# Online and Blended Teacher Learning and Professional Development

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Professional development is the chief means for improving classroom instruction and, in turn, student achievement.[1] Professional development comprises all of a teacher's opportunities for growth after the formal work associated with getting certified and securing a job. Although many teachers enter the teaching profession because of the high value they place on learning, too few engage in professional development on a regular, extended basis throughout their career. Almost all teachers participate in some professional development annually, but it is often superficial in both time and content. Whether expenditures provide a good return on investment and how to improve the cost/benefit ratio of professional development experiences are important educational and policy questions.

As teacher development moves online to take advantage of the scale and other affordances of the web, it's important to ask what works and what doesn't and for whom. To seek answers to these questions, the editors of this volume sought to highlight many of the best models in this rapidly changing field by identifying top developers of online professional development—with an emphasis on science, technology, engineering, and mathematics (STEM) education, where much exciting innovation has taken place—and inviting them to write about what they have learned in the process of designing and implementing their professional development models.

This resulting volume is intended to serve as an overview of online teacher professional development (sometimes referred to as oTPD) to help research-

ers and developers understand the range of effective models and their conditions for success. It will also help teachers, funders, and policy makers to better understand alternative options for professional development and to make more informed decisions regarding professional development. Educators are eager to understand more about what is promising and what is still in need of investigation. We think that readers will share the excitement of the authors featured in this volume.

## CONTRASTING PROFESSIONAL DEVELOPMENT WITH TEACHER LEARNING

The title of this book includes the terms *professional development* and *teacher learning,* the key distinctions of which are agency and formality. Professional development may be mandated for teachers and is generally a formal experience with a fixed duration, curriculum, and instructional strategy and expected outcomes. Teacher learning, by contrast, is typically begun by an educator as a voluntary activity and may be informal, with duration, content, form of learning, and eventual impact uncertain at its inception. The various models described in the following chapters fall on a continuum, with mandated, formal professional development at one end and voluntary, informal teacher learning at the other, and many approaches somewhere in between.

These models that combine professional development and teacher learning may use a specific, commercial curriculum as the focus of professional development. There is an inherent tension between the goals of the developers and the users, however, and this is often denoted as a lack of consistency between the *intended* curriculum as envisioned by the developers and the *enacted* curriculum as implemented by the teacher.[2] This tension often leads to different perceived goals of professional development. For example, in communities of practice based primarily on peer learning but enriched by experts, giving teachers what they need (e.g., strategies for promoting scientific inquiry) as opposed to what they want (e.g., a worksheet to check if students can balance equations) is sometimes a challenge. That said, the richest forms of professional learning lie toward the middle of the continuum, combining theoretical and research-based insights with the wisdom of practice. These can foster teacher ownership by providing some autonomy while accomplishing lasting impacts via expert modeling of innova-

tive practices and teacher-led discussions about overcoming challenges in implementation.

In discussing almost any form of innovation in schooling, the dialogue inevitably turns to how teachers can be helped to effectively adapt a new approach to the particular constraints of their own classroom settings. Despite attempts to develop "teacher-proof" instructional strategies or "teacher-in-a-box" standalone education technologies, enabling students to achieve deep motivation and learning requires personalized guidance from a skilled, knowledgeable educator. Many a promising instructional innovation has failed because its implementation did not include adequate methods for professional development and teacher learning.

Professional development is very important for shifts in teachers' practices because participants must not only learn new skills but also "unlearn" almost unconscious beliefs, assumptions, and values about the nature of teaching, learning, and schooling.[3] Professional development that requires unlearning necessitates high levels of emotional/social support in addition to mastering the intellectual and technical dimensions involved. In order for teachers of STEM subjects to transform from presentational, assimilative instruction to active inquiry-based forms of student learning, teachers must unlearn their own mental models, which include emotional investments developed over decades of, first, being a student receiving traditional instruction and then years of building skills in conventional instruction. Without unlearning, teachers teach as they themselves were taught.

