
This material is based upon work supported by the National Science Foundation under Grant No. 0514426. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.
Abstract

This article highlights key online teacher professional development (oTPD) areas in need of research, based on a review of current oTPD research conducted in conjunction with a NSF-sponsored oTPD conference held at Harvard University in fall 2005. Our literature review of this field (Whitehouse, Breit, McCloskey, Ketelhut, & Dede, 2006) documents much work that is 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. Unless more rigorous research is conducted on oTPD, developers are hard-pressed to know the best design features to include, educators are left with little knowledge of which program will help support teacher change and student learning, and funders have few guidelines for where their support is best directed. We believe that the recommendations in this article for a research agenda will guide oTPD scholarship toward an evidence-based conceptual framework that provides robust explanatory power for theory and model building.

Keywords: research agenda, online learning, teacher professional development, technology

The Importance of Online 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, such that administrators have added workdays devoted to professional development to the school calendar. But this improvement comes at a price in resources and time. During the 1990’s, school districts spent the equivalent of $200/pupil per year on professional development (Killeen, Monk, & Plecki, 2002), and
professional development adds demands of time and effort 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). 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 (National Commission on Teaching and America’s Future, 2003).

The need for professional development that can fit with teachers’ busy schedules, that draws on powerful resources often not available locally, and that can create an evolutionary path towards providing real-time, ongoing, work-embedded support has stimulated the creation of online teacher professional development programs. Many of these programs are working to realize other potential benefits of online communities of practice among teachers, such as the opportunities for reflection offered by asynchronous interaction; the contributions of teachers who tend to be silent in face-to-face settings but ‘find their voice’ in mediated interaction; and the unique affordances for learning of immersive virtual simulations (Dede, 2004a). 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. Further, online professional development programs also are potentially more scalable than those that depend purely on local resources and face-to-face interactions.

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. Further, for those researchers interested in long-range impact, funding is rarely available to support it.

In our research, we are studying three emerging interactive media:

1. Multi-user virtual environments in which participants become digital people inside of virtual worlds (http://muve.gse.harvard.edu/rivercityproject/).
2. Augmented realities in which participants in a real world context interact with a virtual setting imposed through wireless mobile devices (http://isites.harvard.edu/icb/icb.do?keyword=harp), and
3. Academic socio-semantic networking in which participants’ patterns of social tagging generate formative, diagnostic information about their mental models

(https://isites.harvard.edu/icb/icb.do?keyword=edtags).

Each of these offers novel methods for teacher learning as yet largely unstudied. As discussed later, design-based research is a method that offers tangible examples of powerful learning, and better ties between theory and practice, while acknowledging learning in context (Dede, 2004b; Squire, 2006). As design-based researchers, the authors know how difficult it is to conduct rigorous research on learning media that are evolving rapidly and concurrently. And yet, as challenging as such scholarship is, unless the research issues discussed below are an essential part of studying these innovative technologies, the findings from this work will not prove of much value to the field of teacher learning.

This document sets forward an agenda for research on professional development, delivered via conventional or innovative technologies. The agenda focuses on types of knowledge that are missing or lacking in the current literature for improving oTPD and on assessment of oTPD’s strengths and limitations. In particular, we highlight two areas that should serve as the nucleus of future research ventures: (1) research questions that address understudied areas and (2) design and methodological strategies for studying these questions. We conclude with recommendations on priorities for research in these areas.

Readers may ask what differentiates research about online teacher professional development from scholarship about face-to-face teacher professional development. Certainly, the two approaches share many common themes. Given a particular set of objectives, resources, content, and participants, both online and face-to-face teacher professional development developers ask:
• How should the professional development program be designed (content, pedagogical strategies, methods of delivery, and identification of best practices) to maximize its effectiveness?

• What measures of effectiveness and means of evaluation should be used to document the outcomes and impacts of the professional development program?

• What specific tools, if any, should teachers experience as part of the professional development?

• What types of learner interactions should the program foster through its pedagogy and its infrastructure for delivery?

These categories are discussed below in our review of research and would also be central in an overview of research on face-to-face professional development.

