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Designing Professional Development Opportunities for Teachers that Foster Collaboration, Capacity Building and Reflective Practice

A case is made that professional development activities in science, when designed as generic programs, can limit pathways individual teachers may take or even select to meet their specific professional development needs.

The standards movement across the United States has created a real need for teacher learning. This need has created a critical examination of the practices employed by school districts across the country to provide sustained professional development opportunities for teachers. There is a growing belief that professional development should be targeted and directly related to teachers' practice. This belief also focuses on the notion that professional development should be site-based and sustained over time. It should be integrated into the regular practices of teachers. The focus of the professional development should be curriculum-based so that it helps teachers help their students attain higher levels of content understanding and improved performance.

This approach to professional development design is contrary to the current practice of a generic professional development program focusing on curriculum implementation, content, pedagogical strategies or student assessment strategies designed for all teachers within a system or region. The "one-size fits all" approach to professional development limits pathways individual teachers may take or even select to meet their own professional development needs.

An alternative approach to the design of professional development programs for teachers must be considered by policy makers and school districts to meet the growing needs of teachers to move along three distinct professional growth continua described by Berliner (1994), content knowledge, pedagogical knowledge and student learning knowledge. In fact, in a standards based environment, some even suggest that there is a fourth continuum or pathway that must also be considered, pedagogical content knowledge (Marks, 1990).

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Professional development programs for teachers that view the personal professional development needs of teachers as important also recognize that through these efforts a knowledge base for teaching can be created.

There is a growing consensus that professional development can be optimized when it is long-term, school-based, collaborative, focused on student learning, and linked to curricula (Darling-Hammond and Sykes, 1999; Loucks-Horsley, Hewson, Love and Stiles, 1998). Such programs focus teacher activity around the examination of student work, student performance, joint planning, teaching and revising lessons, and individual and group reflection. This paradigm shift from working in isolation to working in a collaborative group is favorably received by teachers (Garet, Porter, Desimone, Birman and Yoon, 2001).

James Stigler in a conversation with Scott Willis (2002) recommends three teacher outcomes from such an approach to teacher professional development:

- they need to learn to analyze practice—both other teachers' practice and their own. In this context analyze means to think about the relationship between teaching and learning;
- they need to be exposed to alternatives; and
- they need situational judgment to know when to employ which method.

These three recommendations are based upon a belief that teaching is a cultural activity rather than as something one learns to do by studying it at school (Gallimore, 1996). Most teachers learn to teach by growing up in a culture watching their own teachers teach, then adapting these methods for their own practice. Changing teaching means changing the culture of teaching to a knowledge-based practice.

In considering the operational characteristics associated with disciplinary expertise as a foundational framework, the notion of knowledge-based practice provides a methodological perspective for approaching curriculum and instruction for teachers. The distinguishing characteristic of knowledge-based instruction models is that all aspects of instruction (e.g., teaching strategies, student activities, assessment) are related explicitly to an overall design that represents the logical structure of the concepts in the subject-matter discipline to be taught, a curricular structure that should parallel the knowledge organization of disciplinary experts. The explicit

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representation of the knowledge to be learned through the standards movement serves as an organizational framework for all elements of instruction, including the determination of learning sequences, the selection of teaching methods, the specific activities required of learners, and the evaluative assessment of student learning success. In considering the implications of knowledge-based instructional practice for education, it is important to recognize that one of the strongest areas of cognitive science methodology focuses on explicitly representing and accessing knowledge (Romance, Vitale, and Klentschy, in press).

The research foundations of knowledge-based instruction models are consistent with well-established findings from cognitive science. In particular, Bransford et al. (2000), in the recent National Academy Press report, *How People Learn*, stressed the principle that explicitly focusing on the core concepts and relationships that reflect the logical structure of the discipline and enhancing the development of prior knowledge are of paramount importance for meaningful learning to occur. This prior knowledge can also take the form of prior practitioner knowledge.