Recent research on how people learn and how to better assess students has led to new curriculum and new teaching strategies. The present landscape of teaching in the United States is dominated by the Common Core State Standards, the National Research Council's Framework for K–12 Science Education, and the Next Generation Science Standards (NGSS).[4] Although these can be viewed as political documents, in that states may or may not adopt them, all states are being influenced by the changes in emphasis that these documents recommend. Teachers must be able to compare and contrast what they are presently doing in their classrooms with the vision of what could be done as articulated in these documents.

Since both Common Core (math) and NGSS (science) speak to how students will be assessed, teachers must increase their familiarity with these new assessment approaches and teaching methods, which lead to students understanding STEM knowledge and skills more deeply and increasing their

ability to apply these in real-world situations. Teachers also need opportunities to discuss the limitations of the Common Core and NGSS, as some people are confounding the Common Core and NGSS assessments with limitations on the curriculum. For example, NGSS recommends that testing be limited to Newton's Second Law at the high school level, but some teachers misinterpret this to mean that only one of Newton's three laws should be included in the course. Overall, teachers need to understand that the tests are limited in scope and represent only a sampling of what students need to know, with items biased toward what can easily be measured.

Beyond these transformative shifts in STEM teaching, educational approaches must change dramatically to prepare students for work and life (as opposed to further schooling) in the modern era.[5] Rather than moving into stable industrial jobs, young people now must compete in a rapidly shifting, global, knowledge-based, innovation-centered economy. And in order to secure a reasonably comfortable lifestyle, they now must go beyond a high school diploma and acquire not just academic knowledge but also character attributes such as intrinsic motivation, persistence, and flexibility. Moreover, mastery now requires the ability to apply knowledge and skills in real-world contexts, not just in academic settings, by demonstrating proficiency via effective, authentic performances.

In its landmark report *Education for Life and Work*, the National Research Council describes "deeper learning" as the instructional strategy needed to achieve these ambitious goals.[6] The approaches recommended by advocates of deeper learning are not new, and historically these instructional strategies have been described under a variety of terms; until now, however, they have been rarely practiced within schools.

- *Case-based learning* helps students master abstract principles and skills through the analysis of real-world situations.
- *Multiple, varied representations* of concepts provide different ways of explaining complicated things, showing how those depictions are alternative forms of the same underlying ideas.
- *Collaborative learning* enables a team to combine its knowledge and skills in making sense of a complex phenomenon.
- *Apprenticeships* involve working with a mentor who has a specific real-world role and, over time, enables mastery of knowledge and skills.
- *Self-directed, life-wide, open-ended learning* is based on a student's passions and connected to a student's identity in ways that foster academic engagement, self-efficacy, and tenacity.

- *Learning for transfer* emphasizes that the measure of mastery is application in life rather than simply in the classroom.
- *Interdisciplinary studies* help students see how different fields can complement each other, offering a richer perspective on the world than any single discipline can provide.
- *Personalized learning* ensures that students receive instruction and supports that are tailored to their needs and responsive to their interests.
- *Connected learning* encourages students to confront challenges and pursue opportunities that exist outside of their classrooms and schools.
- *Diagnostic assessments* are embedded into learning and are formative for further learning and instruction.

These approaches to deeper learning entail very different teaching strategies than the familiar, lecture-based forms of instruction characteristic of industrial-era schooling, with its one-size-fits-all processing of students. Rather than requiring rote memorization and individual mastery of prescribed material, they involve in-depth, differentiated content; authentic diagnostic assessment embedded in instruction; active forms of learning, often collaborative; and learning about academic subjects linked to personal passions and infused throughout life. Active research in these desired strategies is complex, and professional development is essential as a component of this research. Teacher learning is vital for achieving the transformation in practice emerging from this shift.

