

**An Overview of Current Findings**  
**From Empirical Research on**  
**Online Teacher Professional Development**

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Chris Dede, Lisa Breit, Diane Jass Ketelhut, Erin McCloskey, and Pamela Whitehouse  
Harvard Graduate School of Education  
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## Table of Contents

Table of Contents.....	2
Table of Figures and Tables.....	2
The Importance of Effective Teacher Professional Development.....	3
Visual Depictions of the State of Research in Online Teacher Professional Development .....	6
Selecting Research Literature to Review .....	11
Purposes of Professional Development .....	16
Fostering Teachers’ Abilities to Use Inquiry-Based, Constructivist Pedagogies with Students.....	17
Fostering Teachers’ Abilities to Create Communities of Practice Among Students.....	19
Fostering the Intellectual Development of Teachers to Increase Student Learning .....	20
Measuring Effectiveness.....	21
Enablers of Improvement.....	22
Content and Skills Taught.....	26
Findings about Pedagogical Approaches in Online Teacher Professional Development.....	27
Snapshots of Pedagogies Represented.....	30
The special case of mentoring.....	34
Synthesis of Findings about Pedagogy .....	36
Findings about Research Approaches in Online Teacher Professional Development.....	40
Snapshots of Research Methods Represented.....	42
Summary .....	49
As new ideas and connections come to light, evolving this organizer to fit these new conceptions is an ongoing challenge.....	51
References.....	52
Appendix A.....	56

### Table of Figures and Tables

Figure 1. “Nested” Depiction of Teacher Professional Development.....	8
Figure 2. The interconnected model of professional growth (Clarke & Hollingsworth, 2002).....	9
Figure 3. “Flow” Perspective on Online Teacher Professional Development.....	10
Table 1. Summary of Studies (n=40).....	13
Table 2. Enablers of Improvement.....	23
Figure 4. Content and Skills Addressed by Online Teacher Professional Development.....	27
Figure 5. The influence of pedagogical theory on oTPD research and design.....	29
Figure 6. Structure-Autonomy Continuum of Pedagogies Used in the 40 studies .....	31
Figure 7. Research Methods Continuum .....	42
Figure 8. Research Methods in Graphical Organizer.....	48
Figure 9. The density of reviewed research on oTPD, broken down by area. Darker colors represent more research. ....	49
Figure 10. The revised graphic organizer including three new sections on teacher engagement, evaluation and scaling up.....	51
Table 3. Characteristics and Findings of the forty Research Studies Analyzed.....	56

## **Abstract**

The need for professional development that can customize to fit teachers' busy schedules, that draws on powerful resources often not available locally, and that can provide real-time, on-going, work-embedded support has prompted the creation of online teacher professional development programs. However, while such programs are propagating rapidly and consuming substantial resources both fiscally and logistically, little is known about best practices for the design and implementation of these online teacher professional development models. In this study, we present a synthesis of what is known and not known in terms of recent empirical research about online Teacher Professional Development. We offer this as a first step towards illuminating best practices and evolving a research agenda based on findings and insights from current online teacher professional development models.

### **The Importance of Effective Teacher Professional Development**

In an era of school reform, many consider the education and professional development of teachers as the keystone to educational improvement (Hawley & Valli, 1999). Sparked by a need to meet the student achievement goals mandated by the Elementary and Secondary Education Act reauthorization and the No Child Left Behind legislation, a plethora of professional development programs have arisen, and administrators have added workdays devoted to professional development to teachers' already busy schedules. But this improvement comes at a price in resources and time. School districts spend the equivalent of \$200/pupil on professional development (Killeen, Monk, & Plecki, 2002), and professional development adds time and effort demands to teachers' already over-burdened schedules. While we need to build teachers' capacity for improvement, we also need to be sure that time, effort, and scarce resources are expended only on quality programs that teach with and about best practices.

Unfortunately, many teacher professional development programs are not of high quality, offering “fragmented, intellectually superficial” seminars (Borko, 2004, p 3). In addition, these programs are unable to provide ongoing support for teachers as they attempt to implement new curricula or pedagogies (Barnett, 2002). This problem is exacerbated when teachers attempt to implement these new strategies in environments made hostile by reluctant peers or administrators. As a result, teachers often become frustrated with professional development because it is ineffectual or requires large investments of time they do not have. Further, a lack of day-to-day professional support and mentoring for entry-level teachers – assistance that current approaches to professional development generally fail to provide – is a major factor underlying the nearly 50% attrition rate among new teachers within their first five years in the classroom.

The need for professional development that can fit with individual teacher’s busy schedules, that draws on powerful resources often not available locally, and that can provide real-time, on-going, work-embedded support, has stimulated the creation of online teacher professional development programs. Currently, there are many initiatives in online teacher professional development serving large numbers of educators. A range of objectives for educational improvement underlie these online teacher professional development ventures, such as introducing new curricula, altering teachers’ beliefs and instructional and assessment practices, changing school organization and culture, and enhancing relationships between school and community. Generally, these programs are available to teachers at their convenience and can provide just-in-time assistance. In addition, they often give schools access to experts and archival resources that fiscal and logistical constraints would otherwise limit.

However, while such programs are propagating rapidly and consuming substantial resources both fiscally and logistically, little is known about best practices for the design and

implementation of these online teacher professional development models. Evidence of effectiveness is often lacking, anecdotal, or based on participant surveys completed immediately after the professional development experience rather than later, when a better sense of long-range impact is attainable. Therefore, while online programs help with teachers' time constraints, they may do little to dispel educators' distrust of professional development programs that are often inadequate, whether face-to-face or online.

In particular, measuring the educational effectiveness of an online teacher professional development program is a major challenge. How should implementers define "success" for an online teacher professional development program, and what evidence should they collect to determine whether the program has reached its objectives? Effectiveness includes issues of scalability, sustainability, and cost-benefit. Moreover, assessing "impact" (the degree of transformation in practice) and "reach" (the number of teachers and organizations influenced) are important, but complicated. Often, within the complexity of educational settings, where multiple school change and professional development initiatives may be underway simultaneously and students move from teacher to teacher, it can be difficult to isolate and attribute the contribution of one professional development program on a teacher's development, and even more difficult to gauge the effect of professional development on student achievement or understanding.

Faced with this array of challenges, many organizations using or planning to initiate online teacher professional development are confused and overwhelmed. Designers of conventional teacher professional development, designers and practitioners for all types of distance education, and policymakers and researchers would benefit from research findings that contrast current outcomes from exemplary online teacher professional development projects, build collective insights from these results, and propose key themes and related methodologies

for studying the evolution of effective models. Alas, most of what is published about teacher professional development – whether face-to-face or online – does not present these types of findings based on well-designed empirical research studies.

In this study, we present a synthesis of what is known and not known in terms of empirical research about online Teacher Professional Development. We offer this as a first step towards illuminating best practices and evolving a research agenda based on findings and insights from current online teacher professional development models. The citations on which we base this synthesis are presented in the references section at the end of this paper. We have limited the scope of our study to synthesizing research based on substantial empirical evidence and published in a scholarly journal or similar venue within the past five years.

### **Visual Depictions of the State of Research in Online Teacher Professional Development**

This study attempts to organize the field of online teacher professional development into major categories and to ‘place’ the accumulated empirical research evidence (the known) into each category. Categories relatively unpopulated with research findings provide a measure of what is not known. This mapping of known and unknown facets of online teacher professional development can aid in developing a research agenda for the field.

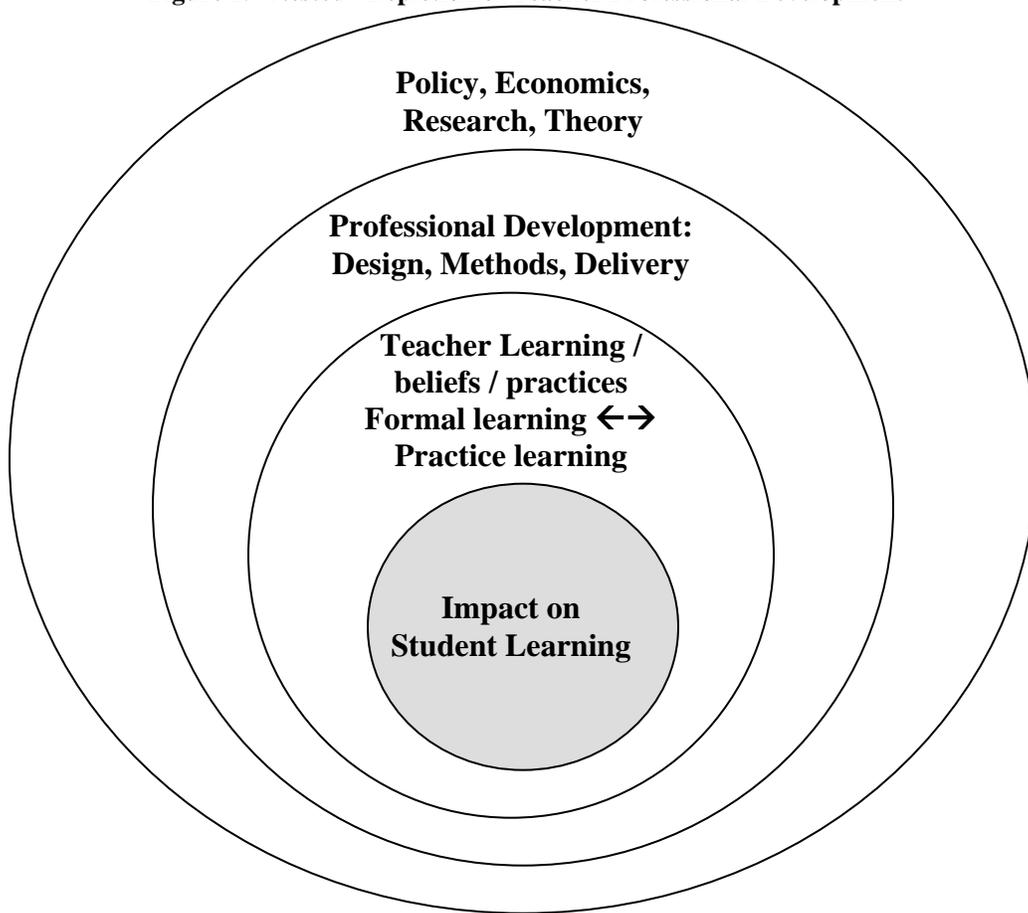
Advance organizers, as defined by Ausubel (1960), create a conceptual framework that helps participants organize a topic at the largest grain-size before delving into details and specific examples. By using an advance organizer, participants keep the forest in view even while observing and learning from individual trees. Since the purpose of this book is to learn from specific research and to map a larger plan for future research, it is crucial that we do not lose sight of the forest as a whole while learning from specific examples.

While Ausubel studied text-based organizers, the investigation and use of graphic organizers is far from new; for example, most of us are familiar with the aphorism that “a picture is worth a thousand words.” Both text and graphic organizers offer the ability to arrange ideas relationally, but only graphic organizers can show both linear and non-linear connections (Minchin, 2004).

We propose a graphic display to organize the field of online teacher professional development. Use of this visual identifies the density gradient of findings and improve discussion about those findings by giving us a common language. However, imposing an organization on the field does not come without problems. The act of creating the organizer can explicitly or implicitly impose a bias or perspective to the data. In addition, in designing such an organizer we risk inadvertently missing a category, thereby diminishing the utility of its portrayal. Therefore, the task we set ourselves was to design a graphical display of what is known and unknown about online teacher professional development general enough not to limit thinking while specific enough to show relationships, and to do so as objectively as possible.

We considered several formats for our organizer. Figure 1 is an example of one type. This organizer met the criteria of showing relationships between the large conceptual aspects of online teacher professional development, but we felt that this organizer would mask small holes in research findings. In addition, the design of this organizer presents its own view that each of these categories is embedded in others. While this may be true, we prefer this judgment to emerge from the findings, not from the visual organization.