The reason for having a specialized research agenda for online teacher professional development is that, while the categories are similar, the menu of options for implementation within each category is different when teacher professional development is delivered online. For example, some pedagogical strategies (e.g., lecture) are likely more effective face-to-face than online, but others (extended rich discussions) may be more effective online than face-to-face: A broader range of participants “find their voice,” many people can contribute at the same time, and the period available for discussion is extended. The availability of attractive online options not available in pure face-face teacher professional development is one reason why many programs are moving to blended or hybrid models that attempt to combine the strengths of both.

Furthermore, at a time when many national commissions are calling for all US students to be competitive in a “flat” world characterized by global markets, online professional development offers an additional set of tools and poses a different set of research issues for how
teachers become fluent in new technologies (many of them online interactive media) than face-to-face professional development has encountered. The National Research Council Workshop on *Enhancing Professional Development for Teachers: Potential Uses of Information Technology* (NRC, 2007) documented these and other factors that make online learning a unique form of teacher professional development. For these reasons, a research agenda for online teacher professional development that builds on prior scholarship in face-to-face teacher professional development, but extends that into the terra incognita of new venues, new methods, and new objectives seems warranted.

**Methodology**

Our understanding about the state of oTPD research comes from two primary sources: an overview of recent literature in the field and the outcomes of the conference on online teacher professional development held at the Harvard Graduate School of Education in Fall 2005. In our analysis, we did not limit the reviewed 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 the hallmarks of rigorous empirical research. Maxwell (1996) wrote that the research methodology must have a coherent design in which the research components fit compatibly and make the critical (empirical) connection to the research questions. We developed the following criteria to guide our choices of studies to review:

- Clear and focused research question(s)
- Rigorous methods of data collection that were connected to the research questions
- Analyses that were framed by the research questions.
- Findings that emerged from the analysis and provided answers to the research
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). Forty research studies met our criteria for high quality empirical research (described further in Whitehouse et al, 2006). 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. To provide an updated landscape of empirical research studies on oTPD, we have added to our discussion in this article a few more recent studies that also meet our research criteria. In addition to this review, the discussions that took place at the oTPD conference (detailed in Dede, 2006) informed our ideas outlined in this article.

**Understudied Aspects of Online Professional Development**

**Current State of the Art**

Research topics in oTPD have expanded substantially from the “no significant difference” outcomes that characterized the comparative studies comprising the bulk of research about online learning environments in the past. As examples of the latter, Navarro and Shoemaker (1999) found no significant difference in six of eight academic variables between students taking an online course and those taking the same course in the traditional classroom. The work of Lin and Davidson (1995) also reported no significant differences between student learning outcomes online or face-to-face. Sujo de Montes and Gonzales (2000) found similar results in comparing two teacher professional development classes taught by the same teacher. These studies and others like them provided important foundational knowledge about online learning environments, but left open many other questions for research.
Currently, there is a move toward empirical studies examining particular aspects (e.g., the effectiveness of online discussions) in various models for oTPD, including research questions that explore why some models have more impact than others on teacher behavioral change and student learning. One of the few studies to examine student outcomes as they link to teacher professional development goals was done by Fishman, Marx, Best and Tal (2003). This study and others are illustrations of how researchers are moving toward empirical, replicable studies to inform model building in oTPD.

Figure 1 identifies the major research foci of the 40 empirical oTPD studies that we reviewed. As we evaluated these research studies, we discovered that their research questions cohered loosely around four categories:

1. *program design*, which evaluated content, pedagogical strategies, methods of delivery, and identification of best practices;
2. *program effectiveness*, which looked largely at self reports on participant satisfaction and short term pedagogical change outcomes;
3. *program technical design*, which compared the effect of individual communication and multimedia tools as well as the effect of technology on specific goals such as collaboration and building a learning community; and
4. *learner interactions*, which evaluated contextual factors such as quality of participation and efficacy of online communication and collaboration.

It is important to recognize that these categories are neither exhaustive nor mutually exclusive, but they represent our best efforts to differentiate among the types of studies that we reviewed for the purposes of our analysis. This process often involved inferring research questions based on the types of findings that were presented. In the following paragraphs, we provide examples
of research to clearly illustrate each category, bearing in mind that some studies may offer findings that overlap categories. The examples that we provide were chosen because they seemed most representative of the features of each category. We point out any flaws or shortcomings only to illustrate the potential for replicating or extending the studies.

