on the overall probability of answering yes is very small and does not change the predicted probability after controlling for leadership status, additional years of experience, and the random effect of school (u_{0j}): -1.69 + 0.06 = -1.63 log odds or a corresponding probability of 0.16. However, the effect gets larger as the dose gets higher. On average, controlling for leadership status, years of experience, and the random effect of classroom, attending 0 PDP sessions is associated with a 0.16 probability that teachers will respond that their principal talked with them about PDP. Controlling for the same predictors, if a principal attended 11 PDP sessions, the average probability of teachers reporting that their principal talked with them about PDP increases to 0.26. In short, on average, as principals attended more PDP sessions, teachers were

more likely to report that principals had talked with them about PDP. Table 9 displays the full results.

Table 9. Probability of answering yes to TALK for each level of DOSE after controlling for predictors and the random effect of school.

Level of Dose	*Log-odds ratio*	*Probability*
0	-1.90	0.13
1	-1.84	0.14
2	-1.78	0.14
3	-1.72	0.15
4	-1.66	0.16
5	-1.60	0.17
6	-1.54	0.18
7	-1.49	0.18
8	-1.43	0.19
9	-1.37	0.20
10	-1.31	0.21
11	-1.25	0.22

Projects: Next we looked at the relationships among principal dose in PDP, teacher leadership role, and years of experience on project participation related to PDP. In Table 8, we see that leadership status has a significant relationship with models where the outcome variable is: DOMATH, DRDG, DODBD, DOPLC, DOACTPLN, and DOCOACH and years of experience has a significant relationship with models where the outcome variable is: DORDG, DOPLC, DOACTPLN, DOBR, and DOCOACH after controlling for the other predictor variables and the random effect of school.

We'll first consider the relationship between leadership status and the seven project-specific outcomes. Table 10 displays the log-odds ratio and corresponding probabilities of responding yes to each of the seven outcomes relating specifically to participating or discussing projects related to PDP. We can see that the probability of responding yes for non-leaders ranges from 0.02 for doing or discussing a project related to coaching (DOCOACH) to 0.12 for doing or discussing a project related to professional learning

communities (DOPLC). For all of the models where leadership is significant (all except model 8 related to standards-based reform), being a leader increases the probability of responding yes to the survey questions, after controlling for years of experience, dose, and the random effect of school. The results now range from a probability of 0.06 to report doing or discussing a PDP project related to coaching to a probability of 0.16 for doing or discussing a project related to professional learning communities. For each of the outcome variables, where the coefficient for LEADER is statistically significant, the changes in probabilities are small, but suggest that leaders may have been the first teachers in the school that principals looked to for diffusing new ideas as a result of the PDP training sessions.

Table 10. Log-odds Ratios and Probabilities for LEADER after controlling for years of experience, dose, and the random effect of school

Project Outcome Variable	*Log-odds ratio for Non-leader*	*Log-odds ratio for Leader*	*Probability for Non-leader*	*Probability for Leader*
3: DOMATH	-3.44	-3.44 + 0.80 = -2.64	0.03	0.07
4: DORDG	-3.04	-3.04 + 0.58 = -2.46	0.05	0.08
5: DODBD	-2.39	-2.39 + 0.56 = -1.83	0.08	0.14
6: DOPLC	-2.04	-2.04 + 0.41 = -1.63	0.12	0.16
7: DOACTPLN	-2.80	-2.80 + 0.57 = -2.23	0.06	0.10
8: DOSBR	-2.48	-2.48 + 0.00 = -2.48~	0.08	0.08
9: DOCOACH	-3.80	-3.80 + 1.04 = -2.76	0.02	0.06

~ The estimate for LEADER was not significant in model 8, therefore, the log-odds for non-leader and leader are identical.

In short, leadership status slightly increases the probability of responding yes to the seven project-related outcome variables.

Years of experience also has a significant relationship with the project-related outcome variables. Table 11 displays the estimated values for each of the level-1 predictors for the 7 models in probability form. The intercept in column *a* provides the

average probabilities of responding yes to the outcome variable for a non-leader with the average years of experience with no PDP participation (DOSE = 0), after controlling for the predictors and the random effect of school. Column *b* reports the probability of answering yes to the outcome variable for leaders, controlling for leadership status, dose, and the random effect of school. Columns *c* and *d* display the change in probability of answering yes as the years of experience of the respondent increases.