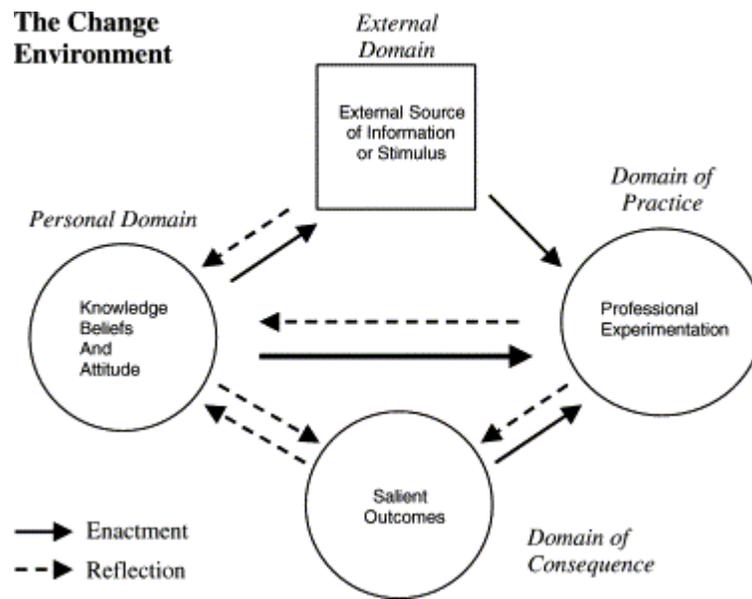
**Figure 1. “Nested” Depiction of Teacher Professional Development**



The literature also is a source of graphic displays of teacher professional development.

The Teacher Professional Growth Consortium developed the one shown in Figure 2.

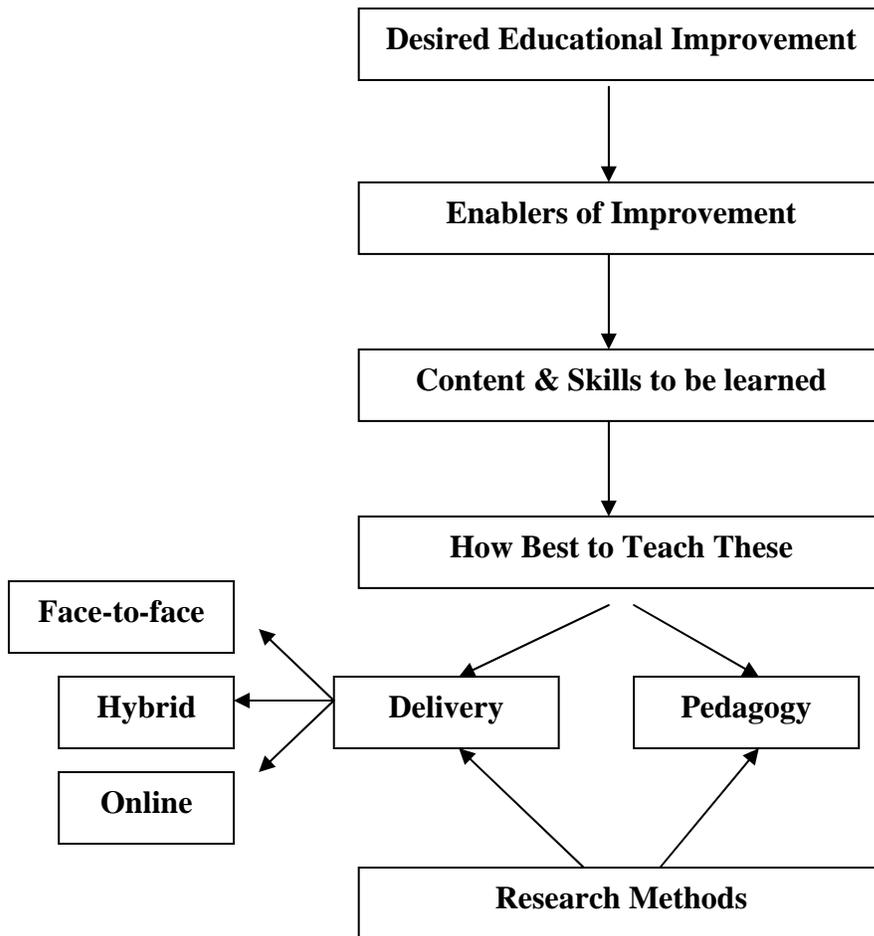
**Figure 2. The interconnected model of professional growth (Clarke & Hollingsworth, 2002)**



This display improves on the first graphic organizer by not limiting the direction of the relationships between each category. However, this display is embedded in theories of change. Therefore, we decided it would not suffice for our purposes.

Figure 3 shows our best model for synthesizing the research on online teacher professional development.

**Figure 3. “Flow” Perspective on Online Teacher Professional Development**



This organizer has the advantage of offering a more optimal grain-size of categories. For example, designers or researchers of online teacher professional development programs could zero in on the area of the developmental/evaluative process they are interested in and discover what is known about best practices in that area. In addition, this design offers categories of “delivery”, a particular interest to the field of online teacher professional development.

However, this is also not an optimal design; this organizer still implies specific relationships that the research findings may or may not validate. On balance, we feel that its advantages outweigh its disadvantages and will use Figure 3 throughout this study as we synthesize the empirical research on online teacher professional development.

## **Selecting Research Literature to Review**

The literature that addresses teacher professional development is extensive and diverse. Research studies in this field stretch back for decades and encompass an array of practical and theoretical approaches, program designs, and research methods that reflect shifts in the aims and purposes of teacher education and school improvement, as well as evolving approaches to education research. This review focuses on a recent (all but one study published in the past five years) and smaller subset of the teacher professional development literature. As our team searched through hundreds of articles, papers and book chapters published in the last decade, we focused on exploring the contours of recent research about online models for teacher professional development (although a few studies are included from the general teacher professional development literature as well). What were the topics and outcomes on which these scholars focused their attention? What empirical methods did they use, and what obstacles and challenges did they encounter? What patterns of findings are beginning to emerge?

Studies of online teacher professional development varied in orientation. Some of the literature we reviewed dealt with professional development with a particular content focus (e.g., math, science, technology skills, reading), a specific program approach (e.g. Understanding by Design), or a particular orientation towards teacher learning (e.g., mentoring, community of practice, cognitive apprenticeship). We encountered a fair amount of work that was anecdotal, describing professional development programs or “lessons learned” without providing full details of the participants, setting, research questions, methods of data collection, or strategies for analysis. Also, a great deal of the literature was theoretical, conceptual, or polemical, all categories outside the scope of this report.

We did not limit our review of the literature to a particular theoretical approach, pedagogy, technology, academic discipline, or method of professional development. Rather, we attempted to identify a group of empirical studies that contained findings based on rigorous methods of data collection and analysis; often, these included a mixture of qualitative and quantitative approaches. In searching, we cast a wide net, reviewing nearly four hundred articles about online, face-to-face, and hybrid teacher professional development programs (a list of which is available at [http://www.gse.harvard.edu/~dedech/oTPD\\_list.pdf](http://www.gse.harvard.edu/~dedech/oTPD_list.pdf)). Below we review in detail forty research studies that met our criteria for high quality empirical research. While the group of studies in this review is by no means exhaustive, we believe that collectively they represent the type of empirical research that has been conducted on online teacher professional development to date.

The research focus and stated purpose of these forty studies tended to address five areas of concern:

*Design of professional development:* the purpose of the study is to use empirical data to contribute to innovations or improvements to the design of professional development content, instruction, delivery or administration, focusing on factors such as program model, delivery, policy influences, contextual factors or best practices.

*Effectiveness of professional development:* the purpose of the study is to measure outcomes of professional development, such as participation levels, participant satisfaction, program quality in relation to a standard, or other intended effects or outcomes.

*Technology to support professional development:* the purpose of the study is to test or improve the design of a technology learning environment, tool, or online delivery system, or to gauge the effect of using a particular technology to support aspects of teachers' learning.

*Online communication and professional development:* the purpose of the study is to understand how instructors, moderators or facilitators can support teachers' learning through effective discourse in an online environment, or to describe the characteristics of teachers' online discourse (e.g., effects of gender, age, years of teaching experience, types of interactions, substantive vs superficial discourse, power dynamics, etc.).

*Research methods:* the study discusses important issues and appropriate research methods for studying teacher professional development.

While most of our discussion in this chapter focuses on the findings of these research studies, Table 1 below summarizes the intended focus of the studies we reviewed.

**Table 1. Summary of Studies (n=40)**

<b>Focus of Research</b>	<b>Studies</b>
<b><i>Design of Professional Development Program</i></b>	
Program design innovations and improvements	Brown & Green (2003) Clarke & Hollingsworth (2002) Kabilan (2004) Schlager & Fusco (2004) Turner et al (2004)
Identification of best practices	Clarke & Hollingsworth (2002) Fishman, et al (2003) Kabilan (2004) Leach, et al (2004) O'Connor & Ertmer (2003) Porter, Garet, et al (2000) Renninger & Shumar (2004) WestEd (2000)
Policy effects	Desimone, Porter, et al (2004) Dutro et al (2002) Porter, Garet, et al (2000)
Contextual factors	Dutro et al (2002) Mouza (2002) Schlager & Fusco (2004) WestEd (2000)
Comparison of methods of delivery	Harlen & Doubler (2004) Hawkes & Good (2000) Hawkes & Romiszowski (2001) King (2002)

	Sherer, Shea & Kristensen (2003) Yang & Liu (2004)
<b><i>Effectiveness of Professional Development</i></b>	
Outcome/change after program	Broadly-Ortmann (2002) Fishman, et al (2003) Harris & Grandgenett (2002) Hawkes & Good (2000) Hawkes & Romiszowski (2001) Leach, et al (2004) McKeown & Beck (2004) Mouza (2002) Neale, Smith & Johnson (1990) Porter, Garet, et al (2000) Schaverien (2003) Turner et al (2004) WestEd (2000)
Participation levels / participant satisfaction	Fishman, et al (2003) Job-Sluder & Barab (2004) Kabilan (2004) King & Dunham (2005) O'Connor & Ertmer (2003) Picciano (2002) Porter, Garet, et al (2000) Richardson & Swan (2003) Turner et al (2004)
Quality of program according to a standard	Brown & Green(2003) Fishman, et al (2003) Kabilan (2004) Porter, Garet, et al (2000)
<b><i>Technology to Support Professional Development</i></b>	
Design of technology environments and tools	Barab, McKinster & Scheckler (2004) Derry et al (2004) McKeown & Beck (2004) Renninger & Shumar (2004) Wearmouth, Smith & Soler (2004)
Effect of technology on specific TPD goals (e.g., teacher participation, professional community, self-efficacy, reflection, collaboration, mastery of new content, etc.)	Barnett, et al (2002) Curtis & Lawson (2001) Harlen & Doubler (2004) Hawkes & Good (2000) Hawkes & Romiszowski (2001) King & Dunham (2005) Koku & Wellman (2004) Leach, et al (2004) Nemirovsky & Galvis (2004) Renninger & Shumar (2004) Riel & Polin (2004)

	Schaverien (2003) Schlager & Fusco (2004) Sherer, Shea & Kristensen (2003) Wang, Sierra & Folger (2003) Wearmouth, Smith & Soler (2004) Yang & Liu (2004)
<b><i>Online Communication and Professional Development</i></b>	
Facilitation of online discourse	Nemirovsky & Galvis (2004) Picciano (2002) Wang, Sierra & Folger (2003)
Characteristics of online discourse communities (type and frequency of posts, analysis of participation by variables such as gender, age, years of teaching experience; topics posted, follow up posts, quality & depth of discussions, etc)	Barab, Barnett & Squire (2002) Barnett, et al (2002) Curtis & Lawson (2001) Harlen & Doubler (2004) Hawkes & Good (2000) Herring (2004) Koku & Wellman (2004) Job-Sluder & Barab (2004) King (2002) Nemirovsky & Galvis (2004) Picciano (2002) Richardson & Swan (2003) Wang, Sierra & Folger (2003) Wearmouth, Smith & Soler (2004)
<b><i>Research for Studying Professional Development</i></b>	
Methods and issues	Barab, Barnett & Squire (2002) Curtis & Lawson (2001) Fishman, et al (2003) Herring (2004) Job-Sluder & Barab (2004) Porter, Garet, et al (2000) Riel & Polin (2004) Schlager & Fusco (2004)

Note that most of the studies address more than one area of concern. For example, a study that looks at design of an online discussion environment to support teacher professional development may also examine the particular qualities of discourse in that environment, as well as the role of discussion facilitators.