In emphasizing the role of prior knowledge in practice, the consensus research findings presented by Bransford et al. (2000) emphasized that both the conceptual understanding and use of knowledge by experts in application tasks (teaching) is primarily a matter of accessing and applying prior knowledge of practice under conditions of automaticity. As characteristics of learning processes, the preceding emphasizes that extensive amounts of varied experiences (alternative methods of teaching) focusing on knowledge in the form of the concept relationships to be learned are critical to the development of the different aspects of automaticity associated with expert mastery in science teaching. Considered together, these findings represent an emerging knowledge-based emphasis on the linkage between the logical structure of what is to be taught with the instructional means to accomplish meaningful learning.

From the 1999 TIMSS Video Studies (Hiebert et al., 2003; Roth et al., in press) three recommendations are made regarding how to change the culture of teaching to improve student achievement through professional development programs for teachers that are focused on developing a professional knowledge base for teachers:

- shift priorities to spend some time daily or weekly to study teaching practices; focus on planning lessons and then reflecting on their effectiveness;
- provide teachers with examples of alternative teaching methods; and
- have teachers learn to analyze students' work and understand their thinking to see how to adjust and improve their thinking.

It is a means for teachers to draw on a shared knowledge base to improve

teacher practice. This practitioner knowledge is the foundation of developing a professional knowledge base for teachers (Heibert, Gallimore and Stigler, 2002).

There are three features that make practitioner knowledge useful for teachers: practitioner knowledge is linked with practice; practitioner knowledge is detailed, concrete and specific; and practitioner knowledge is integrated.

Practitioner knowledge is useful for practice because it develops a response to specific problems of practice. In addition to addressing problems of practice, knowledge linked with practice is grounded in the context in which teachers work. These are collaborative practices and involve teachers in the following activities:

- defining the problem and creating a shared language to describe the problem;
- analyzing the classroom practice related to the problem;
- creating alternatives to solve the problem;
- testing the alternatives and reflecting on their effects; and
- recording what is learned in a way that is shareable with other teachers.

This form of knowledge is linked to practice though its creation from the problems of practice and connected to the process of teaching and learning that actually occur in classrooms.

Imperial County, California, has established a sustained program of professional development in science for teachers grounded in the belief that teacher capacity building can be best accomplished through a process that focuses on the power of practitioner knowledge enhanced through the process of lesson study and expanded though a technology supported platform, LessonLab.

The Valle Imperial Project in Science and Imperial County, California

In Imperial County, California, professional development programs focusing on developing teacher capacity and a professional knowledge base in science teaching have been in existence for a decade. In 1995 a pilot program, with assistance from the California Institute of Technology—CAPSI Program, began in the El Centro School District. That pilot effort led to the creation of a countywide consortium in the National Science Foundation funded Valle Imperial Project in Science (VIPS) in 1996. These initial efforts have led to the establishment of a California Science Subject Matter Project from the University of California, Office of the President at the local university, San Diego State University—Imperial Valley Campus. In 2004, this consortium was awarded a California Math—Science Partnership by the California Department of Education. This consortium has long recognized the need to provide systemic approaches for the development of a teacher professional knowledge base for teachers in the 14 school districts in Imperial County, California, that comprise their project. This has led to the sustainability of this professional development effort.

Imperial County, California, is located in the southeast corner of California along the United States border with Mexico and is one of the largest (4597 sq. mi.) and most sparsely populated (142,361) counties in California. Located in the extreme southeast corner of the state, the county lacks any large metropolitan area and residents must travel to San Diego (120+ miles) or Los Angeles (200+ miles) to the nearest urban areas.

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Many Imperial County residents live in extreme poverty, with household incomes declining in real dollars over the last decade. The county had a 2000 mean per capita income of $17,550, the lowest of all California counties. The county's unemployment rates increased from 17.1% in 1991 to 26.3% in 2000, while statewide unemployment rates remained fewer than 4.9%. Imperial County ranks highest in poverty of all 58 counties in California.