[put figure 1 here]

The first category, program design, encompasses content, delivery methods and pedagogical strategies as they are mediated in the online environment. Renninger and Shumar’s research study of The Math Forum (2004) is an example of the program design category because it explores the development of an external professional development website that 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. The design decisions were framed by ideas of teacher-centered professional development that allow teachers access to resources and tools to design their own learning experiences. In a similar study, Farooq et al. used a participatory design methodology to identify three design strategies that play a significant role in developing a sustainable online community for teachers in Tapped In 2 (Farooq, Schank, Harris, Fusco, & Schlager, 2007).

The second category, measuring the effectiveness of an online teacher professional development program, has generally involved evaluative studies that derive their findings from course participant surveys. The purpose of this type of research is to immediately measure the perceived value of program design components and content, as well as to assess learner satisfaction. The EdTech Leaders Online (ETLO) program, for example, gathers pre- and post-survey data from participants in its instructor-training program as well as course evaluations from course participants as part of their ongoing assessment of program design and participant satisfaction (Kleiman & Treacy, 2006). Unfortunately, focusing on methods of assessment
typical of traditional face-to-face TPD programs overlooks important sources of data that are uniquely possible in online educational settings. Graham (2007), on the other hand, used a mixed method research design to measure the effectiveness of a professional learning community for improving teacher effectiveness in middle school teachers. The findings indicated that professional learning community activities can result in improved teacher effectiveness, but achieving this goal is highly dependent upon leadership and organizational practices within the school, as well as the need for teachers to develop collaborative skills and a shared language around practice.

Program technical design is well illustrated by the work of Barab et al. (2006). The Quest Atlantis Project was designed to embed in the classroom professional development for teachers that draws from emerging research on computer gaming and inquiry-based learning theories. The technical design of the project developed from the assumption that meaningful learning occurs in context rather than in abstract content—learning by doing rather than learning by listening. The findings about the technical design were based on sharing the experience of doing the project and highlighting the strengths and limitations of the project as they emerged. This type of emergent and exploratory research is useful toward model and theory building, but in its initial stages lacked enough specificity to provide good indications for building new metrics to analyze durable teacher change. Vavasseur and MacGregor (2008) have extended the idea of technical design with a mixed methods study in which they explored how content-focused online communities for middle school teachers strengthened an existing face-to-face technology professional development program. Their findings included the importance of the principals’ instructional leadership, the organization of teachers by teams, a focus on content rather than
software, and the need for providing multiple spaces for teachers to share their expertise and to
develop a shared language.

Hawkes and Good (2000), whose research project straddles the line between program
technical design and learner interactions, offered an example of how to attain understandings
difficult or impossible to achieve using only pre/post surveys, by making use of a data stream
which is unavailable in face-to-face projects. They examined the telecommunications of 44 rural
educators who participated in three new problem-based learning curricula. Their findings,
derived from a theoretically-grounded analysis of audio and text communications, 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. Analysis of
online communications was a common methodology in studies about learner interactions. For
example, Yang and Liu (2004) did a case study of an online workshop designed to evaluate the
effectiveness of such workshops as tools for creating professional learning communities. Their
analysis scrutinized the content of message posts in online forums to determine the quality of the
dialogue and the mentoring received from the expert teachers. Whitaker et al. (2007) studied the
levels of support offered participants in a large scale oTPD program. The 235 teachers in the
study were assigned to groups provided with different levels of services to support their learning
and development: 66 teachers received a laptop, and access to a website of limited resources,
although they were not required to use it; 89 teachers received, in addition to the resources for
the first group, printed materials and a full featured website; and the last group received all of the
above, plus a videoconferencing camera, bi-weekly discussions with a consultant, and video of
their own teaching for reflecting on their practice, as well as being required to access the website
on a regular basis. The analysis used online sources such as web navigation logs as well as
surveys and teacher focus groups to find that higher levels of service was correlated to higher levels of teacher use. Teachers receiving the highest level of service (including all of the online interactions) were most positive about the experience, as well as the most frequent users of the oTPD program.

As can be seen in Figure 1, the studies are fairly evenly divided into the areas of program design, program effectiveness, and technical design, with learner interactions represented only slightly less. While these are worthy foci for scholarship, empirical research that provides answers about why some models have a greater impact than others on teacher behavioral change and student learning is a pressing, heretofore unmet need for advancing the field.