Table 11. Estimated probabilities for YRSEXP after controlling for all other predictors and random effect of school

Model	*(a) Intercept*	*(b)Years of exp =5*	*(c) Years of exp = 10*	*(d) Years of exp =20*
3: DOMATH	0.03	0.03~	0.03~	0.03~
4: DORDG	0.05	0.05	0.06	0.08
5: DODBD	0.08	0.08~	0.08~	0.08~
6: DOPLC	0.12	0.13	0.15	0.19
7: DOACTPLN	0.06	0.06	0.08	0.10
8: DOSBR	0.08	0.09	0.12	0.19
9: DOCOACH	0.02	0.03	0.03	0.05

~The estimate for YEARSEXP for Models 3 and 5 is not significant. Therefore, there is no change in the probability of responding yes to the outcome when years of experience increases to 5, 10, and 20 years.

The results show us that small increases in probability of response are associated with increased years of experience. The difference is not as large as with the results for leadership status, but the results suggest a positive trend in the relationship between years of experience and increasing probability of doing or discussing projects related to the PDP.

In sum, the highest average probabilities of positive response are for model 1 (AWARE), followed by model 2 (TALK), and then by all of the models indicating action on some kind of project related to PDP. The number of sessions that principals attended was only significant for the outcome variable TALK (model 2 results presented in table 10). Two interesting findings are related to the seven outcomes related to doing or discussing projects related to the PDP. We found that a teacher's leadership status within

the school increased the probability of responding yes to doing or discussing PDP projects related to math, reading, data-based decision making, professional learning communities, action planning, and coaching. The only project outcome variable with a non-significant relationship with leadership status was doing or discussing standards based reform (DOSBR). This may be due to a higher likelihood that all teachers in the school (not just leaders) were involved in discussions or projects related to standards based reform.

Similarly, we found that teachers with additional years of experience were more likely to respond that they participated in PDP projects related to reading, professional learning communities, action planning, standards based reform, and coaching. We must interpret these two sets of findings with some caution due to the possibility of a relationship between higher years of experience and teacher leadership status, but it does suggest that school-level leaders and/or more experienced teachers were more likely to be involved in principals' initial school-level efforts to implement topics learned during PDP.

Further Exploration

We initially hypothesized that principal attendance at PDP sessions (DOSE) would be related to teacher survey responses on measures of familiarity and project participation. The teacher survey responses are conceptualized as a measure of principal participant responsiveness as well as an indication of principals' efforts to diffuse the ideas and activities that are central ideas in the PDP curriculum to teachers throughout the school. Our results show that DOSE is not significantly related to any of the outcome variables except TALK, however. In an attempt to explain these findings, we then

considered whether TALK was the mediating factor in the model rather than DOSE. That is, is there a relationship between teachers reporting that the principal talked with them about PDP and teacher participation in PDP projects after controlling for leadership status, years of experience, and the random effect of school? If attending sessions (DOSE) is not related to doing projects, is whether the principal talked about PDP with teachers the implementation mechanism?

To examine this new idea, we analyzed seven additional HLM models with each of the project-specific survey questions as each of the seven outcome variables, and using three level-1 predictors: LEADER, inserted in its original dummy-coded metric, YRSEXP, included in the model grand-mean centered, and TALK, the outcome variable for Model 2, now included as a level-1 predictor in its original dummy-coded metric. TALK was a significant predictor of the project-related outcome variables for professional learning communities, action planning, standards-based reform, and coaching (models 13-16). Table 12 presents the results of the seven models in log-odds ratios and Table 13 translates the results of the logit models into probabilities for easier interpretation.

Table 12. Results for each of the seven project-related outcomes, with TALK included as a level-1 predictor

	Outcomes (Unit-specific model with robust standard errors, reported in log-odds)						
	Model 10: DOMATH	*Model 11: DORDG*	*Model 12: DODBD*	*Model 13: DOPLC*	*Model 14: DOACTPLN*	*Model 15: DOSBR*	*Model 16: DOCOACH*
Fixed effects							
INTERCEPT, β_{0j}							
INTERCEPT, γ_{00}	-3.33*** (0.23)	-2.91*** (0.20)	-2.35*** (0.17)	-2.07*** (0.15)	-2.83*** (0.18)	-2.49*** (0.14)	-3.92*** (0.36)
LEADER, β_{1j}							
INTERCEPT, γ_{10}	0.78** (0.27)	0.63* (0.25)	0.58* (0.22)	0.39 (0.22)	0.58* (0.28)	0.43 (0.23)	1.01* (0.41)
YRSEXP, β_{2j}							
INTERCEPT, γ_{20}	0.01 (0.01)	0.02* (0.01)	0.02 (0.01)	0.03** (0.01)	0.03* (0.01)	0.05*** (0.01)	0.03* (0.01)
TALK, β_{3j}							
INTERCEPT, γ_{30}	0.52 (0.35)	0.29 (0.32)	0.53 (0.30)	0.67* (0.27)	0.75** (0.24)	0.72** (0.23)	1.03** (0.38)
Variance component							
τ	0.50 (0.25)	0.30 (0.09)	0.36* (0.13)	0.30 (0.09)	0.41 (0.17)	0.32 (0.10)	0.59* (0.34)

*Indicates p <0.05, ** Indicates p <0.01, *** Indicates p < 0.001.

