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Today, after two decades of reform, standards define how we think and talk about American education. Almost all states have adopted content standards that define what students should know and be able to do in four core subject areas of language arts, mathematics, and science. All states administer assessments linked to those standards in at least some of those subject areas. The No Child Left Behind Act of 2001(NCLB) has incorporated content standards and assessments into federal law, along with specified consequences for schools that do not meet particular performance requirements.

This direction stems from the theory that standards-based education results in improved teaching and student learning, but there has been no systematic examination of the evidence supporting this theory. To address this lack of analysis, in the summer of 2005, McREL researchers conducted and published a synthesis of the research about the influence of standards on K–12 teaching and student learning. The synthesis focused on three

variables closely related to teaching and student learning: standards-based curriculum, standards-based instructional guidelines, and standards-based accountability assessments.

In conducting the synthesis, the first thing we found was that, in the research, "standards-based" education had at least two definitions.

- The first definition emphasizes the content that teachers need to cover in classrooms and the outcomes that are required to demonstrate success. It specifies a policy approach focusing on

  a) Broad goals for student learning (or content standards)

  b) Definitions of student performance relative to those goals

  c) Assessment that provides feedback about learning

- The second definition draws on the content-based instructional reforms of the NCTM and other groups. This definition of "standards-based" can also mean "reform-oriented," and incorporates constructivist ideas about learning, including student-centered pedagogy, active learning, and cooperative grouping structures.

So what does this mean for teacher learning? Using the first definition of "standards-based education," the policy definition, teachers may not need to learn much beyond the content they need to cover according to content standards. However, if we consider standards as "reform-oriented," embodying higher order learning skills, the answer becomes more complex.

Teachers tend to teach in the ways that they are taught. They develop instructional repertoires that are consistent with their beliefs and attitudes about content and student learning. Often, these are firmly nested within the paradigm of teacher-centered instruction. But, if teachers are asked to

shift to more student-centered ways of instruction, they also must adjust their beliefs to fit the new paradigm. To teach in the ways envisioned by standards reformers, teachers need strong content knowledge and the ability to change their pedagogical repertoire as well as their underlying beliefs and attitudes about it.

To do this successfully, teachers need opportunities for deep learning of content, as well as opportunities to learn how to use reform-oriented strategies, practice those strategies in the classroom, and observe their effects on student learning. Therefore, standards-based professional development is the cornerstone of a successful standards-based system.

Research on Standards-Based Professional Development

Initially, we included standards-based professional development as a topic for the broader McREL research synthesis conducted in the summer. Sixty articles were selected through systematic searches of the literature and clearinghouse services such as ERIC, Psychological Abstracts, and Dissertation Abstracts. Further searching into some of those references led to another 11 studies of standards-based professional development. The studies were synthesized for this article and the main results are reported here. To be included in the professional development synthesis, studies needed to address the following research question: What is the influence of standards-based professional development on teacher instruction and student achievement?

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Studies also needed to meet the same criteria for inclusion that we had established for the larger synthesis, including quality criteria for the methods used. Each study that met the criteria was coded using a standard form parallel to the coding process for the broader research synthesis. For a complete description of the synthesis search, coding processes, and inclusion criteria, see *The Influence of Standards on K–12 Teaching and Student Learning: A Research Synthesis* (Lauer, P., et al., 2005), available at www.mcrel.org.

Of the 71 studies read, 54 met our requirements for inclusion and were reviewed as part of this synthesis. Another 17 articles were bundled with other studies that they duplicated or complemented (for instance, if there were multiple evaluation reports of a long-term professional development intervention). Therefore, we included 54 articles that addressed 37 major studies.

Of these 37 studies, most were descriptive, but many used both quantitative and qualitative data. Five studies used quantitative quasi-experimental designs, where data from comparison groups were analyzed to try to attribute changes in teacher instruction or student achievement to a particular professional development intervention. But most studies lacked comparison groups. Mixed-method studies were common (10 of the studies reviewed used quantitative and qualitative methods), as were quantitative non-experimental studies (another 13 studies used quantitative data with no comparison groups). Finally, nine qualitative studies provided insight on how teachers structure their learning in professional development opportunities. Most of the studies focused on particular content in mathematics, science, or both, with fewer studies of language arts and social studies.

Here we provide highlights of the research on the influence of standards-based professional development on teacher instruction and student achievement. We identify trends in the data across the studies and point out possible moderators of the findings based on individual studies. We then examine the current policy environment for professional development in light of these findings, and identify the implications for policymakers in the Central Region.