## **Purposes of Professional Development**

Even as the literature we reviewed addressed one or more of the five areas of research described above, the professional development programs and settings from which their data was programs addressed a variety of school needs and reflected a range of theories about what teachers need to know, how teachers learn, the best conditions for learning, and how technology might support learning.

All professional development, either explicitly or implicitly, carries the intention to change something about a school in order to make it better. Whether that change is directed at students, administrators, or teachers, professional development may serve one or more purposes in a school—academic, administrative, political, civic, or social. The intent of a course of teacher professional development might be targeted and direct (for example, the improvement of a fifth grade teacher’s knowledge of a specific topic in mathematics or science) or more diffuse (creating a community of practice); it could be intended to improve efficiency (learning to use a new phone system or reporting form), or aimed at pedagogy (learning to use inquiry learning methods or a new technology in instruction), or directed towards classroom management (differentiation of instruction for students with different learning styles). Whatever the nature or source of a desired education improvement, all professional development interventions encompass someone’s definition of what needs to be changed – some skill, subject knowledge, practice or dynamic – a notion of what would be better, ideas about how to help members of the school community learn important skills and knowledge, and some definition of what would serve as evidence of improvement.

## Fostering Teachers' Abilities to Use Inquiry-Based, Constructivist Pedagogies with Students

In the studies we reviewed, one group of teacher professional development programs focused on changes in teachers' thinking and practice in their instruction of students towards what could broadly be described as a more constructivist approach. Derry, Seymour, Steinkuehler, Lee and Siegel (2004), through a TPD program called the Knowledge Building Community Model (KBC), studied how discourse in an online environment could help preservice teachers and their in-service mentors shift from didactic methods of instruction to "problem-based learning" (PBL). Hawkes and Good (2000) and Hawkes and Rominszowski (2001) looked at how computer-mediated collaborative dialogue compared with face-to-face dialogue to foster critical reflection among teachers learning to design curriculum for problem based learning. Barnett, Keating, Harwood and Saam (2002) studied teachers' web-based discussions focused on "inquiry-based pedagogies."

As another means of defining the objectives of professional development, Porter, Garet, Disimone, Yoon and Birman (2000) examined longitudinal data from the National Evaluation of the Eisenhower Professional Development Program in order to identify best practices that "enhance teaching and, ultimately, improve student learning" (p.10). Specifically, they looked at teacher professional development effectiveness and quality, as well as teachers' perceptions of how Eisenhower-sponsored professional development contributed to changes in their classroom practices. Models of professional development varied among schools participating in Eisenhower program, and this study does not provide details of their individual offerings. However, the working definitions of "effective instruction" and "good teaching practice" used in the study indicate that the Eisenhower-intended educational improvements included both increased alignment with national standards for math (NCTM) and science (NRC) and the

cultivation of teaching strategies to promote higher order thinking, inquiry, and active, project-centered instruction.

As another example of delineating the objectives of professional development, Clarke and Hollingsworth (2002) examined data from three Australian TPD programs (the ARTISM Study, The EMIC Study and the Negotiation of Meaning Project) to illustrate their model of teachers' professional growth. While the desired educational outcomes of these three TPD programs were not described in detail in Clarke and Hollingsworth's paper, one can infer what kinds of instructional changes might have been intended from their report of how teachers in these programs changed practice (i.e., emphasis on student participation, use of extended investigation projects tied to real world contexts, increase in student self-assessment, attention to different learning styles, generation of problem-solving strategies).

Fishman, Marx, Best and Tal (2003), in one of the only studies to examine teacher and student outcomes directly linked to teacher professional development goals, used data from the implementation of a LeTUS program in Detroit to develop an analytic framework linking teacher professional development to teachers' and students' learning. The aim of LeTUS is for middle school science teachers to learn to develop and implement project-based science curricula that help students meet district standards. Similarly, Neale, Smith, and Johnson (1990) explored how effectively teachers learned and implemented "conceptual change" teaching strategies for elementary school science—an approach involving greater use of inquiry in the classroom. Like the Fishman et al study, Neale, Smith, and Johnson's study attempts to measure the effect of professional development on teachers' practice and students' learning.

## Fostering Teachers' Abilities to Create Communities of Practice Among Students

Another group of professional development programs represented in these studies focused on fostering teachers' ability to create communities of practice among students in their classrooms, often aided by an online communications component. In general, encouraging the articulation and exchange of practice knowledge, creating opportunities for collaboration around common objectives, developing a common language, and supporting a culture of professional learning are among the desired educational improvements that communities of practice are intended to support (Riel and Polin, 2004). For example, Barab, Barnett and Squire (2002) studied a practice community model for pre-service teachers at Indiana University. The premise of this online PD program is that teachers learn through social and professional apprenticeship. They must experience the negotiation of meaning, reflection and collaboration of a learning community directly in order to create such learning communities in their own classrooms.

Even if desired educational improvements are not explicitly stated in the research focused on teacher professional development oriented towards communities of practice, an implied intention appears to be that articulating and sharing practice knowledge, reflecting on one's practice, collaborating, and engaging in dialogue are desirable aims in and of themselves likely to lead to changes in the instruction of students. Sherer, Shea, and Kristensen (2003) described how an online "Faculty Learning Community Portal" helped sustain interaction and learning among higher education faculty. Koku and Wellman (2004) conducted a similar study of university faculty using TeachNet to strengthen interdisciplinary exchange. Both studies were designed to observe and describe how faculty interactions evolved in their respective online forums, but neither described the student learning or instructional improvements these portals were developed to cultivate.

The goals of online and face-to-face mathematics workshops for pre-service teachers in Taiwan, studied by Yang and Liu (2004), were more explicit: to improve teacher interns' repertoires of mathematics knowledge and curricula through "cognitive apprenticeship." Schaverien (2003) reports on the use of a research-based, web-delivered "context" called the Generative Virtual Classroom (GVC), which was designed to help pre-service teachers and others develop their ability "to recognize, describe, analyze and theorize learning" (p 1). One aim of the GVC is to accelerate the process by which undergraduate teacher interns learn how to teach science with technology. Similarly, Wearmouth, Smith and Soler (2004) described a TPD program to reduce isolation and provide access to expertise for special education teachers. Another aim of this program was to develop a knowledge-building community of teacher researchers. Nemirovsky and Galvis (2004) go further in articulating the aims of a teacher professional development program that uses online video cases as the basis for "grounded," specific discussion of instructional practice and content knowledge. The aim of this program is to help teachers jointly invoke a shared language, focus on evidence, and avoid generalizations – and possibly to foster these types of thinking skills in students through using similar forms of discussion in classroom instruction.

#### Fostering the Intellectual Development of Teachers to Increase Student Learning

Many of the programs examined in this research were intended to foster the intellectual development of teachers: their knowledge of content in their academic disciplines and of pedagogical strategies related to that content. Renninger and Shumar (2004) studied how teachers engaged in rich discourse using the extensive content resources and communication tools available in the Math Forum. As described by Porter et al (2000), the Eisenhower-sponsored teacher professional development programs – the Inquiry Learning Forum (JobSluder

and Barab, 2004, Barnett, et al, 2002), the RUSMP Summer Campus (Turner, Cruz and Papakonstantinou, 2004) and LeTUS (Fishman et al, 2003) – were developed in part to support the improvement of teachers’ math and/or science knowledge. Dutro, Fiske, Koch, Roop and Wixson (2002) studied a Michigan program to improve teachers’ knowledge of curriculum standards in language arts.

In several of these studies, teachers’ learning to integrate new technology in instruction was the desired educational improvement. Leach, Patel, Peters, Power, Ahmed and Makalima’s (2004) study of Project DEEP looked at how teachers learned to use handheld computers to improve the teaching of literacy, numeracy and science in primary schools in Egypt and South Africa. Harris and Grandgenett (2002) studied how learning to use Internet tools and resources in instruction influenced teachers’ pedagogy overall. Mouza (2002) and Curtis and Lawson (2001) also studied teachers learning to integrate new technology in instruction.

### Measuring Effectiveness

Overall, while all of the research we reviewed drew empirical data from actual teacher professional development situations, it is notable that only a few studies were concerned with measuring how effectively the desired educational improvements at the heart of these teacher professional development interventions or programs were realized. Few studies attempted to measure observable changes in teachers’ knowledge or skill as a result of teacher professional development, and fewer addressed the ultimate effect of teacher professional development on student learning. Rather, the studies tend to look more closely at various aspects of the design, delivery, and use of oTPD—effects such as discourse patterns, contextual influences, and the formation of practice communities with conditions that support interaction, collaboration, participation, and teacher self-efficacy within these communities. One study that attempted to

document change in both teachers' approach and evidence of student learning was published by WestEd (2000). Using case studies, the WestEd researchers examined best practices of eight diverse schools that were recipients of the National Awards Program for Model Professional Development. At all eight sites, students made significant academic gains, regardless of socioeconomic factors, and teachers were able to describe consistently the pervasive changes in school culture, infrastructure, and their own knowledge and skills that contributed to these gains. Even so, for the majority of this group of studies, it appears that the purpose and desired outcomes of current research on oTPD are not often closely wedded to the aims and desired outcomes of the specific TPD program being studied. It is sometimes difficult, therefore, to discern how usable knowledge generated by these studies connects clearly and directly back to the concerns and perspectives of school leaders, teachers, and ultimately their students (as opposed to the work of university researchers and teacher professional development designers).

### **Enablers of Improvement**

Table 2 below shows specifically what aspects of teacher knowledge, skill or practice the TPD interventions in the studies in our review were trying to change in order to enable educational improvement.

**Table 2. Enablers of Improvement**

Study	Enablers of Improvement												
	Subject knowledge	Pedagogical knowledge	Pedagogy & subject knowledge	Critical reflection/ beliefs/ orientation	Align curriculum with standards	Skill / efficiency	Teacher leadership	Teacher discourse / collaboration	Practice community	Teacher's learning	Student's learning	Better TPD or oTPD design	Better research design
Barab et al (2004)			•					•		•		•	
Barab, Barnett and Squire (2002)				•				•		•		•	
Barnett et al (2002)		•		•			•			•		•	
Broady-Ortmann (2002)	•					•				•			
Brown & Green (2003)										•		•	
Clarke and Hollingsworth (2002)		•								•	•		
Curtis and Lawson (2001)							•			•		•	
Derry et al (2004)		•		•						•			
Desimone et al (2004)					•					•		•	
Dutro et al (2002)				•	•		•			•			
Fishman et al(2003)			•	•	•					•	•		•
Harlen and Doubler (2004)			•	•				•		•			
Harris and Grandgenett (2002)		•								•	•		
Hawkes and Good (2000)		•		•						•		•	
Hawkes and Romiszowski (2001)				•			•			•			
Herring (2004)							•	•					•
Job-Sluder and Barab (2004)								•		•		•	
Kaliban (2004)					•					•		•	

Study	Subject knowledge	Pedagogical knowledge	Pedagogy & subject knowledge	Critical reflection/ beliefs/ orientation	Align curriculum with standards	Skill / efficiency	Teacher leadership	Teacher discourse / collaboration	Practice community	Teacher's learning	Student's learning	Better TPD or oTPD design	Better research design
King (2002)				•				•		•		•	•
King and Dunham (2005)				•				•		•		•	
Koku and Wellman (2004)								•		•		•	
Leach et al (2004)		•								•	•		
McKeown and Beck (2004)		•								•		•	
Mouza (2002)	•					•			•	•			
Neale, Smith and Johnson (1990)			•	•						•	•		
Nemirovsky and Galvis (2004)			•	•						•			
O'Connor and Ertmer (2003)								•		•		•	
Picciano (2002)	•							•		•			
Porter, Garet et al (2000)			•							•	•	•	
Renninger and Shumar (2004)								•		•		•	
Richardson and Swan (2003)								•				•	
Riel and Polin (2004)				•				•		•			
Schaverien (2003)			•	•				•		•			
Schlager & Fusco (2004)								•		•		•	•
Sherer et al (2003)								•		•			
Turner et al (2004)			•		•			•		•			
Wang et al (2003)								•		•		•	
Wearmouth et al (2004)				•			•	•		•		•	
WestEd (2000)			•	•				•		•	•		
Yang and Liu (2004)	•							•					

In terms of the categories in Table 2:

*Subject knowledge*: focused on improving teachers' knowledge depth in their academic discipline, such as math, special education, science or language arts.