One purpose of our analysis was to surface the types of research questions for oTPD which have yet to be fully considered. In an attempt to discover whether there were understudied areas, we analyzed the expressed goals for the professional development programs articulated in the studies discussed above to see what light they shed on research. In most cases, these goals aligned with the research focus and provided the framework for the research questions and methods used in the studies described herein. The main categories of professional development goals that emerged from our focused literature review are defined below and shown in Figure 2:

- **Desired Educational Improvement**: includes interventions aimed at teacher change, classroom climate change, and improved student learning and outcomes
- **Enablers of Improvement**: includes interventions designed to improve teacher pedagogical content knowledge, skills and practices
- **Content and Skills**: includes programs designed to improve content area knowledge and subject matter expertise
○ **How Best to Teach**: program design includes programs with face to face, hybrid or online pedagogical approaches

○ **Program Evaluation Design and Theoretical Frameworks**: includes research methods, methodologies, developing theoretical frameworks for analysis

(*[put figure 2 here]*)

As can be seen in Figure 2, the largest slice of the program purposes pie is Program Evaluation Design and Theoretical Frameworks; the studies in this category mainly focused on building theory-based conceptual frameworks for creating better program design as highlighted in the Quest Atlantis example. In another example of conceptual research, Schlager and Fusco (2004) derived eight guideposts for designers to create communities of practice that include teachers and stakeholders working together toward instructional improvement. The second largest research category (22%) focused on implications for pedagogy through examining learner interactions. As an illustration, Wiske and Perkins’s (2004) analysis of WIDE World Online Professional Development centered on how teachers may accommodate rather than assimilate new practices after taking a course that both models and teaches research-based pedagogies such as Teaching for Understanding.

Studies on content and skills (20%) followed closely. For example, Renninger and Shumar (2004) explored the impact on participant learning and the culture of participation in The Math Forum, an online teacher resource designed to build community as well as support individual math teachers as they develop new content knowledge and skills in teaching math. The two smallest categories of program purposes are Desired Educational Improvement (7%) and Enablers of Improvement (12%).

Taken together, these two graphs reveal that current oTPD program and research
initiatives center on program design and effectiveness, largely within a community-of-practice theoretical framework that promotes collaboration and reflection. For example, Barab, Kling and Gray (2004) recently published a book that articulates alternative design models for virtual learning communities of teachers, based on applying activity theory within a communities-of-practice framework. This analysis underscores a core tension for researchers and other stakeholders that we discovered during our analysis: the market pressures that encourage evalutative studies of program effectiveness versus the need for research that informs design and extends our understanding of models that impact teacher learning and behavioral change.

New Approaches to OTPD Research

Based on this analysis, a “blended” empirical research model designed not only to answer questions about whether a program design works well, but also to provide evidence to explain why it works well seems a reasonable and effective alternative to the evaluation-centric approach now prevalent. Such a research strategy also mitigates researcher-practitioner tensions: on the one hand, the need for evaluation-based marketing in academia, a ‘necessary evil’ for many scholars; on the other hand, the more theoretical work of explaining why and to what extent design interventions work, at best the ‘icing on the cake’ to developers and marketers of oTPD.

Our recommendation, then, is that research strategies that respond to both needs should be promoted, as opposed to privileging one objective at the expense of the other. The reader might ask if it is really necessary or wise to blend evaluation and empirical research. As discussed in the previous paragraphs, we have taken a pragmatic stance in response to a need that was only too clearly highlighted by our search through the literature for high quality empirical oTPD research. The 40 empirical studies that we chose as representative of the current state of the art do more than cast light on under-researched aspects of oTPD. They are powerful evidence
that empirical research has been under-funded to a serious degree. To promote this research agenda, we recommend purposeful “blending” of the funding for such research to assure researchers the time and scope needed to achieve both marketing and explanatory power. For example, a Design Based Research (DBR) model offers a ‘best practice’ stance that has proved useful in complex learning environments such as oTPD, particularly because formative evaluation plays a significant role in this research model. Collins, Joseph, and Bielaczyc (2004) define DBR thus:

Design experiments bring together two critical pieces in order to guide us to better educational refinement: a design focus and assessment of critical design elements. Ethnography provides qualitative methods for looking carefully at how a design plays out in practice, and how social and contextual variables interact with cognitive variables. Large-scale studies provide quantitative methods for evaluating the effects of independent variables on the dependent variables. Design experiments are contextualized in educational settings, but with a focus on generalizing from those settings to guide the design process. They fill a niche in the array of experimental methods that is needed to improve educational practices.