Research Findings

Standards-based professional development can have a positive effect on classroom practice, particularly in terms of reform-oriented practices. It can also have a positive effect on student achievement. But the research is very mixed. Research/evaluation designs cannot always attribute effects to a specific professional development opportunity, either because there is no comparison group, or because professional development is often part of a multi-pronged systemic improvement strategy.

In addition to the attribution issue described above, we can identify two other sources of variance in the professional development research:

- Professional development, even when standards-based, can vary widely in quality. Fortunately there are a number of studies that have refined the definition of high-quality professional development.
- Available achievement measures may be poorly aligned with the learning goals of the professional development. Using mismatched tests to measure the impact of professional development is analogous to planting apple trees but counting oranges to measure the success of the apple crop!

Dimensions of Quality in Professional Development

Further, the research indicates that such professional development holds promise for improving student achievement, although these data are more inconsistent. A number of studies have found similar aspects of professional development quality (e.g., the National Staff Development Council, 2001; Guskey, 2003); however this paper focuses on the themes emergent from our synthesis.

Based on our synthesis of the research, professional development that is most likely to positively affect teacher instruction is

- Of considerable duration
- Focused on specific content and/or instructional strategies rather than general
- Characterized by collective participation of educators (in the form of grade-level or school-level teams)
- Coherent
- Infused with active learning, rather than a stand-and-deliver model

Extended Duration of Professional Development

Overall, the data suggest that deep changes in teacher instruction, like those required by reformers, take considerable time. Often, this may entail initial participation in a summer training institute and then follow-up throughout the school year with on-site coaches to encourage teacher reflection and facilitate instructional change. For instance, one long-term evaluation of the Merck Institute for Science Education (MISE) used surveys to explore the relationship between professional development and teachers' use of reform-based teaching practices in science. The researchers found that teachers who had 80 or more hours of science-related

professional development during the previous year were significantly more likely to use reform-based teacher instruction than teachers who had fewer hours (Corcoran, McVay, & Riordan, 2003). They also found that student achievement improved significantly with increased exposure to reform-based teacher instruction, but with less consistency.

Another study found similar patterns in the relation between duration of standards-based professional development and reform-oriented changes in teacher instruction. Using data from the National Science Foundation's Local Systemic Change (LSC) initiative, Supovitz and Turner (2000) found statistical associations between the amount of teacher professional development and use of inquiry-based teaching practices in science. It was only after participating in at least 80 hours of professional development in the previous year that teachers reported using inquiry-based practices significantly more frequently than teachers with fewer hours. In terms of creating an "investigative classroom culture," the study found that substantive change occurs mainly after 160 hours of professional development.

This pattern occurs within considerable variation in teacher practice. Even with long-term efforts, there can still be considerable variation in implementation; evaluation studies of the LSC initiative indicated that, even after several years, teachers, although improving, tended to struggle with using higher-order questioning strategies and demonstrating "big picture" meaning for how activities fit into the larger content domain (Pasley, 2002). Even so, the more time spent on professional development, the more coherent teacher instruction relative to national mathematics or science standards (Boyd, Banilower, Pasley & Weiss, 2003).

The relation with achievement is less consistent, although, in general, student achievement is positively correlated with extent of teacher participation in quality professional development. One issue is that there may be a transition period before achievement gains are realized, particularly for disadvantaged students. Banilower (2002) found that student achievement growth was associated with extensive teacher participation in the LSC professional development, but that, in some cases, student performance gaps seemed to widen relative to participation. This could be because it may be more difficult for disadvantaged students to make the transition to a student-centered style of learning—or that their teachers can only make incremental adjustments in instruction. The size of achievement gaps decreased with increased teacher time spent on professional development, indicating that teachers can work through this plateau with more training.

Focus on specific content and strategies

Changes in practice also depend on a sustained and targeted professional development focus on particular content knowledge and instructional strategies to have effects on teacher instruction and achievement. In their research study on the effects of California mathematics replacement units on reform-oriented instruction and student achievement, Cohen and Hill (2000) noted that the content of what teachers learn is very important. They found that professional development focused on specific curricula resulted in more reform-oriented practice than more general professional development. And reform-oriented teacher instruction was positively related to student achievement. The researcher findings suggest that, for classroom practice to change, professional learning opportunities should be

- Grounded in the curriculum that students study,

- Embedded within an aligned system and connected to several elements of instruction (e.g., assessments, curriculum), and
- Extended in time, with time built in for practice, coaching, and follow-ups.