*Pedagogical knowledge*: focused on classroom practice and the design and delivery of instruction.

*Subject knowledge and pedagogy*: focused on design and delivery of instruction specific to a subject domain.

*Critical reflection/beliefs/orientation*: focused on changing teachers' beliefs and/or approach to instruction, and to encourage reflective practice.

*Standards alignment*: focused on the implementation of curriculum standards developed by a district, state, or subject-matter authority such as NCTM.

*Skill/efficiency*: highlighted the mastery of skills that could be applied across disciplines and pedagogical methods, such as learning some new hardware and software, or developing skills for communicating effectively online.

*Teacher leadership*: cultivated teachers' capacity to serve as change agents or to practice research in school setting.

*Teacher discourse/collaboration*: built teachers' capacity to discuss practice and collaborate on curriculum development, planning of instruction, or other school matters.

*Practice community*: created or supported a community of practice (usually using online communications), for reasons often not clearly specified beyond community-building itself.

Note that all of the programs in these studies focused on multiple enablers. All but four of the studies were primarily concerned with teachers' learning. The four that did not specifically address teachers' learning were studies more intent on improving the design,

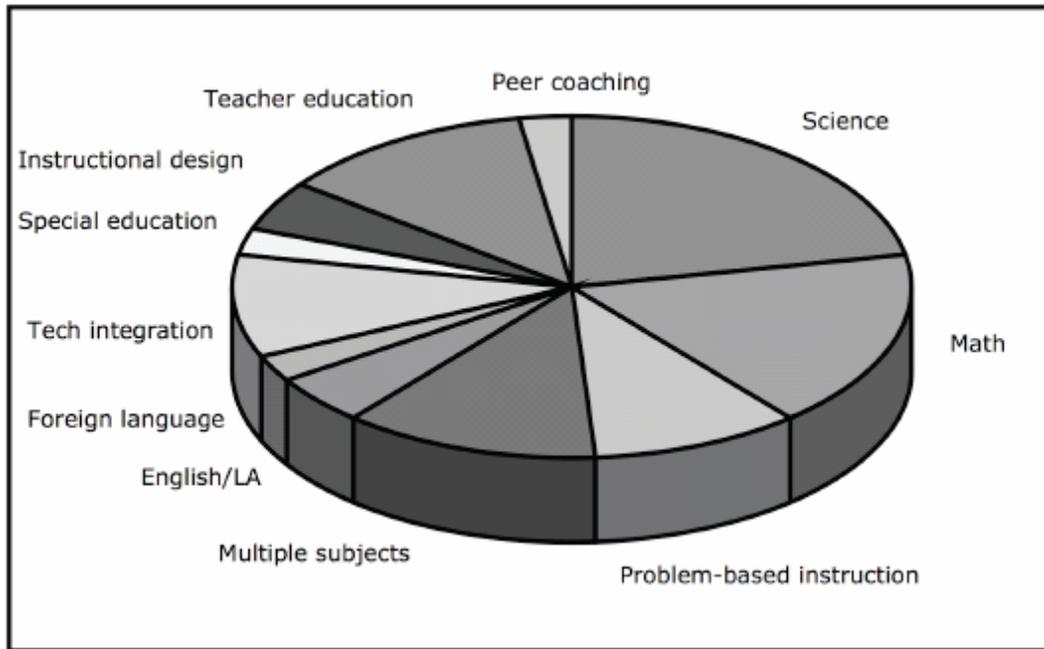
delivery or facilitation of professional development for any population, not specific to teachers, or else on developing research methods for studying professional development.

Table 2 also indicates which studies stated the improvement of professional development programs (either online or not) or the development of new methods for studying professional development was a primary research goal. It is notable that only five of the research studies we reviewed attempted to determine the effect of teacher professional development on student learning or educational outcomes.

### **Content and Skills Taught**

The professional development in the studies we reviewed addressed a number of content areas (e.g., math, science, language arts) and professional skills (e.g., instructional design, peer coaching). Some addressed more than one primary topic (e.g., both math and science, or crossdisciplinary exchanges). Figure 4 shows that the largest number of professional development programs were for math (n=8) and science (n=9) content, followed by programs that involved multiple subjects (n=5), and those focused on learning new pedagogical methods -- specifically, "problem-based learning." (n=4). Several courses focused on other content, such as English/language arts (n=2), foreign language (n=1), special education (n=1), and technology integration (n=4). A number of the professional development programs in the studies were for pre-service teacher education (n=5), including instructional design (n=2) and peer coaching (n=1). Six of the studies did not describe a particular content focus or skill.

**Figure 4. Content and Skills Addressed by Online Teacher Professional Development**



The next section describes the pedagogical strategies used to convey the content and skills.

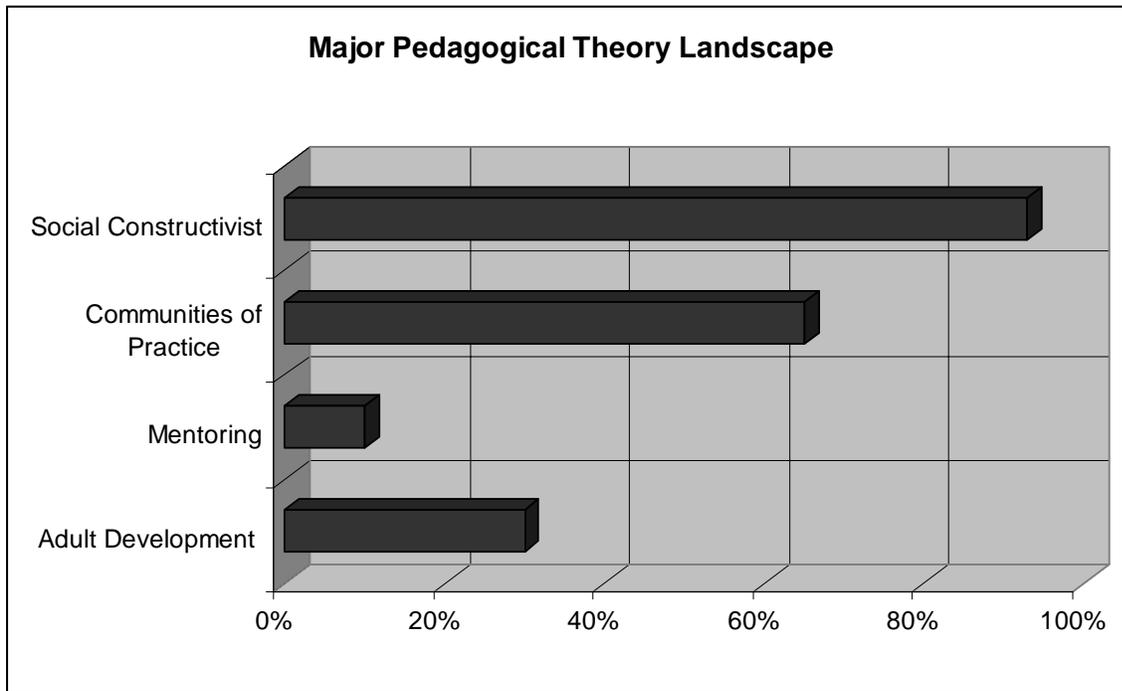
#### **Findings about Pedagogical Approaches in Online Teacher Professional Development**

Rudestam and Schoenholtz-Read (2002) write that “electronic teaching developed from advances in communications technology, not from innovative changes in pedagogy.” On the other hand, Amy Bruckman (2004) argues that technological design and pedagogy have the potential to co-evolve, and recent research in online teacher professional development programs supports this idea. The teacher professional development programs described by the empirical research included in this chapter were designed and implemented based on explicit and implicit pedagogical assumptions held by the designers and instructors about the new ways teachers can learn when the affordances of new information technologies are utilized. This section explores the diverse range of pedagogical stances adopted by the designers of these teacher professional development programs in order to shed light on the current state of pedagogy in online teacher professional development.

The degree to which the studies included in this chapter made clear the programs' pedagogies varied widely: from making no explicit mention of pedagogy to devoting a section on the theoretical framework that informed the program design. The degrees of difference are of course influenced by the research questions that informed the study and the data collected in order to answer those questions. However, a common theme emerged across the range—most describe a “social constructivist” or “communities of practice” stance, albeit often with a very cursory definition of the meaning of these terms in their research context.

Figure 5, below, gives a sense of the influence of these pedagogical theories on oTPD research and design—for example, the social constructivist approach appears to have influenced nearly every study, with communities of practice theory following closely. Most of the studies we looked at derived their pedagogical approach from more than one theory (for example, many used social constructivist principles and communities of practice approaches), so the percentages reflect the landscape, not a cumulative count of every pedagogical theory referenced in each study.

**Figure 5. The influence of pedagogical theory on oTPD research and design**



Almost all of the professional development programs, as represented in these studies, claim or imply pedagogy grounded in social constructivism. Underneath the social constructivist umbrella, however, lie various interpretations of social constructivism and diverse uses of language to define them. Common pedagogical approaches, writ large, include communities of practice, situated learning, problem-based learning, collaborative learning, inquiry-based learning, and mentoring. Within these program designs, we found a range of methods of realizing teacher learning, including grounded discussions, critical reflection, case-based learning, modeling, and cognitive apprenticeship.

The distinctions these researchers made between methods of enacting pedagogy and the pedagogies themselves are soft distinctions at best. Many programs included overlapping approaches to the delivery of the professional development program, for example, problem-based learning tasks nested in a community of practice (Brown & Green, 2003). Similarly, some

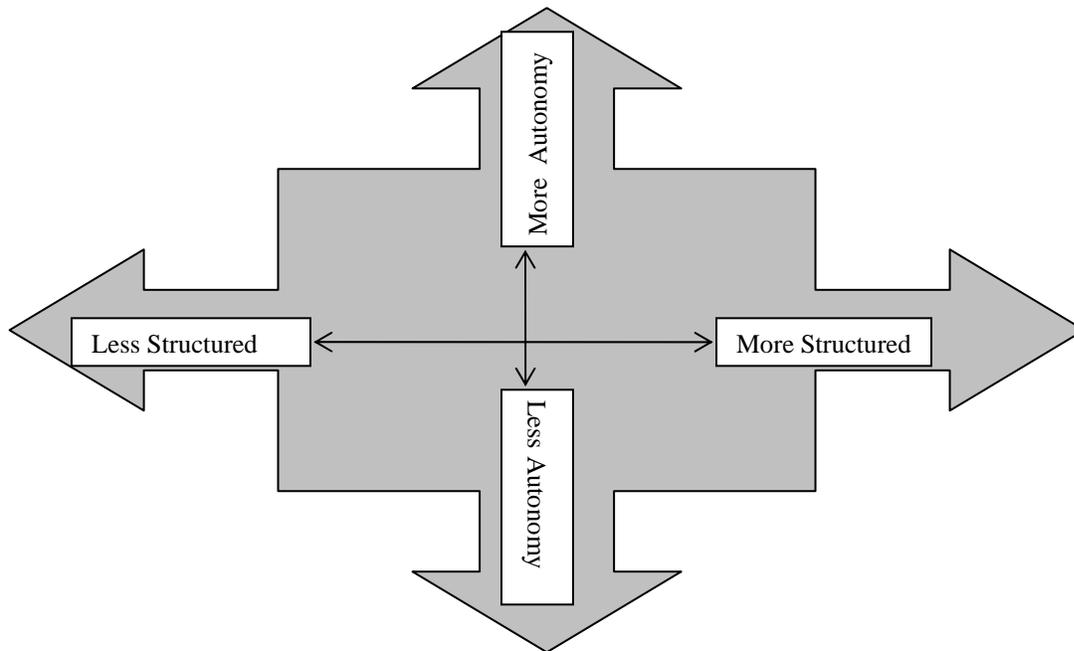
methods of delivery were used in the service of different pedagogies; as an illustration, cases of instructional practice were included in programs that used them as fodder for a particular kind of discussion with other teachers (Nemirovsky & Galvis, 2004) or as stand-alone materials to be processed by the individual teacher as s/he wishes (McKeown & Beck, 2004).