(p. 16)

DBR requires iterative cycles of analysis and revision that attempt to account for how and why cognitive variables interact with social and contextual variables (Ketelhut, McCloskey, Dede, Breit, Whitehouse, 2006). As such, in contrast to other forms of research, DBR answers what works; for whom; under what authentic, field-based conditions; and how/why this approach is effective. These are central questions for teacher professional development, whether online or face-to-face.

Study Design and Methodology
We noted in the previous section that research in online teacher professional development is characterized by its emphasis on program evaluation, with empirical research (whether qualitative or quantitative) taking a back seat. In this section, we focus on the need for more empirical research to complement program evaluation, and we present guidelines to introduce more rigor and standardization across empirical studies. This should not be interpreted to mean that research should largely displace program evaluation. The field needs to have a strong focused interest in how and why without segregating this understanding from the high need for understanding what.

What key features should a well-designed oTPD research project contain? First, the study must center on a set of clear research questions, which then drive all subsequent decisions. Many of the 400 articles we reviewed lacked this. In previous sections, we presented some illustrative areas that need well-designed, question-driven research to improve understanding. We caution, however, that these questions need to be both research questions—about understanding some aspect of oTPD—and program evaluation questions. For example, a research question might ask how using a particular technology affects a teacher’s instructional practices in the classroom, while the complementary program evaluation question might ask usability questions about a particular program technology.

Next, we suggest that research projects clearly define their terminology and assumptions. Terminology is often used without description or definition, which can lead the reader to interpret it based on his/her own frame of reference. It is jokingly said that a roomful of constructivist theorists will contain a roomful of definitions of constructivism. Many of our reviewed articles revealed there is a kernel of truth in that joke. Simply saying that the theory of constructivism underlies design decisions is not clear enough. If patterns of understanding are to
emerge from research on oTPD, then knowing how an underlying theory guides the design is essential. Likewise, researchers and designers studying teachers’ practices may embed assumptions about participants’ needs, beliefs, and motivations in their design of a survey or observation protocol. These assumptions often are made without input from teachers themselves and may or may not accurately reflect the actions and intentions of that group (Ketelhut et al, 2006). While making these assumptions is inevitable to a degree, allowing those assumptions to be revealed through research can yield powerful, if unexpected, understandings that should be incorporated into the analysis.

The eMSS mentoring program (Jaffe, Moir, Swanson, & Wheeler, 2006) is an example of this issue with assumptions. The National Science Teachers Association, in partnership with the New Teacher Center at the University of California at Santa Cruz and the Science/Math Resource Center and Burns Telecom Center at Montana State University, developed a mentoring program (eMSS) for middle school science teachers, using scientists and experienced science teachers to provide mentoring services in an online environment. The purpose of the program was to deepen science teachers’ pedagogical content knowledge through reflective, professionally facilitated dialogue that made connections between pedagogy and practice, with the ultimate goal of improving student outcomes. The results of the formative evaluation performed early in the program revealed that teachers mainly used the program mentors for advice and resources—not to increase their content knowledge or teaching skills. These findings suggest that the teacher participants want resources and ideas for their teaching, while deepening their pedagogical content knowledge is not as high on their professional development priority list. This outcome illustrates assumptions about participant purposes and needs which in a larger sense might point to assumptions about who decides what is worth learning and how professional
development should be used to accomplish the broader goals of school improvement.

In our review of the oTPD literature, it also became clear that new outcome measures would need to be created. Much of the professional development research we encountered was based on a limited number of outcome measures, which in turn limit our understanding of the effects of professional development. For instance, currently much research on how a teacher’s classroom practice is affected by professional development is based on self-reports. While self-reports offer one kind of insight—namely a teacher’s perspectives on his or her own practice, they do not provide data that can be used to assess teachers’ knowledge, or compare a teachers’ practices to a standard or to goals for improvement, or to other characteristics that a researcher might wish to observe. While we do not want to imply that all studies use self-report, our research indicates that it is emphasized. Thus, the field needs to refocus priorities and develop additional measures of teacher change that are more objective to complement self-reports, and funding needs to be provided for this purpose specifically.