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A longitudinal analysis of data from the evaluation of the Eisenhower Professional Development Program in mathematics and science also emphasized the importance of focus, this time on teaching strategies. "Professional development focused on specific higher order teaching strategies increases teachers' use of those strategies in the classroom," say the researchers, with other aspects of quality strengthening the likelihood that professional development leads to changed practice (Porter, Garet, Desimone, Yoon, & Birman, 2000).

There are indications that once teachers learn how to make such instructional changes, the changes are long-lasting; an analysis of teacher instruction relative to participation in Ohio's Project Discovery indicated that the professional development resulted in significant increases in inquiry-based instruction at the middle school level, and that these changes were sustained up to three years after professional development participation (Supovitz, Mayer, & Kahle, 2000).

Using student data to provide a focus for professional development and to evaluate its effectiveness is one approach to this situation. Fishman, Marx, Best, and Tal (in press) describe this process in terms of using student tests to identify specific science content that students are not learning. They then developed an in-depth active-learning-oriented professional development opportunity linked to that content, and then re-administered the initial test to determine how well the teachers' professional development translated into student learning.

Collective participation, coherence, and active learning.

Other important qualities of professional development associated in the research with teacher instructional change and student achievement are collective participation in professional development; coherent approaches to improving student learning, with policies and materials aligning with the professional development focus; and aspects of active learning, in which teachers participate in the same types of sense-making activities that their students would, in a reform-oriented standards-based classroom.

Porter et al. (2000) affirm the value of focused professional development and identify other aspects of quality that, when present, intensify the effects on teacher instruction. These include the following:

- Professional development of a reform type (e.g., teacher networks or teacher study groups) rather than workshop or conference participation. Much of the power of reform-type professional development is in its relatively longer duration than more traditional professional development delivery methods.
- Consistency with teachers' goals, other activities, and materials and policies. Professional development has more of an effect when

its goals are in alignment with instructional materials, student assessments, and policies.

- Collective participation in professional development by a group of teachers or other educators from the same subject, grade, or school. This can provide a broader base of understanding at the local implementation level, not only for teachers, but also for principals and others who can provide instructional support.

Collective participation helps to create school-level support groups and a "critical mass" for instructional change. Data from the MISE evaluation also supports this idea of collective participation. The evaluators found that, on some achievement measures, student performance was related to the proportion of teachers in the school engaged in professional development, but 78 percent of the teachers in the school needed to be engaged in professional development before the relationship was apparent (Corcoran, et al., 2003). So, while depth of professional development is important, in terms of sustained duration and a strong focus, breadth is also important.

Other, nationally-representative data from the evaluation of the Eisenhower Professional Development program indicate that longer-lasting activities tend to emphasize several of these other features of quality; more emphasis on content, more opportunities for teachers to participate in active learning, and more coherence (Garet, Birman, Porter, Desimone, & Herman, 1999).

Professional Development and Achievement

The research we reviewed indicated a mixed relationship between standards-based professional development and student achievement. But when studies examine high-quality professional development into the equation (e.g., sustained duration and focus on content, active learning, coherence), a slight positive relationship can be seen. But this is highly dependent on the achievement measure. Even quasi-experimental studies, which are stronger in attributing achievement effects to professional development, may show different results, depending on the measure. For example, one study comparing student mathematics scores for elementary students in a professional development school (PDS) and comparison schools had different findings depending on the achievement measure used. On a holistic measure tied to specific math problem-solving, PDS students outperformed the other students, but differences were inconclusive on two standardized measures (Devlin-Scherer, et al., 1997).

Other studies show inconsistent effects of professional development on achievement by student grade level. Van Haneghan, Pruet, and Bamberger (2004), in their examination of the Marysville Mathematics Initiative, found significant achievement effects for fifth grade students, but not for second grade students, who scored no differently than did their comparison group. Wiley and Yoon (1995), in their analysis of the influence of professional development in California on student achievement, found similarly inconsistent patterns by grade.

Many studies examined student achievement within a short timeframe, but the data have shown that substantive changes in teacher instruction take considerable time. This could have implications for policy, as it might take several years to demonstrate a particular professional development's effect on instruction, let alone student achievement. As we saw with Banilower's (2002) study of teacher LSC participation and student gaps

in achievement, there was an initial plateau effect. For teachers to work through effects such as these, it requires patience, ongoing support and data collection, and a realistic approach to setting deadlines by which a particular professional development approach must demonstrate influences on student achievement.