In the subsection that follows, our sketch of the pedagogical research terrain includes both those pedagogies that were clearly articulated and our inferences (from research questions, analyses or findings presented) about pedagogies that informed less specifically described teacher professional development programs. In an attempt to outline the uneven landscape of pedagogy and delivery, we have framed our discussion of social constructivist pedagogies in terms of a continuum of autonomy and structure. We believe this approach allows space to consider the teacher as learner within a social and professional pedagogical context called for by a social constructivist pedagogical stance, as well as to elicit implications for design decisions in light of that consideration. We provide examples of studies and programs that seem to best represent particular points along the continuum.

### Snapshots of Pedagogies Represented

Overall, the pedagogies represented in the professional development programs we analyzed fall along a continuum of structure (from the program perspective) and a corresponding scale of autonomy (from the individual adult learner perspective). The figure below provides a visual representation of the continuum, and deliberately suggests that projects fall not only on the lines, but also in the quadrants between them.

**Figure 6. Structure-Autonomy Continuum of Pedagogies Used in the 40 studies**



On the less structured end of the scale, there are professional development systems in which participants largely determine the content of their learning, as well as the extent and nature of their participation in the structure that supports their learning. Tapped In 2 (TI2) represents a professional development approach that we would place in the upper left quadrant of this diagram, because it is both less structured and more autonomous in its approach than most other programs. TI2 allows individual teachers and both formal and informal educational groups to use the tools in the online environment, while also providing support for institutions. The underlying constructivist pedagogy is that learners are capable of creating their own structures for learning if given control of the tools, while simultaneously offering the same tools to institutions that may provide more structured learning programs (Schlager & Fusco, 2004).

The Math Forum, documented in Renninger and Shumar's work (2004) is a typical example of an external professional development website because it offers a multitude of resources and archived teaching-related materials, as well as several types of opportunities to interact with fellow teachers, mentors, researchers and educators. Regardless of the type of

interaction, the participating teacher largely determines the nature and direction of the conversation, according to his/her needs and based on his/her own experiences and reactions to the available content. Social constructivism in this context becomes a matter of allowing individuals the autonomy to determine the course of their own learning while providing a space where a structure – in the form of content resources, fellow learners and facilitators – can emerge around those needs in support of that learning.

On the other end of the spectrum, in the bottom right quadrant of Figure 6, the Seeing Math Elementary and Seeing Math Secondary Telecommunications Projects represent a more rigid approach with established content and specific behaviors that teachers are asked to engage in around that content. Developed by the Concord Consortium (<http://www.concord.org/>), the Seeing Math Projects utilize video-based case studies of math teaching coupled with video commentary by expert math educators and interactives that allow exploration of targeted math concepts in new ways. The cases for the elementary and secondary programs, distributed by Teachscape, Inc. (<http://www.teachscape.com>) and PBS Teacherline (<http://teacherline.pbs.org/teacherline>), respectively, were designed to highlight math concepts identified by the National Council of Teachers of Mathematics as particularly difficult to teach. Participating teachers are expected to learn about instructional practices and typical student difficulties by engaging in facilitated discussions about the cases in online formats or possibly in mixed online and face-to-face settings. The cases offer concrete instructional examples around which practical discussions are built and in relation to which teachers reflect on and analyze their own teaching. Furthermore, an expert math educator's commentary on a teaching case can further teachers' thinking by presenting an alternate view on an instructional challenge (George Collison, personal communication, August 2005). In this context, where the curriculum is

determined *a priori*, pedagogical and social constructivism is primarily enacted in the fostering of explicit interactions among the teacher-learners around rich and specific experiences of video, expert commentary, and dynamic interactives. Nemirovsky and Galvis (2001) offer a preliminary report on online dialogue on one Seeing Math Elementary case in a pilot district in Rapid City, South Dakota.

The Inquiry Learning Forum (Job-Sluder & Barab, 2004) represents a pedagogical approach somewhere in the middle of our continuum. In this context, the enactment of social constructivism positions the teacher-learner as both recipient and catalyst of content. Likewise, while each individual occupies an equal role in the learning process, the needs of individual learner are constantly negotiated in relation to the needs of the community, especially regarding the learning process. The shared overarching goal, the willing creation of a structure to support the co-construction of knowledge, maintains its primacy in order for the community and the individual to advance in their understanding.

Another example at the structured and controlled end of the continuum is WIDE World, an online teacher professional development program created by two faculty members at the Harvard Graduate School of Education (Wiske & Perkins, 2005). Even though this program does not have empirical research results comparable to the forty studies we synthesized, WIDE is in our discussion because this program “sails against the wind” with innovative pedagogical practices that wrestle with important issues of scaling up to serve large numbers of educators. In particular, WIDE program design includes using coaches to help participants in large enrollment courses feel connected, and content and tools that promote accommodation rather than assimilation of their practice to new pedagogical principles (see Piaget Goes Digital chapter for a discussion of the Piagetian notions of assimilation versus accommodation). WIDE World’s

communities of practice aspect is nested within a presentational format in which teacher learners work as individuals and in small groups to develop curricula or lesson plans using specific teaching methods (for example Teaching for Understanding developed by David Perkins and his colleagues [1992], or Howard Gardner's Multiple Intelligences [1999]). As discussed next, the mentoring aspect exemplified by coaches in WIDE World is more clearly reflected and developed in other research included in our study.

### *The special case of mentoring*

Several programs represented in this analysis involve some form of mentoring. The way in which mentoring is used varies from program to program; most forms of mentoring are nested in a social constructivist perspective. Given the increasing prominence of mentoring in professional development programs and in research about online, hybrid, and face-to-face models, it is worth noting the variety of mentoring enactments in the studies we reviewed. Overall, the ways in which mentoring is used in these programs reflects the same structure-autonomy-control continuum for the learner.

Studies in this sub-category had mentors available to participating teachers in the form of guest experts (Wearmouth et al, 2004), experienced in-service teachers for teacher education students (Barnett et al, 2002), or fellow teachers in peer-to-peer collaborative settings (Yang and Liu, 2004). Some mentoring opportunities were very loosely structured. For example, in the Inquiry Learning Forum, pre-service teachers had the opportunity to engage with in-service teachers online in asynchronous discussions about inquiry-based pedagogies; the inquiry-based content of the discussions was prescribed, but the role of teacher-mentor was less structured. Mentors were "present" simply to participate in the discussion, responding to participants' queries and offering their perspectives. (Barnett et al, 2002).

Other online teacher professional development models positioned mentors in a specific role and intended for their participation to meet a particular need. For example, Wearmouth et al (2004) investigated the role of the guest expert in the computer conferencing component of a hybrid graduate-level course for special educational needs coordinators. The guest expert, available only in the online component of the course and during specific time periods, was intended to fulfill a particular instructional need -- prompting discussions about specific topics that had already arisen in the course and helping the students to be more reflective in all their discussions. The intended requirements for content and process, then, locate this version of mentoring more towards the structured end of the scale of Figure 6.

Taiwan's Mathematical Competency Workshops represent an approach to mentoring between the extremes of structure, autonomy and control. Yang and Liu (2004) investigated a hybrid professional development program that combined lectures, coaching, modeling, discussions and other opportunities to join together teachers of many experience levels. In this model, the official mentors were senior math teachers who assisted online course facilitators in the more didactic aspects of the course, while all participating teachers were positioned as potential mentors to each other depending on the topic under consideration. Certain aspects of the course content were highly controlled; for example, the mentors determined the topics of the weekly synchronous chats. The way in which the mentors were supposed to facilitate, however, and the goals of the discussions, remained unprescribed. The combination of managing discussion content, while allowing for various kinds of mentor involvement in different aspects of the workshops, positions this model in the middle of the control-autonomy spectrum.

In the following section, we offer highlights and prevalent themes about pedagogy that emerged from the findings of the forty studies we reviewed.

## Synthesis of Findings about Pedagogy

In the discussion above, we have presented a range of pedagogical stances along the continuums of tight program structure/loose program structure and individual autonomy/control in order to highlight the teacher as learner. Up to this point, we have purposely not included the findings from the research done on the programs we described. We believe that it is more powerful for the reader to consider the pedagogical implications first conceptually, then within the context of the major findings.

Most of the findings from empirical studies related to pedagogy were concerned with interactions among individuals and groups participating in the programs studied and the contexts or conditions that appeared to foster those interactions. Other findings included claims about what kinds of design components facilitate learning in online teacher professional development, and still others offered comparisons between face-to-face and online interactions. Few of the studies included empirical evidence of teacher change or of student improvement, although most recommended further research to address these concerns.

Of the many studies that investigated the nature of interactions online, overall there are indications that meaningful ways of engaging in dialogue can emerge and that desirable thinking skills can develop through online interaction. Online discussions and individual contributions can be reflective, interactive, collaborative or community building. Their emergence, however, is hardly guaranteed by the provision of a space to develop those discussions and skills; support structures are required to overcome participants' unfamiliarity with technological environments or with the experience of communicating primarily in writing. Since it lies beyond the scope of this chapter to detail the results from every study in this analysis, the following section offers a sampling of robust and representative findings from the group of studies reviewed.

Broady and Ortmann (2002), in their investigation of a distance learning course for German teachers, found that participants perceived the public nature of the learning as threatening rather than unifying; as such, a cohort failed to emerge despite anticipation to the contrary. In a more fine-grained analysis of community, Wang, Sierra and Folger (2003) found that the markers of a community (active participation, development of shared identity and social networking) were present in an online-only environment among a group of teachers enrolled in an instructional design course, despite the absence of direct attempts to foster community. The authors suggest that collaborative learning tasks demanded of the students contributed to the formation of community. Nevertheless, the more prevalent kinds of communications in evidence were of the social interaction and information sharing type, rather than negotiations or argumentations, implying that more deliberate structure may be needed to deepen the nature of participants' engagement with each other.

Barnett et al (2002) offer insights into what some of the supporting structures might be. In their investigation of the Inquiry Learning Forum, Barnett and colleagues found that, in general, the students explored their beliefs about inquiry-based learning more when asked pointed, focused questions; instructor intervention was necessary to get students to offer evidence for those beliefs. The most in-depth online discussions were those that involved an in-service teacher acting in a mentoring capacity to the students, or those sessions when the discussion was centered on a video-based example of teaching practice.

Nemirovsky and Galvis (2004) offer another perspective on the cultivation of discussion behaviors in online environments. In their investigation of South Dakota's Seeing Math Telecommunications Project, they found that grounded contributions (i.e. grounded in the specifics of the teaching practice examples seen in video cases) fail to happen spontaneously and

that they need to be fostered explicitly by instructors. Mirroring the results of Barnett et al's (2002) findings, it was not enough to ask participants to be specific in their contributions. Rather, asking about a specific criterion within the case or in relation to their own teaching, about which teachers could offer detailed commentary, made the difference in generating discussion grounded in the specifics of teaching practice. The authors suggest that combining these discussion prompts with other learning tasks that relate to the ideas from the discussions is a good way to generate grounded interactions.