Most Imperial County residents have strong cultural and linguistic ties to Mexico. Of the approximately 36,000 K-12 students in Imperial County, 82% are Hispanic, Caucasian (13%), African-American (2.0%), Asians (1.0%) and Native Americans (2%) make up the rest of the population. A total of 48% of the students in the county are Limited English Proficient. Ten percent of the students are children of migrant farm workers. Nearly all of the county's schools qualify for Title I and 67% of all students are eligible for free and reduced lunches. The need for a systemic approach to teacher capacity building has been acute in this region.

The Valle Imperial Project in Science (VIPS) has served as a catalyst

to develop a strong and collaborative partnership between the 14 participating school districts and the local university, San Diego State University—Imperial Valley Campus (SDSU-IVC), modeled after the partner schools associated with the National Network for Educational Renewal (Clark, 1995). A joint research project between SDSU-IVC and the El Centro School District has produced one of the few studies documenting the positive effects of a

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National Science Foundation funded Science Local Systemic Change Project and has been well documented in the literature (Amaral, Garrison, and Klentschy, 2002; Jorgeson and Vanosdall, 2002; Jorgenson and Smith, 2002; Saul, et al., 2002; Klentschy and Molina-De La Torre, 2004). Through these initiatives, strong alliances have been formed between the local school districts, SDSU-IVC, Imperial Valley College and other university partners such as California Institute of Technology – CAPSI, and the University of California Office of the President with a California Science Subject Matter Project at SDSU-IVC.

In 2004, this collaboration for sustained teacher professional development in science has been expanded through a California Math Science Partnership initiative. A critical component of this expansion was the creation of a plan of action to transform practitioner knowledge into a professional knowledge base. The professional development action plan viewed this process as multi-dimensional included two critical elements associated with success in this regard, opportunities to refine instructional delivery through reflection and lesson study groups and applications of technology (Klentschy and Molina—De La Torre, 2002). These critical elements form a strong systemic approach specifically designed to build a strong science education learning community.

Opportunities to refine instructional delivery through reflection and lesson study groups.

Lesson study is a problem-solving process used by Japanese teachers for professional enhancement. This process facilitates systematic examination of teaching-learning processes through initial planning, teaching, observation and reflection of teaching practices. Teachers working in grade level groups, begin by defining a problem that is of interest to the study group and which will lead to some new understanding about teaching, the selected content drawn from the California Science Content Standards, and student learning. The selected problem becomes the goal that will guide the group's investigation. The group collaboratively plans a lesson that will eventually be taught by each of the teachers. Group members observe the lesson, and later, the group meets to evaluate and reflect on the lesson. The group decides to modify the lesson and have another group member teach the revised lesson or accepts the lesson as complete. The final step in lesson study is to share findings with colleagues. Lesson study is continuous and is situated in the school within the context of the individual classrooms. This process or cycle is usually repeated three times within a content unit of study and within a nine to eleven week time frame.

The benefit of lesson study as an effective means for sustained teacher professional development is well documented by Stigler and Hiebert (1999). They state, "the power of Lesson Study is that it facilitates teachers' contribution to the field and to their own professional development. That is, when teachers are able to contribute to the field of education they are simultaneously developing their professional understandings." (p. 122).

Now that teachers have participated in a sustained program of professional development, focusing on both deepening their science content knowledge and strengthening their pedagogical skills, a more intellectually rigorous and self-reflective professional culture is the next step. The challenge is now a second order task, but one that has been deliberately addressed by VIPS and in, which substantial progress has been made. The project offered, for the first time, during the 2000-2001 school year, opportunities for teachers to participate in lesson study groups. Selected lessons may be videotaped and discussed during the following meeting. These lessons will also become a part of a project-wide digital

library. These efforts have moved the overall culture toward greater professionalism. (For a detailed description of the lesson study process in Imperial County see Amaral and Garrison, 2004.)