Similarly, a truly valid evaluation of the effects of professional development on student learning should be based on measures that help augment and interpret the meaning of the oft-used standardized test scores, and that enable researchers to study the kinds of effects that are not measured well by quantitative means. Both self-reports and standardized test scores have a place in research; however, because they offer only one view of change, relying on them to the exclusion of other measures actually may serve to limit our understanding of the effects of professional development. In addition to using a variety of methods, another important factor is the timing of assessments. Currently, most data is collected immediately after a program ends. However, since teachers realistically apply what they learn in professional development to practice over time, it makes sense to collect data over time as well—one month later, several
months later, et cetera. Overall, the more measures we can design and the more varied the timing for implementing them, the more likely we are to develop a complete understanding of what teachers learn while engaged in professional development, how they make sense of their new knowledge and skills once they must apply these to practice, and what changes, if any, result.

One of the key challenges on which the field needs to concentrate is designing studies that help build collective knowledge. We suggest four main ways that this can be done.

1. Studies should draw upon previous research conducted on oTPD. Given the competition for participants, program design and evaluation is sometimes conducted in isolation, thus losing an opportunity to learn from others and further the understanding of the oTPD community.

2. Research designs should make use of the data streams collected in technology-mediated interactions – and not typically possible via traditional face-to-face methodologies – to investigate new questions of interaction, collaboration, and communication. For example, while surveys and interviews are typical methodologies for traditional learning environments, online environments can be tied to a database that can not only record everything each participant says and does, but also, for example, to what and to whom they respond, in what order they solve problems, and their trajectory of learning.

3. We can learn much from studies of professional development in other domains, such as medicine, law, and industry; too often, we end up recreating the wheel. For example, Wutoh, Boren and Balas (2004) investigated the impact of internet-based continuing education versus the more traditional face-to-face continuing education on performance of doctors. They found both to be equally effective for learning, but suggested that more
research needed to be conducted to investigate the effect on practice.

4. All studies should commit to reflecting on and revising theory as an overarching goal. If we are to address the issue of effectiveness and impact, we need to contribute continuously to an evidence-based conceptual framework that provides robust explanatory power for theory and model building to support designers, implementers, and participants.

Finally, we would like to qualify our conception of collective knowledge to emphasize that the knowledge should be “usable knowledge.” Usable knowledge comes from insights gleaned from research that can be applied to inform practice. Therefore, we suggest that scholars not only build theory and complex understanding of issues, but also disseminate this knowledge in a way that helps the field access, interpret and apply these insights. This process of creating and sharing usable knowledge is best accomplished by a community of researchers and practitioners working together, as opposed to researchers developing findings for practitioners to consume.

Such a community also may better accomplish collective theory building than now occurs with fragmented creation and distribution of scholarly findings. No single study can accomplish all the types of research insights that could emerge from a complex oTPD intervention. Funding programs could support this by creating portfolios in which various studies cover different portions of this complex scholarly territory, with complementary research outcomes enabling full coverage and collective theory-building (Borko, 2004).

A research agenda

In the previous sections, we delineated the current state of the art in research in online teacher professional development and found several understudied areas in the field that would
benefit from further research. Further, we established that there is a core tension between the need for marketing programs and for scholarly research. Given the results of our analyses and findings from the current state of research in the field we recommend that future ventures into oTPD prioritize:

- **Research questions** that address:
  
  o Enablers of durable teacher change, such as interventions designed to increase pedagogical content knowledge;
  
  o Impact of professional development on teacher change, particularly improvements that transform practice;
  
  o Effects of teacher change on student learning;
  
  o Factors influencing the sustainability of teacher improvement; and
  
  o Scalability of oTPD programs into a variety of contexts.

- **Research strategies** that respond to both marketing and theoretical needs, rather than privileging one at the expense of the other.
  
  o Developers and researchers are encouraged to use already existing delivery environments for oTPD, if those contain the features necessary for that approach, rather than spending precious funds creating yet another minor variant in implementation infrastructure.

- **Research models** that use a broad spectrum of research methods, including both formative methodologies such as Design Based Research (DBR) and summative methods such as random clinical trials:
  
  o DBR offers a ‘best practice’ stance that has proved useful in complex learning environments, where formative evaluation plays a significant role; this methodology incorporates both evaluation and empirical analyses and provides multiple entry points for various scholarly endeavors.
  
  o Mixed-method studies with both qualitative and quantitative analyses are important for understanding both whether an oTPD program is effective and why.