Richardson and Swan (2003) offer a look into the way social relationships in online learning contexts connect to actual learner outcomes, investigating a diverse group of graduate students (rather than practicing teachers) enrolled in online courses in a variety of subjects. The researchers found that online social presence (as perceived by participants) can be developed and that it correlates fairly strongly with both perceived learning and satisfaction with the course instructor. Specifically, social presence was found to be a statistically significant predictor of perceived learning, and the correlations between perceived presence and learning were highest in class discussion/Q&A areas and group projects.

All of the above findings converge with the more theoretical work of Riel and Polin (2004), who have investigated the dimensions of community in three different teacher learning settings and derived a theoretical framework for the development of technological environments. They argue that learning activities are situated in task-, practice-, or knowledge-based communities, which are part of a larger organizational learning structure where creating systems of interchange among the groups supports a culture of community learning.

The few studies that attempted to compare face-to-face and online learning experiences offer beginning insights into the differences between the settings. All of these studies recognize

the difficulty of comparing face-to-face and online data, despite rigorous efforts in collection and analysis to make the data comparable. Harlen and Doubler (2004), in investigating the online and offline versions of the *TryScience* course for science teachers, found promising results in favor of the potential benefits of online professional development for building science understanding and inquiry skills. They found that online participants were more reflective about their learning and about the inquiry process (a target goal of the professional development course) than their face-to-face participants, though both groups of teachers were employing science inquiry skills. More time was spent by the online than the offline participants, and there was no significant difference in the way the two groups perceived their benefit from participating in their working groups online or off. Importantly, teachers learned more science in the online course than in the face-to-face version.

Hawkes and Good (2000), in their investigation of a hybrid program designed to foster participating teachers' capacity for developing problem-based learning curricula, found that, overall, face-to-face discourse rated higher for interactivity than did online discourse, but that online discourse was significantly more reflective. Comfort with technology was shown to have a fairly strong correlation with the degree of reflection evidenced in participants' contributions. Teachers recognized the convenience and potential of technology for communication; still, most believed that online could not replace in person communication. Their objections to online communications implicated both the technology itself (a disjointed way of communicating) but also more deeply ingrained beliefs about teaching culture (how the forum was public).

In another set of studies on the same professional development program, Hawkes and Romiszowski (2001) found similar results regarding the two venues for teacher communication: more reflective dialog online, more interactive dialog face-to-face, but neither venue producing

abundantly reflective dialog. Online communication was found to include more self-efficacy building and motivational language among participants, but that higher levels of self-efficacy do not automatically translate into more reflective contributions in either environment. Hawkes and Good (2000) recommend that to increase the level of reflectivity in discourse both on- and offline when there is specific work to be done, the task should drive the agenda, and critical reflection should be planned as an explicit objective of the process.

The next section analyzes the kind of research methods used to derive the types of findings above. We depict how research approaches are evolving as new models of teacher professional development emerge.

### **Findings about Research Approaches in Online Teacher Professional Development**

The first online teacher professional development programs, created a decade or more ago, were often characterized by the transfer of face-to-face pedagogy and text-centered course content to a web-based container (Stevens-Long & Crowell, 2002). As the usability and functionality of various technologies has improved over time, video, audio, and other forms of multimedia have been used more frequently to represent current content in online professional development programs. In response to the increasing capacity of technologies and their environments, new pedagogical models designed specifically for online learning have developed. As a result, research methods for analyzing oTPD have also evolved over time (Bruckman, 2004).

In the early years of online teacher professional development, new ground was broken in research methodologies on efficacy, learning, and pedagogy by researcher/designer/instructors. Harasim, Hiltz, Toles and Turoff (1996) and Palloff and Pratt (1999) were very influential in this research with their descriptive and prescriptive qualitative studies of learning networks for

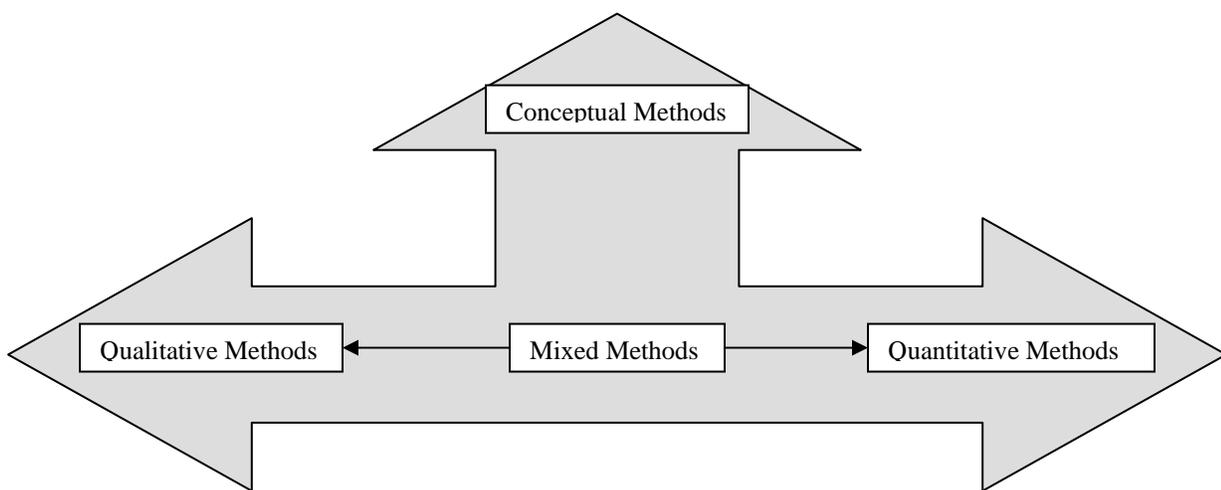
teachers in the 1990s. Other researchers used quantitative methods to compare outcomes between face-to-face and online courses, often finding “no significant difference” in outcomes, yet these methods raised many intriguing questions about other aspects of teachers learning online (Joy & Garcia, 2000).

Now, the research methods used for exploring oTPD have expanded to include empirical methods -- both quantitative and qualitative --that are replicable, although most studies are still on a very small scale and not robustly generalizable across contexts (Borko, 2004). In order to sketch out the research landscape of online teacher professional development, in this section we will describe the research methods used in the recent, empirical studies included in this overview.

A majority of the research studies we examined used a range of qualitative methods in their approach. These methodologies ranged from using qualitative software packages to by-hand, grounded methods in coding audio and/or video interviews, observations, and documents. Quantitative research methods were used in some larger scale studies, primarily at the district level. However, much of the quantitative analyses were part of a mixed methods methodology. In those cases, qualitative data, such as interviews, were often coded and used to support the quantitative findings; or, contrarily, statistical analyses of survey responses or data frequencies (for example, the number of postings to an asynchronous discussion forum) were used to support qualitative coding methods. Several of the studies included are more conceptual in nature—they develop an argument and produce a particular analytical framework for aiding the design of online teacher professional development or for gaining a better understanding of group and individual interactions. In fact, most of the studies we could find to review were focused on the nature of the interactivity in the program and/or participants being studied.

We present our findings about research methods across a field similar to that in the pedagogical section that moves from qualitative to mixed methods to quantitative, with conceptual methods to provide context for new and innovative research designs. We think this is a useful way of painting in this landscape because it highlights our emphasis on conceptual/empirical research as opposed to descriptive/prescriptive research.

**Figure 7. Research Methods Continuum**



The following subsection provides snapshots of research methods used in selected studies presented at the Online Teacher Professional Development Conference, and from the literature that are representative of the spectrum of research methods used overall.

#### Snapshots of Research Methods Represented

As an example of the upper, conceptual area of Figure 7, Barab, Kling, and Gray (2004) recently published a book that explores online teacher professional development from the designers' perspective. Several of the studies in the book are included in this overview. These studies tend to be conceptual in nature—in that they provide a description of the landscape to be explored, develop an argument for using a particular analytic framework, and then propose

questions for further research as well as recommendations for using the framework for further analysis. For example, Barab, MaKinster and Scheckler (2004) present a social view of learning as a central aspect for design consideration and then walk the reader through development of an analytic framework based on communities of practice theory and activity theory to develop six dualities or tensions of design that are important to understanding and sustaining communities of practice for teachers in the Inquiry Learning Forum. Schlager and Fusco (2004) write of the concept of practice and argue that communities of purpose better describe effective online teacher professional development. They use activity theory and communities of practice theory to develop eight guideposts that help designers connect stakeholders (education practitioners, providers and researchers) in online teacher professional development that supports work in instructional improvement.

Two studies will serve as examples of more qualitative mixed methods (towards the left of center in Figure 7), Renninger and Shumar (2004) problematize the terms “community” and “culture” to explore the impact on participant learning in *The Math Forum*. They use quantitative and qualitative findings from the BRAP project (Bridging Research and Practice) to support their claims that *The Math Forum*'s effective leveraging of community and culture led to individual needs being met while the community also benefits (Renninger & Shumar, 2004).

Yang and Liu (2004) did a case study of an online workshop designed to evaluate the effectiveness of online workshops as a tool for creating professional learning communities (as evidenced by participant perceptions, quality of interactions, and quality of mentoring). This workshop enacted a cognitive apprenticeship model in which expert teachers mentored both pre- and in-service teachers. The researchers analyzed the content of message posts to determine the quality of both the participants' dialogical exchanges and the mentoring received from the expert

teachers. As was the case in many of the studies we reviewed for this chapter, the content of the online interactions was analyzed according to a relevant rubric or taxonomy to assess the desired skill or behavior under investigation; in this case, Yang and Liu coded participants' postings in accordance with the knowledge-building quality criteria proposed by Stahl (1999) and by Bozdin & Park (2000). To assess the quality of the mentoring, they based their coding on an adaptation of the twelve forms of electronic mentoring and facilitation, as documented in Bonk and Kim (1998) and Bonk, Angeli, Malikowski, and Supplee (2001). The investigators found that little interaction between mentors and mentees—less than 10% of posts were responses to each other, and the rest were introductions and organizing messages.

Both Yang and Liu's and Renninger's two studies investigated specific groups and individual interactions that were an explicit goal within a particular oTPD program using mainly qualitative methods; the following studies focus on interactions that occur within the program, not necessarily as a specific goal of the program. Staying with the mixed methods/qualitative end of the continuum of Figure 7, Hawkes and Good (2000) studied the importance of critical reflection and how it arises in collaborative computer-mediated dialogue, using 28 teachers from 10 Chicago schools. They describe their research strategy as a multi-method, quasi-experimental approach in which they compared the presence (or lack) of reflection in unmoderated online and face-to-face discourse, through use of audio-recordings of face-to-face meetings and text archives from the online discussions. They coded both audio and text in the same way, using a reflection matrix developed by Simmons, Sparks, Starko, Pasc, Colton and Grinberg's (1989) taxonomy for assessing reflective thinking. Their findings claimed that online communication is capable of facilitating reflective discourse at a level that encourages teachers to collaboratively examine their practice in light of instructional theory.

Also in this part of the research methods continuum of Figure 7, Harlan and Doubler (2004) did a comparative study of an online course called *TryScience*, for which they compared aspects of the online course with a face-to-face course with the same objectives and content. They combined video observations and field notes from trained observers to document the experience of the teacher learners in the face-to-face classroom, while the archive of online postings was used to record the experience of teacher-learners online. Participants' contributions to both environments were analyzed according to the researchers' own matrix, most of which described various levels of reflection, inquiry, and content knowledge evidence. Pre-and post-questionnaires were used in similar ways for both groups of participants. They found that participants online were more reflective on their practice and felt they had benefited more from the course than the face-to-face group.

Some larger scale studies, also using mixed methods, focused on reform initiatives at the district or regional level rather than on small group or individual interactions. Although the reviewed studies are not “typical” of online teacher professional development research, they do represent the research methodologies used to investigate educational practices on a large scale that may well include online teacher professional development. For example, Dutro, et al (2002) explored how encounters with standards-based professional development affected language arts teachers’ visions of themselves as agents of change, both within their classrooms and in the district. They used thematic analysis of open-ended interviews and self-reports of attitude changes; they also assessed increased teacher capacity through studying artifacts from about 50 teachers and administrators in 4 school districts in Michigan. Their findings were that for a district to invest large sums in professional development and focus on the development of teachers can have substantial payoffs.