Lesson study is unique in that it has built into its process three very important elements that help sustain professional development overtime, once initial efforts have been successfully instituted. One of these elements is the development of a professional digital library that can be studied overtime by the group or used as a starter for a new group. A second element of lesson study is that it promotes professional community by including sharing and dissemination of results among participants. Teachers become teacher-researchers. Finally, a third, unique element of lesson study is that discussions are data based, and connected to actual lessons. The cycle of improvement is linked integrally to a growing body of classroom data, usually student work.

Lesson study fills gaps left by other professional development programs that expose teachers to new ideas and methodologies, but do not provide support while the teacher is trying to implement these ideas in the classroom. Lesson study has gained favor with teachers because it provides opportunities for teachers to practice, receive feedback, and share with their colleagues. Lesson study groups generate knowledge that shares key features with practitioners' knowledge in that the group members work on a problem that is directly linked to their practice.

The implementation of lesson study required policy makers in Imperial County to address several key issues related to changing the culture of teaching. First, finding time in the weekly or daily schedule was addressed. At the elementary school level, principals, reading coaches and VIPS and IV-CaMSP Science Resource Teachers are utilized to release teachers to conduct the classroom observations. These observations are usually conducted during the last hour of the day. Group debriefing is led by a trained lesson study facilitator, usually a VIPS or IV-CaMSP Science Resource Teacher immediately after the lesson and usually after school. At the middle school level, principals have found creative ways to release science teachers for lesson study observations during the school day and to create a master schedule that allows for the scheduling of the lesson debriefings during a common conference period for the science teachers involved.

Second, VIPS and the IV-CaMSP recognized that teachers must be provided with examples of alternative ways of teaching. Analyzing videos in detail, focusing on the ways teachers implement science content, questioning strategies, problems encountered and student understanding can be useful as lesson study groups plan and revise their own lessons. Teachers actually begin the lesson study process with video analysis as part of their training for lesson observation and providing feedback (Amaral and Garrison, 2004). To this end, a media technician is employed by the project to create videos for this purpose.

Teacher analysis of videos, both of themselves and others, is an essential feature for improving teacher practice and developing a professional knowledge base for teaching.

VIPS and IV-CaMSP also recognized that teachers must have opportunities to study student work in relation to the changes teachers make in the classroom. The best source of student work came in the form of student entries in their science notebooks from the lessons. VIPS has long held the belief that student science notebooks offer the best record of what was actually taught by the teacher and what was actually learned by individual students (Klentschy and Molina-De La Torre, 2004). Learning to analyze student work and to make inferences about student thinking can lead to significant changes in teacher practice and expand their professional knowledge base.

The implementation of these three policy changes regarding teacher professional development: collaborative time, video analysis and analysis of student work are consistent with the recommendations made by Hiebert and Stigler (2004) to change the culture of teaching and to build a professional knowledge base.

The professional development program using lesson study as a core has created a means to use the digital library as a tool to strengthen teaching practices.

Applications of technology

Another catalyst for change in approaches to teacher development emanates from the study of approaches used by teachers in several countries that participated in international mathematics and science assessments (Hiebert et al., 2003, Roth et al., in press). During analyses of videotapes

of teachers whose students were particularly successful on these assessments (Stigler and Hiebert, 1999), researchers and teachers were surprised to see that there was a far greater difference in teaching practice across cultures than there was within a culture. They began to see that there are many more ways to teach a lesson then they had ever imagined, and some far more effective.

VIPS began the process of designing teacher professional development programs based upon the belief that Internet accessible digital libraries of lesson videos with teacher commentary could provide tools and resources needed to address two challenges faced by teachers as they transform practitioner knowledge into professional knowledge. The first challenge was to provide teachers with alternatives to current practice. If the professional development design would enable teachers to move from novice to expert in their teaching practice, then alternatives to the current classroom practice were necessary. The second challenge was providing teachers with a means of communicating what they have learned. The creation of an Internet accessible digital video library would address the second challenge.