- **Research designs** that have:
  
  o A clearly articulated set of research questions that address theory and practice;
• Explicitly stated assumptions and concisely defined operational terminology;

• Alignment between purposes, questions, and methodologies; and

• A scope that goes beyond small “boutique” programs and special groups of participants not easily replicated in other contexts to emphasize findings generalizable across content areas and teacher learning goals.

• **Research methodologies** that do not simply replicate methods used in studying face-to-face professional development, but instead take advantage of the unique data-collection possible in online programs by:

  o Diversifying the number of outcome measures to offer higher degrees of validity to authentic practice;

  o Extending the analysis of outcome measures across time to allow measurement of different stages of teacher change/learning and impact on students;

  o Creating new research questions on issues of online collaboration, communication, and community.

• **Research issues** of coordination and dissemination so that:

  o Collaborations between researchers and designers are catalyzed;

  o Conferences and symposia are convened to share ideas and results;

  o A central repository, a “clearinghouse,” is created to identify the current shape and trajectory of the field.

• Finally, **high quality research** should:

  o Build upon previous research;

  o Draw from best professional development practices in other domains such as law, medicine and industry;

  o Take into consideration new knowledge from expanding research on instructional design and online learning; and

  o Cover a broad developmental range and cycles of oTPD programs from small pilots to large-scale implementations.

We believe that this set of recommendations will guide oTPD research toward an
overarching conceptual framework integrating theory and evidence-based practice. This is necessary to establishing education as a profession with the standing of the professions of medicine or law. Building such an encompassing theory is a collaborative effort, involving all participants and fields of expertise. oTPD research will play its part in providing robust explanatory power for theory and model building as well as informing marketing needs.

**Conclusion**

In this article, we have outlined an agenda for research into oTPD research with both conventional and emerging technologies. These recommendations are based on studies we conducted in conjunction with an NSF-sponsored oTPD conference held at the Harvard Graduate School of Education in fall 2005. To support this agenda, we also recommend dramatic increases in funding for research on teacher professional development in general, including online approaches. Sherwood (2006) documents that, over the past decade, the Research, Evaluation, and Communication Division of NSF’s Education Directorate made only 42 awards in this area, with total funding of $35.5 million (5.4% by number and 5.9% by funds of the their total awards during this period). In the same directorate, for NSF’s Elementary and Secondary Education division and Division of Undergraduate Education combined, 43 awards were made totaling 1.7% of the total awards and1.8% of the total dollars. As noted in Sherwood’s paper:

In the recently completed *Studying Teacher Education: The Report of the AERA Panel on Research and Teacher Education* (Cochran-Smith & Zeichner, 2005), the authors note that, “Again it is worth repeating that this dearth of larger and longer studies is the case, at least in part, because teacher education has rarely been a research priority for funding agencies or a focus of well-supported programmatic research.” (p. 5).
A research agenda is of value only if adequate funding is available to make investments based on its recommendations. We offer this agenda with that caveat in mind.
Authors’ note

We asked the following people for their critical assessment of the ideas expressed in an earlier draft of this research agenda. They sent back detailed and insightful comments that have made the ideas in this article richer and more representative of the thinking of the oTPD community. We would like to gratefully acknowledge their contribution to it and thank them.

Glen Bull, University of Virginia; Hilda Borko, Stanford University; Sharon J. Derry, University of Wisconsin-Madison; Barry J. Fishman, University of Michigan; Kathleen Fulton, National Commission on Teaching and America’s Future; Ann Lieberman, Columbia University; Michael Russell, Boston College; Bonnie Smith-Skripps, Western Illinois University; Debra R. Sprague, George Mason University.

References


Figures and Tables

**Figure 1: Landscape of Empirical Research as Represented by the 40 Reviewed Research Studies**

![Bar chart showing the distribution of research purposes across different dimensions: Program Design, Program Effectiveness, Program Technical Design, Learner Interactions. The chart highlights the significant focus on Program Design and Program Effectiveness, with Learner Interactions being the least represented.]

**Figure 2: oTPD Program Purposes**

![Pie chart depicting the purposes of research with percentages: Desired Educational Improvement (39%), Enablers of Improvement (12%), Content & Skills (20%), How Best to Teach: Pedagogy (22%), Program Evaluation & Theoretical Frameworks (7%).]