Table 13. Log-odds Ratios and Probabilities for TALK after controlling for all other predictors and random effect of school

Model	*Log-odds ratio for TALK = 0*	*Log-odds ratio for TALK = 1*	*Probability for TALK = 0*	*Probability for TALK = 1*
10: DOMATH	-3.33	-3.33 + 0.00 = -3.33~	0.03	0.03
11: DORDG	-2.91	-2.91 + 0.00 = -2.91~	0.05	0.05
12: DODBD	-2.35	-2.35 + 0.00 = -2.35~	0.09	0.09
13: DOPLC	-2.07	-2.07 + 0.67 = -1.74	0.11	0.15
14: DOACTPLN	-2.83	-2.83 + 0.75 = -2.13	0.06	0.11
15: DOSBR	-2.49	-2.49 + 0.72 = -1.77	0.08	0.15
16: DOCOACH	-3.92	-3.92 + 1.03 = -2.89	0.02	0.05

~The estimate for TALK for Models 10, 11, and 12 is not significant. Therefore, there is no change in the probability of responding yes to the outcome when TALK=1.

When considering the difference between probability of responding yes to each of the seven project related outcomes and the predictor TALK, we can see that for models 13-16 (outcome variable: DOPLC, DOACTPLN, DOSBR, and DOCOACH), the

probability of responding yes increased slightly when teachers reported that their principal talked with them about PDP, even after controlling for leadership status, years of experience, and the random effect of classroom. This suggests that TALK rather than DOSE is a mediating mechanism by which principals diffused the PDP concepts in their individual schools. It seems that merely attending a PDP session is not a mechanism for implementing change if the principal does not return to his or her schools and specifically talk with teachers.

Conclusion

In the analyses described here, we focused on two ways of measuring fidelity of implementation in an evaluation of the PDP program – dose and participant responsiveness (Dane and Schneider, 1998) – while also considering implementation as a phase in the diffusion process (Rogers, 2003). We defined dose as the number of PDP sessions attended by principals during the course of a 10-month period when 11 sessions were offered, and participant responsiveness as the way in which principals conveyed the information that they learned during the PDP sessions to the teachers at their school. Participant responsiveness was measured by teacher survey responses organized in three increasing levels of engagement: first, teacher awareness about the PDP, second, whether the principal had talked with teachers about the PDP, and third, teacher participation in projects or discussions related to seven key aspects of the PDP (mathematics instruction, reading instruction, data-based decision making, professional learning communities, action planning, professional learning communities, and coaching). We considered the diffusion process in terms of which teachers in the

schools indicated that they were aware, had talked about, or had participated in PDP activities. We believe that both conceptualizations of implementation are relevant and necessary to take into account when evaluating the success of an intervention that is designed to provide participants with the knowledge and skills to take what has been learned and apply it to an organizational context.

Our findings indicate that there is variation in attendance at PDP as expected. Just because the district offers a professional development program and encourages principals to attend, it does not necessarily mean that principals will comply.[2] Principals can decide if, when, and how to apply the principles of the PDP curriculum in their own schools. There is also variation between schools in familiarity and participation in PDP activities. Two schools with a high percentage of teacher responsiveness and implementation of projects related to PDP had principals who had attended all 11 PDP training sessions. The implementation of the PDP program by these two principals (as measured by their teacher's survey responses) is not typical of the sample, however. There was large variation in teacher familiarly and participation in PDP activities. Beyond the two schools that were very active in PDP projects, other schools worked on projects in one area covered in the PDP curriculum.

We found a significant relationship between dose and whether or not the principal talked with teachers about the PDP. In all of the other analyses, the number of PDP sessions a principal attended was not significantly related to whether teachers participated in implementation projects. However, the two high performing principals (schools A and B) do provide interesting cases for future exploration and research.

[2] As part of this project, we have conducted a series of interviews with district officials to explain and understand the district's perspectives on the PDP program and principal participation.

Next, we considered the relationship among teacher leadership status, years of teacher experience, principal's PDP dose and familiarity/participation in PDP activities. We hypothesized that more experienced teachers and teachers with leadership status would be more likely to respond that they were familiar or had participated in PDP projects because principals had selected to diffuse their new learning through the organization by starting with the more experienced or leader teachers. Our findings support this hypothesis, but we are also mindful that there may not have been enough time for the diffusion process to take place to consider this possibility fully. Similarly, with the PDP training ending after 10 months, the issue of sustainability may be an explanation for why information was not diffused throughout the schools of principals who had attended PDP sessions. We also found that principals who talked with teachers about the PDP were more likely to be in schools where teachers indicated they were working on projects related to the PDP curriculum.