Teachers in the Imperial County have access to a countywide fiber optic network. There are numerous computers, all equipped with Internet access, found in every classroom. Through the Imperial County Office of Education there are frequent workshops conducted on technology applications for classroom teachers. As a result of the great geographic isolation found in Imperial County, professional development opportunities are conducted over the fiber-optic network, thus reducing the travel time and distance for teachers. Regionalized centers can conduct simultaneous professional development, assisted by teacher leader facilitators. All participants can interact and view the same content simultaneously.

In today's climate of standards, assessment and accountability, a paradigm shift is necessary for systems to improve teaching and learning in their classrooms.

In early 2001, VIPS established a partnership with LessonLab through the California Science Subject Matter Project. Current work with LessonLab has focused on launching a comprehensive software platform to support the development and implementation of innovative, case-based professional learning programs. LessonLab is a video- and Internet-based based teacher professional development learning platform developed to help teachers improve their teaching.

This application of technology consists of an integrated platform for creating and delivering case-based content in an interactive format over the World Wide Web. This technology incorporates a mix of streaming video, user discussions, supplemental materials, and personal learning tools to create an enriching professional development experience. It generally involves teachers viewing videos of classroom teaching practice, reflecting on what they see teachers in the video do, analyzing that teaching in light of their own practice, and working with others to improve their teaching. Videos can be viewed on a CD-Rom for those without Internet access, or online, which allows users to communicate with each other and to access Web-based resources.

Also embedded in the LessonLab platform are resources related to each video lesson, such as samples of student work, a teacher's quiz or lesson plan, learner assessment results and other resources related to teaching the subject, topic or skill in question. In addition, all lessons are keyed to state and district curricular standards. The platform also contains an online notebook where teachers and/or facilitators can take and store notes as they watch a video, and a discussion forum for communicating with facilitators, trainers, experts and teacher peers. LessonLab also is designed to allow groups of teachers to create their own digital libraries of teaching practice, perhaps as they engage in Lesson Study, and to share their work with their colleagues. Course developers also can use LessonLab to create online courses.

The VIPS professional development planners have begun the process of building a digital library of science lessons. Teaching is a performance. It occurs in real time, in a real classrooms, with real students. Video is the best way of representing that process so it can be studied and analyzed. Video extends live classroom observations by providing opportunities to return to the lesson for group discussion, deeper analysis, and reflection. This process combined with analysis of student work generated from the lesson can lead to a deeper understanding of what was learned and what can be improved in the lesson. LessonLab has become a platform where teachers

can share their own knowledge of what they have learned about lesson improvement with lesson plans and student work combined with the actual performance.

The professional development program using lesson study as a core has created a means to use the digital library as a tool to strengthen teaching practices. On-line courses are in development. The courses are built around video cases, typically a classroom lesson, and engage teachers in activities designed to promote deep-level analyses of the case. Activities will involve teachers in linking the results of their analyses to their own practice, through planning, trying out and reflecting on their own practice in the classroom. An assessment component will also be available to provide teachers or course facilitators with opportunities to assess teacher learning.

Researchers from San Diego State University—Imperial Valley Campus and from the IV-CaMSP are currently studying the effects of lesson study and LessonLab on teacher practice and student achievement.

Final Thoughts

Teacher professional development programs in science have consistently been designed to address system wide needs. These needs may or may not have been consistent with the needs of individual teachers. In today's climate of standards, assessment and accountability, a paradigm shift is necessary for systems to improve teaching and learning in their classrooms. This paradigm shift must focus to recognize the power of practitioner knowledge and utilize that knowledge base as a starting point for the design of professional development programs. Increasingly, systems must design professional development programs that are site-based, collaborative, focus on the analysis of practice in the context of teaching and learning, and be exposed to alternatives. Lesson study and the use of technology driven platforms are two emerging pathways that should be considered in the design of any professional development program that is to be sustained over time. The transformation of practitioner knowledge through a professional knowledge base is the ultimate goal of such a design and subsequent action plan. The teaching profession then can be one that is defined by a knowledge base, which allows the profession to improve its practices over time.

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