The work of Desimone, Garet and Yoon (2004) is a more typical example of a mixed method study at the district-level with an emphasis on the quantitative (towards the right of the continuum in Figure 7). These researchers used data from the Eisenhower Project to explore links between federal policies and strategies of implementation for reform. The data was collected from a national probability sample of Eisenhower districts in 1997, from computer-assisted phone interviews of district professional development coordinators, and survey data from a sample of Eisenhower coordinators. For research methods, descriptive statistics analysis and ordinary least squares regression equations were used to allow development of a path model that examined the prevalence of district strategies nationwide and determined where patterns of district support differed according to poverty level or district size. The researchers found that larger districts were more likely to be aligned with state standards and that the relationship of district poverty levels with support was not statistically significant. They also found that the most common forms of needs assessment are teacher surveys and informal conversations.

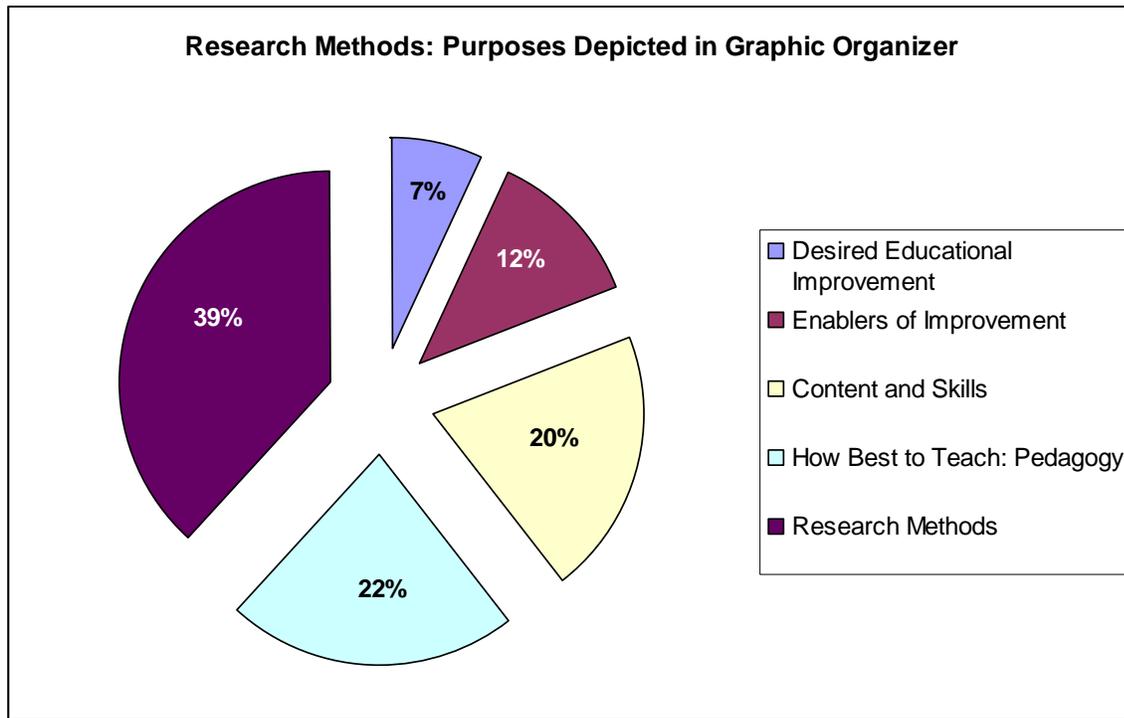
Another large study we examined was quantitative and based on a national sample. Porter and colleagues (2000) also used data from a national survey sponsored by the Eisenhower Project to identify characteristics of professional development that improve teaching practice. For research methods, the investigators used ordinary least squares regression (OLS) to estimate a formal causal link between the structural and substantive forms of TPD, hierarchical linear modeling to analyze differences in the six dimensions of quality, multivariate analysis to see whether or not the PD focused on specific teaching strategies or sets of strategies, and factor analysis to measure quality of teaching practice. They found that there were no significant differences in quality between Eisenhower funded and non-Eisenhower funded activities. Despite little change over time in teaching practices on average, individual teachers in the

sample did vary in their classroom practices, and moderate variation did occur in the classroom practices of teachers from year to year.

The range of research methods used to study online and face-to-face teacher professional development cuts a wide swathe across the research terrain, although the findings generally seem clustered into studies on design, pedagogy and interactions on a small scale, and research on implications of district level reform on a large scale. Findings do not always seem well aligned with the purposes of the research, but the analytic methods indicate a spectrum of approaches effective for various types of research questions. Overall, through these research approaches the field has learned much about the nature of interactions in online teacher professional development, but less about actual teacher changes in practice or how these might connect to improvement in student learning.

To place the research methods section in the more abstract context of our graphic organizers, Figure 8 below shows that most of the studies we examined (39%) were about types of research methods developed from research- and theory-based conceptual frameworks for creating better understanding design, pedagogy and other factors of oTPD and TPD.

**Figure 8. Research Methods in Graphical Organizer**

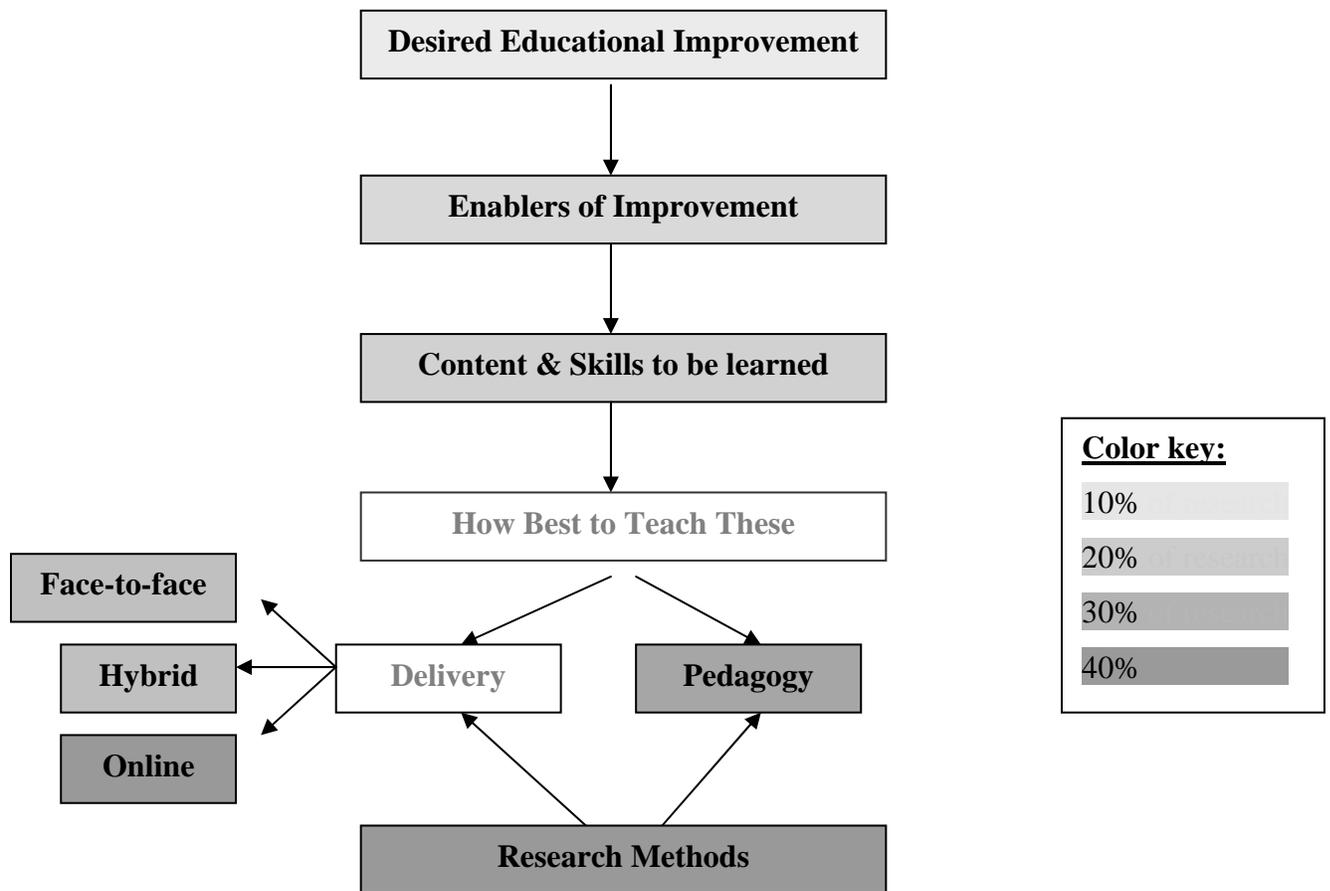


The next largest percentage (22%) of research methods clustered around issues of pedagogy. These studies tended to examine programs that both model and teach a particular pedagogical method, or to draw out implications for pedagogy through examining learner interactions and design decisions. Twenty percent of the research methods were designed to elicit new knowledge about content and skills in oTPD and TPD—for example, in the snapshot section we described a program designed to help German language teachers both develop listening skills in themselves and their students. The smallest slice of the research methods pie is devoted to Desired Educational Improvements, which includes teacher change and improved student learning and test outcomes. The research methods terrain revealed offers rich findings on design and the nature of online interactions, but is much thinner on teacher change and improved student learning and outcomes. (See Appendix A for a matrix, Table 3, which includes all the studies we selected to analyze, sorted into each category of this graphic organizer.)

## Summary

Throughout this paper, we have attempted to highlight the key points of the 40 empirical studies that we reviewed in detail. In Figure 9, we present a density gradient that summarizes where this research falls in our organizer. The shading represents what percent of the reviewed articles considered the topic, with light colors representing a low percent and darker colors representing a higher percent.