The Policy and Practice are not Aligned with Quality Professional Development

According to our review of the research, the relationship between standards-based professional development in general and teacher instruction/student achievement is mixed. When aspects of the professional development's focus, duration, and nature are considered, however, some positive outcomes emerge in instructional change and also in student achievement, provided the test is aligned with the goals of the professional development training.

Given these data, it is important to examine the typical standards-based professional development that teachers experience. In general, they do not receive the types of learning opportunities that are likely to change their instruction and improve student achievement. For example, recent data from a national probability sample of mathematics and science Eisenhower participants indicated the following:

- The average time span of a professional development activity was less than a week.
- The average amount of contact hours per activity was 25 and the median was 15.
- Most activities did not have collective participation.
- Most activities did not have a major emphasis on content.
- Most activities had limited coherence and a small number of active learning opportunities (Garet, et al., 1999).

Additional data from these studies indicate that professional development opportunities vary tremendously from teacher to teacher— it is a highly individualized experience. Two teachers in the same school may have widely different professional development experiences, indicating that schools have traditionally lacked coherence in their training plans. Similarly, the same teacher may experience extreme fluctuations in the quality of professional development experiences from year to year (Porter, et al., 2000), raising questions about the sustainability of professional development efforts over time. While NCLB has possibly provided some coherence by requiring districts and schools to integrate professional development plans with their school improvement plans, it remains unclear that this has been helpful at the local level. Schools and districts may lack the capacity to apply knowledge about effective professional development and require additional assistance.

At the federal level, NCLB has provided some guidance about effective professional development in its list of characteristics of high-quality professional development. Characteristics include attention to building content knowledge and a focus on student learning, linked with achieving standards. They specifically exclude activities that are one-day or short-term workshops or conferences. NCLB also recommends the inclusion of professional development on using data and assessments to inform and instruct classroom practice (NCLB, 2001, sec. 910, p. 1963). The law also emphasizes the importance of regularly evaluating professional development programs for their impact on teacher effectiveness, defined in terms of student achievement.

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At the state level, policies are similarly phrased to provide schools and districts with timelines, guidelines and requirements for creating professional development plans. But, with the exception of Missouri, states in the Central Region are characterized by a laissez-faire approach to shaping and funding professional development. A recent scan of state policies indicates that, while all states require professional development for recertification, requirements are based primarily on clock hours. Also, although most states have developed professional development program guidelines that are based on the NSDC recommendations, of the seven Central Region states, only Colorado has defined "high-quality" professional development in state policy. Kansas, on the other hand, is the only state with explicit policy language requiring professional development to be linked with standards. Other states display miscellaneous efforts around linking professional development with standards, but in many sites, these are pro forma, consisting of reporting professional development days in accountability reports. Importantly, no state in the Central Region has adopted policy for evaluating professional development programs (Education Commission of the States, 2005).

In the Central Region, intermediate education service agencies play an important role in helping schools and districts improve professional development so that it has a better chance of affecting teacher practice and student learning. A recent study of education service agencies indicated that the professional development they offer is becoming more coherent and of longer duration, consistent with research recommendations. But funding is still an issue; most of the agencies report a lack of sufficient resources, regardless of their funding formulas. Staff are described as "too thinly stretched" among schools that need help and technology-based professional development is being used as one way to handle that issue (McIver, 2002).

Conclusions and Recommendations

Given the lack of alignment between what we know about high-quality standards-based professional development and what's currently happening in the Central Region, there are several implications for policy.

Emphasize High-quality Professional Development Programs

Policymakers at all levels need to emphasize high-quality programs. But providing professional development that is long-lasting and focused on specific content and pedagogy requires more resources to implement than less effective professional development. States, districts and schools face hard choices between offering high-quality targeted professional development to fewer teachers and, as has been done in the past, providing more general professional development to greater numbers of teachers. However, repeating the past will not lead to different results.

Strengthen the Evidence Base

Policy requirements linking professional development plans with school improvement help to ensure that efforts are focused on student learning. However, following NCLB's example, state and district policymakers can help strengthen the evidence base by making high-quality program evaluation an integral requirement for professional development funding. Evidence of a rigorous evaluation design can be a requirement of professional development funding, and states can develop specific rubrics and policies to evaluate these designs. Such rubrics should include the following:

- Evidence that the professional development proposed is of high quality (e.g., has measures to ensure duration, considerable follow-up, active learning, and is focused on specific content and instructional strategies).
- Evidence that teacher instruction is examined as an outcome with descriptions of how instructional change is measured.
- Evidence that an achievement measure is used to assess impact on student learning and that the measure meets criteria for technical qualities (e.g., reliability, validity). While achievement on accountability measures is important, it also is important to measure student achievement on tests that are closely tied to the actual curriculum that the professional development addresses.
- Evidence that the research or evaluation design can attribute changes to the effect of the professional development. This may require comparing groups of teachers and students who don't participate in training or if that is not feasible, measuring teachers' attributions about changes in practice due to a professional development program.