Many professional development programs mandate attendance or participation. However, few professional development programs for principals, if any, mandate, teach or discuss implementation or interaction with teachers when principals return to their school buildings. Principals are very autonomous in terms of how they work with teachers to improve instruction and educational outcomes for children. The findings from this paper suggest that how principals engage with professional development is complex and certainly attendance does not necessarily translate into implementation of what is learned.

This paper describes an initial set of ideas of thinking about implementation. Our next steps include relating project implementation to changes in teaching and learning to

begin to further wrestles with the notion of implementation diffusion in terms of thinking about the amount of diffusion that constitutes change and can impact student achievement.

References

Bossert, S.T., Dwyer, D.C., Rowan, B. & G.V. Lee. (1982). The instructional management role of the principal. *Educational Administration Quarterly*, *18*(3): 34-64.

Brown, L.B. (1981). *Innovation diffusion: A new perspective*. London: Methuen.

Bryk, A. S. & Raudenbush, S. W. (1992.) *Hierarchical linear models*. Newbury Park, CA: Sage Publications.

Clark. (1984). *Innovation diffusion: Contemporary geographical approaches.* Norwich: Geo Books.

Dane, A. V., & Schneider, B. H. (1998). Program integrity in primary and early secondary prevention: Are implementation effects out of control? *Clinical Psychology Review, 18,* 23-4.

Dobson, D., & Cook, T. J. (1980). Avoiding type III errors in program evaluation: Results from a field experiment. *Evaluation and Program Planning, 3,* 269-376.

Durlak, J.A. & E.P. DuPre. (2008). Implementation matters: A review of research on the influence of implementation on program outcomes and the factors affecting implementation. *American Journal of Community Psychology.*

Dusenbury, L., Brannigan, R., Falco, M., & Hansen, W. (2003) A Review of Research on Fidelity of Implementation : Implications for Drug Abuse Prevention in School Settings, *, 18*: 237-256.

Fullan, M. & A. Pomfret. (1977). Research on curriculum and instruction implementation. *Review of Educational Research, 47* (2); 335-397.

Goldring, E. B., & Pasternack, R. (1994). Principals' coordinating strategies and school effectiveness. *School Effectiveness and School Improvement*, 5, 239-253.

Hallinger, P., & Heck, R.H. (1996). Reassessing the principal's role in school effectiveness: A review of empirical research, 1980-1995. *Educational Administration Quarterly*, *32*(1), 5-44.

Mowbray, C.T., Holter, M.C., Teague, G.B., & D. Bybee. (2003). Fidelity criteria: Developmental, measurement, and validation. *American Journal of Evaluation, 24,* 315-340.

Jensen, J. L. (2004). A multipopulation comparison of the diffusion of public organizations and policies across space and time. *The Policy Studies Journal, 32*(1): 109-127.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical Linear Models: Applications and Data Analysis Methods.* Newbury Park, CA: Sage Publications.

Rogers, E.M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.

Appendix

Table A. Percentage of Teachers Responding Yes for All Schools Indicated on Figures 2-10.

	Nine Survey Questions (measures of participant responsiveness)									
School	DOSE	AWARE	TALK	DOMATH	DORDG	DODBD	DOPLC	DOACTPLN	DOSBR	DOCOACH
A	11*	0.46	0.49	0.22	0.19	0.22	0.27	0.19	0.32	0.14
B	11	0.56	0.53	0.09	0.12	0.29	0.36	0.31	0.31	0.03
D	3	0.31	0.33	0.06	0.06	0.09	0.17	0.11	0.11	0.06
E	0	0.42	0.35	0.08	0.09	0.10	0.13	0.08	0.11	0.03
F	8	0.39	0.43	0.05	0.07	0.14	0.07	0.09	0.02	0.10
G	11	0.44	0.50	0.08	0.07	0.15	0.20	0.08	0.15	0.05
H	0	0.39	0.54	0.02	0.07	0.19	0.24	0.17	0.17	0.13
J	0	0.37	0.20	0.14	0.14	0.18	0.29	0.14	0.20	0.11
K	0	0.19	0.09	0.12	0.12	0.09	0.06	0.09	0.06	0.06
L	1	0.12	0.08	0.08	0.08	0.20	0.20	0.12	0.12	0.17
M	11	0.38	0.27	0.08	0.12	0.18	0.22	0.14	0.18	0.16
N	0	0.32	0.27	0.05	0.03	0.03	0.17	0.08	0.11	0.00
O	11	0.44	0.27	0.10	0.15	0.20	0.15	0.05	0.13	0.00

*Trainer