**Figure 9. The density of reviewed research on oTPD, by area. Darker colors represent more research.**

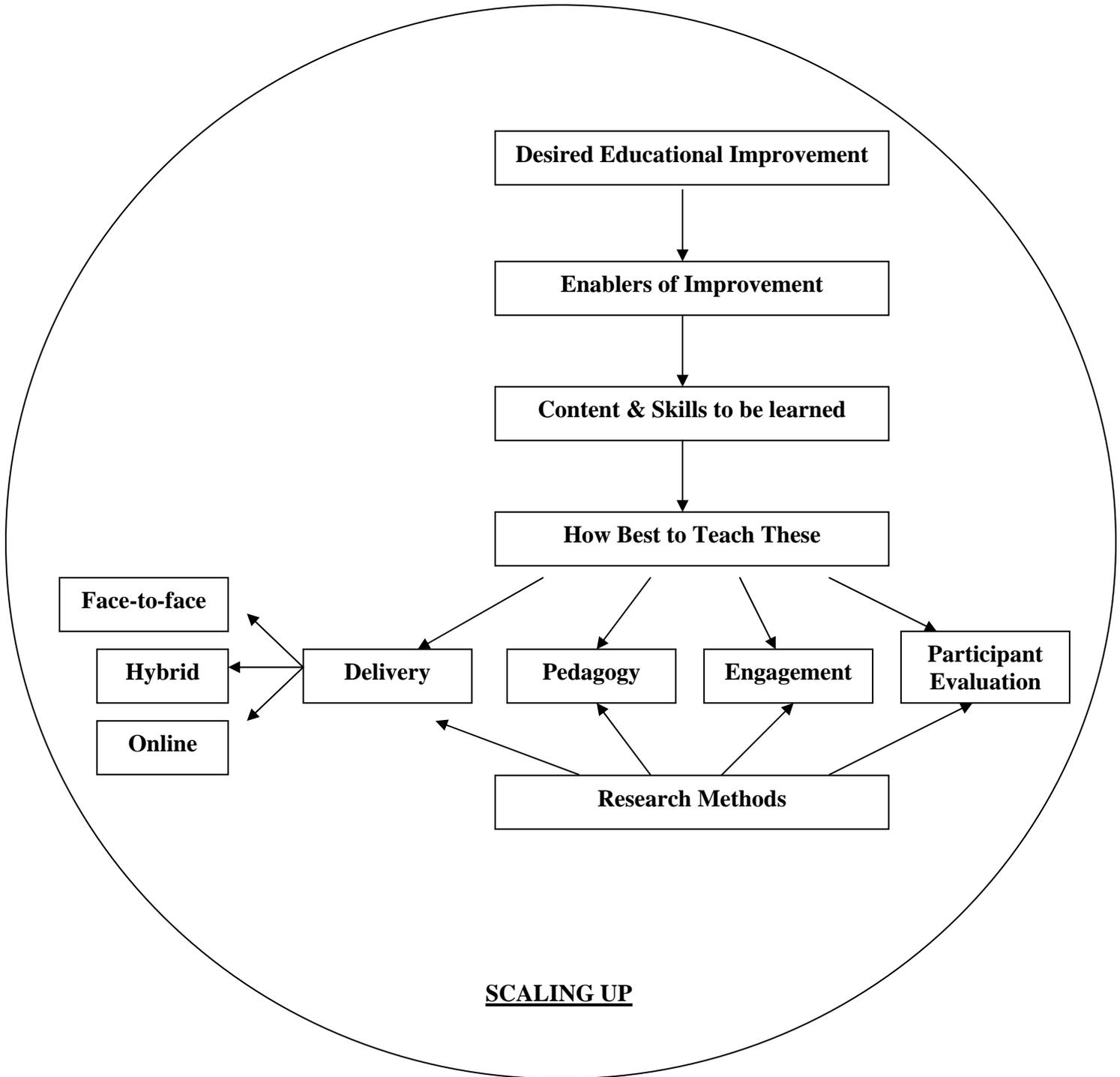


As can be seen from Figure 9, the intensity of research differs by area. For example, 40% of our reviewed articles studied purely online methods of delivery, while the remaining articles were nearly evenly split between hybrid and face-to-face delivery methods. In contrast, only

15% of the articles addressed the “enablers of improvement” with an even fewer, 8%, attending to the overall desired educational improvement. However, care needs to be taken in drawing conclusions from this density gradient as each of these “buckets” of research covers a large area, and areas that look poorly covered in toto might have sub-categories more fully attended to as outlined in the details throughout this paper.

As we stated in the beginning of this paper, organizers come with several liabilities; a key one is their potential for limiting thinking to the categories presented. Upon review of our articles and on receipt of comments from conference participants, we have concluded that our organizer presents oTPD more from the perspective of design and implementers and less from the standpoint of the participants. As a result, we have added two new categories: engagement and participant evaluation. Engagement covers research on how to get teachers to commit to TPD programs and how to keep them involved throughout the program. Participant evaluation comprises research on teachers’ evaluations of the program, including whether it met their expectations. One final piece of analyzing research on TPD needs to include studies on taking small programs to scale. Since this affects every aspect of the program’s design from initiation through delivery and engagement, we have encircled the entire organizer with this field. Figure 10 shows a revised organizer that can guide future, related work.

Figure 10. The revised graphic organizer including three new sections on teacher engagement, evaluation and scaling up.



As new ideas and connections come to light, evolving this organizer to fit these new conceptions is an ongoing challenge.

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## Appendix A

**Table 3. Characteristics and Findings of the forty Research Studies Analyzed**

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery		Pedagogy	
				F2F	Hybrid	On line	
Barab, Barnett & Squire (2002)				†			Study examined a pre-service teacher program through a conceptual lens of CoP and four tensions of design, which revealed a constant process of revision was the crux of the learning experience.
Barab, MaKinster & Scheckler (2004)					†		Inquiry-based learning Proposes design principles for oTPD
Barnett, Keating, Harwood & Saam (2002)					†		The most in-depth asynchronous discussions involved in-service teacher participation; constant instructor intervention, including focused questions, was needed to foster more reflective participation among pre-service teachers.

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery		Pedagogy	
				F2 F	Hybr id	On line	
Broady-Ortmann (2002)			Ten teachers participated in an online pilot course to learn listening skills for teaching German.			†	
Brown & Green (2003)		Advises instructors of online courses about improving teaching and learning online.				†	
Clarke & Hollingsworth (2002)				†			The analytic framework developed suggests that teacher change through TPD occurs through mediating processes of <i>reflection and enactment</i> in four distinct domains in the teacher's world: -the personal domain -the domain of practice -the domain of consequence -the external domain.

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery		Pedagogy	
				F2 F	Hybr id	On line	
Curtis & Lawson (2001)						†	Analysis of online collaborative learning behaviors in teacher work groups found that there was an absence of challenging behaviors and explanations for one's own posts.
Derry, Seymour, Steinkuehler, Lee & Siegel (2004)			A partnership between university faculty, classroom teachers and teacher education students learning to use PBL		†		Problem-based learning
Desimone, Porter, Birman, Garet & Yoon (2004)	Activities in large districts are significantly more likely to be aligned with state and district standards and assessments than TPD in small districts. Poverty level differences in alignment are not significant.			Not addressed			

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery	Pedagogy		
				F2 F	Hybr id	On line	
Dutro, Fisk, Koch, Roop & Wixson (2002)	There may be strategic points in a district's development when it makes sense to invest large sums in professional development. It may make sense to invest money in districts that are focused on development of teacher leaders.			<b>Not addressed</b>			
Fishman, Marx, Best & Tal (2003)				†			Evaluation of PD combines teacher reflection, classroom observations, ongoing assessment of student performance; illuminates the value of studying PD by accounting for student learning; furthers progress towards linking students' and teachers' learning; students had statistically significant increases in test on PD science content

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery		Pedagogy	
				F2F	Hybrid	Online	
Harlen & Doubler (2004)			Learners in an online course intended to improve their skills at inquiry based teaching tended to be more reflective than their counterparts in a similar F2F course as well as learned more science.			†	Inquiry-based learning and teaching
Harris & Grandgenett (2002).		Teachers who currently help their students use online tools and resources in curriculum-based learning are experienced, innovative, flexible, student-centered, collaborative, reflective, active professional learners who are willing to share their knowledge with both peers and protégés.			†		

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery		Pedagogy	
				F2F	Hybrid	Online	
Hawkes & Good (2000)			While f2f discourse rated higher than online, critical reflection was evident online and significantly higher in the online discussion environment than in the f2f environment.			†	
Hawkes & Romiszowski (2001)			Collaboratively produced network-based communication between teachers was significantly more reflective than f2f discourse, but neither CMC nor the face-to-face discourse was abundantly reflective.			†	
Herring (2004)						†	Advocates Computer-Mediated Discourse Analysis for gaining better understanding of online discourse.

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery	Pedagogy		
				F2 F	Hybr id	On line	
Job-Sluder & Barab (2004)						†	Contextual Analysis: The use of Sociability as a research tool to focus on design affordances rather than emergent behavior patterns; the authors believe it is applicable to more problems in design of learning environments.
Kabilan (2004)				Not addressed			The author identifies a trend toward research into a more self-managed and self-directed processes for enhancing professional development, using the Internet as the delivery system.
King (2002)					†		A hybrid course and an online-only course offer similar online participation experiences; facilitation is important to develop discussion.

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery		Pedagogy	
				F2 F	Hybr id	On line	
King & Dunham (2005)						†	Implications for further research include four areas of importance, which emerged in research on teacher needs in online PD: expectations, support, content and incentives
Koku & Wellman (2004)					†		Social network analysis revealed that the nature of the tie (social or professional) between members of a scholarly network dictated the types of interactions more than the nature of the communication task did.
Leach, Patel, Peters, Power, Ahmed & Makalima (2004)				†			Researchers observed that the hand-held device was used in many collaborative and technological learning activities that were new to both teachers and students.

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery	Pedagogy		
				F2 F	Hybr id	On line	
McKeown & Beck (2004)				†			Researchers wrote PD cases called “Accessibles” to help teachers develop their QtA (questioning the author) practice; teachers found them helpful in implementing a Q&A format in their classrooms.
Mouza (2002)			Teachers were taught to integrate new technologies into their classroom teaching.	†			
Neale, Smith & Johnson (1990)				†			How well teachers could use conceptual change strategies revealed that there was a gain in student test scores afterward, although teacher gains varied, and many still had problems with content features like summarizing and conceptual emphasis

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery		Pedagogy	
				F2 F	Hybr id	On line	
Nemirovsky & Galvis (2004)						†	Online video case studies, focusing on web-based discussions of specific events portrayed in the case. Grounded discussions must be facilitated; they do not happen spontaneously.
O'Connor & Ertmer (2003)				†			Process of developing coaches for TPD revealed that coaches work continually on their own PD; teachers should be encouraged to take on roles involving staff development; flexibility and skill in prioritizing are essential.
Picciano (2002)						†	Relationships between performance, sense of presence and student interaction; perceived learning and interaction were correlated.

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery	Pedagogy		
				F2 F	Hybr id	On line	
Porter, Garet, Desimone, Yoon & Birman (2000)				Not addressed			Methodological contribution in the survey design and analysis of large quantitative data sets about teacher participation in and improvement of practice from PD based on content standards and currently promoted pedagogical models.
Renninger & Shumar (2004)		Problematizing 'culture' and 'community' are ways of understanding how design and pedagogy support both the individual learner and the group in oTPD.			†		
Richardson & Swan (2003)			Social presence was perceived as integral aspect of their online experience and permeated even the typically 'individual' activities.			†	

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery		Pedagogy	
				F2 F	Hybr id	On line	
Riel & Polin (2004)					†		<p>Researchers advocate that learning communities are often subdivisions of activity systems. As such, design should be understood in terms of learning activities situated in task-, practice-, or knowledge-based communities that are part of a larger organizational learning structure in which creating systems of interchange among the groups supports a community learning culture.</p>

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery		Pedagogy	
				F2F	Hybrid	On line	
Schaverien (2003)		Used a web-delivered, self-directed “context” (Generative Virtual Classroom) to help undergrad teacher interns develop ability “to recognize, describe, analyze and theorize learning” in teaching elementary science with technology. Used parallel to FTF instruction and field supervision			†		
Schlager & Fusco (2004)					†		Eight guideposts for designing oTPD were developed using Activity Theory and CoP theory; recommendations for further research.

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery	Pedagogy		
				F2 F	Hybr id	On line	
Sherer, Shea, & Kristensen (2003)		A descriptive research that describes FLCs (faculty learning communities) as communities of practice that offer great potential for improving teaching and learning.				†	
Turner, Cruz & Papakonstantinou (2004)				†			Measuring the impact of a math program for teachers revealed that participants felt better about their work and scored better on tests than those who did not participate in the program.
Wang, Sierra & Folger (2003)						†	Communities can develop online; collaborative activities enhance participation; no significant social or gender differences in online discourse were found.

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery		Pedagogy	
				F2F	Hybrid	Online	
Wearmouth, Smith, & Soler (2004)						†	Implications for design of online oTPD: guest experts created peak interest in online learning environment, but participation overall was low; time and access were barriers to participation; need for more research about guest expert role.
WestEd (2000)	Examines best practices of eight diverse schools that are winners of the National Awards Program for Model Professional Development and in all of which students have made significant academic gains; demonstrates that pervasive TPD improves student achievement in schools regardless of demographic and geographic factors.			†			

Name of Study	Desired educational improvement	Enablers of Improvement	Content & Skills to be learned	How Best to teach these			Research Methods
				Delivery		Pedagogy	
				F2 F	Hybr id	On line	
Yang & Liu (2004)		The effectiveness of an online workshop for creating a professional learning community was mediated by the findings that participation online was not very interactive or reflective; mentor-mentee interaction was minimal and informational, rather than reflective.				†	Cognitive Apprenticeship