These types of evidence would allow policymakers and educators to make the case more readily that investment in high-quality professional development will lead to improved teaching and learning. They can be used to better identify promising programs and to monitor progress on an ongoing basis, in order to make adjustments, if necessary.

Take a Long-term View

The research indicates that substantial changes in teacher instruction and student learning take time. To that end, policymakers need to look beyond the current school year when examining the teaching and learning outcomes of professional development. Progress should be assessed on an ongoing basis, but districts and schools need to have the time and resources to really put these learning reforms into place and sustain them. It is unclear how this fits in with NCLB's timelines around Annual Yearly Progress (AYP) and its year-by-year implementation of consequences for schools that do not achieve AYP. But, in general, the research evidence suggests that NCLB's timeline for progress is too short and its accountability measures too far from the classroom for schools to see the effects of even high-quality professional development on student achievement. Policymakers and educators will need to balance issues of the resources that NCLB provides with these requirements.

Focus on Particular Areas of District and Teacher Need

The data indicate that some districts, particularly small and isolated ones, may need extra assistance in developing high-quality professional development programs. Many small districts lack centralized office capacity for content-specific professional development and lack literacy and mathematics specialists. They also often lack capacity for data analysis at the district level. Further, the time and money for teachers to attend centralized professional development may be prohibitive in remote sites.

One way to address this problem is through policy support for technology-delivered professional development, which can bring teachers together virtually. An example of this approach is McREL's Online Learning Communities.

Another area of need is teachers of special populations who do not generally receive targeted professional development. Nor do teachers who are placed in hard-to-teach schools. Teachers in these groups need high-quality, sustained, and focused standards-based learning opportunities. Providing incentives for participating in professional development is one way to reach out to these teachers. Current NCLB policy addresses this to some extent with initial technical assistance, but it is unclear whether federal timelines for showing improvement are adequate or not for substantive change. Pressure and increasing proximity to the policy's interventions of restructuring or school closure may detract from the sustained focus required to change teacher practice and student achievement.

Marshall Intellectual and Fiscal Resources

Schools and districts must assume responsibility as informed consumers of standards-based professional development. But frequently decisionmakers are at the mercy of unreliable information from the developer's marketing department. NCLB has attempted to address some of these issues in its emphasis on interventions that are proven through "scientifically based research," but, as our scan of the literature shows, such a research base is still in development. States can help by establishing accessible, centralized clearinghouses of promising professional development programs. Materials included in the clearinghouses should meet standards of quality, which could be centrally determined by the state using rubrics similar to the one suggested above for evaluating professional development. They should include examples of professional development created by individual schools and districts as well as by commercial providers.

A variety of materials are already available for districts to assess the quality of their professional development programs, but a centralized clearinghouse with clear quality indicators is still lacking. In Kansas, districts can use the Staff Development Rubric for District/School Assessment, which is based on the twelve National Staff Development Council (NSDC) Standards for Staff Development and addresses the quality of a district's staff development related to Context, Process and Content. McREL's Teacher Quality Toolkit has checklists and assessments that district and school personnel can use to audit the quality of their professional development programs, professional learning communities, and partnerships (Lauer, Dean, Martin-Glenn, & Asensio, 2005).

States and districts should ensure that all schools have the resources, time and money to participate in high-quality professional development. Resources should be made available through a combination of outside sources and reallocation of existing funds. The NCLB emphasis on evaluating professional development quality through research should be considered an opportunity for local policymakers to examine the effectiveness of their own programs and show evidence of particular successes.

NCLB states that all students should be taught by "highly qualified" teachers. If being highly qualified means that a teacher must be aware of and cover content linked to standards, professional development programs do not require tremendous change. But if highly qualified teachers are deemed educators who have deep content knowledge, can use appropriate pedagogy for higher-order learning, and can target different students' learning needs appropriately so that they learn in ways that can be documented on a wide variety of assessments— this type of professional development venture is something else entirely. And without

focused allocation of increased resources to support teachers' learning opportunities, the promise of "highly qualified" teachers becomes an empty political phrase.

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