## CHALLENGES AND OPPORTUNITIES IN PROFESSIONAL DEVELOPMENT

A precursor to this book, Chris Dede's edited volume *Online Professional Development for Teachers*, published in 2006, provides a dismal picture of professional development at that time:

> Unfortunately, at present most teacher professional development programs are not of high quality, offering "fragmented, intellectually superficial" seminars (Borko, 2004, 3). In addition, face-to-face, pull-out programs are unable to provide ongoing daily guidance for teachers as they attempt to implement novel curricula or pedagogies. This problem of just-in-time support is exacerbated when teachers attempt to implement new strategies in environments made hostile by reluctant peers or administrators who see those innovations as undercutting the

current school culture. Further, conventional approaches to professional development typically fail to provide day-to-day professional mentoring for entry-level teachers; this lack of guidance is a major factor underlying the high attrition rate among new teachers within their first five years in the classroom. As a result of all these factors, teachers often become frustrated with professional development, at times because it is ineffectual, and at times because it requires sacrifices disproportionate to the enhancement it provides.[7]

This situation has not substantially improved in the past decade. Most teacher professional development is one-size-fits-all (despite dramatic differences among individual teachers), just-in-case rather than just-in-time (so forgotten when the opportunity finally arises for application), and focused on superficial improvements rather than needed major shifts, such as transforming STEM instruction based on the Common Core and NGSS.[8]

The failure to provide universal, high-quality professional development in education is in sharp contrast to other professions (e.g., law, medicine), and this shortfall is in part responsible for continuing difficulties in both attracting strong people to teaching and keeping them in classroom instruction for more than a few years.[9] Moreover, few forms of professional development have been studied using strong methods of evaluation and research, so improvement is difficult given a lack of findings about what strategies are working well and why.[10]

The chapters comprising this book delineate insights about the process of professional development and teacher learning that have emerged in the last decade. While advances in theory and empirical research have enriched the field, the most profound change during this period has been the evolution of digital technology, particularly the rise of mobile devices, wireless broadband, and social media. A mobile infrastructure is now in place that allows educators to access professional learning experiences life-wide, regardless of place and time, using ubiquitous devices that have become part of everyone's personal activities.

Further, this infrastructure supports a broad range of peer-based capabilities for sharing educational artifacts, thinking together, and cocreating learning resources. The following list is illustrative of a much richer array of social media, digital tools on which the models in this book draw:

- *sharing:* social bookmarking, photo/video sharing, social networking, writers' workshops and fanfiction

- *thinking:* blogs, podcasts, online discussion forums, Twitter
- *cocreating:* wikis/collaborative file creation, mashups/collective media creation, collaborative social change communities.

Technological constraints that plagued professional development models in 2006 are largely gone, creating exciting opportunities for rich interaction and universal access. This book features models of professional development and teacher learning that go well beyond what was possible a decade ago, although, to date, achieving scale and sustainability for these approaches has been difficult.

### THE GENESIS AND DESIGN OF THIS BOOK

A decade has passed since the workshop at Harvard leading to the publication of *Online Professional Development for Teachers*.[11] During that time, the publication and adoption of Active Physics, an innovative project-based high school curriculum, generated a need to provide high-quality online professional development that received National Science Foundation (NSF) support.[12] A related project, also supported by NSF, studied the professional development choices that teachers are making to teach the revised Advanced Placement (AP) curriculum.[13] That project brought Chris Dede, Arthur Eisenkraft, Kim Frumin, Alex Hartley, and others together.

Based on these intersecting interests, it seemed time for another synthesis of how digital media are shaping professional development and teacher learning. Gerhard Salinger, in one of his final acts in a long, illustrious, productive, and inspiring career with NSF, authorized remaining funding from one of these grants to be allocated for supporting an Online Teacher Professional Development Summit that was held November 14–16, 2014, at the University of Massachusetts Boston. The event was organized by the four coeditors of this book to focus on innovative models of online professional development and teacher learning in STEM subjects because substantial investment in the last decade has produced novel, powerful approaches. The organizers asked colleagues and others working in the field for recommendations for people to invite who represented the top developers of online teacher professional development for STEM instruction. They received approximately one hundred recommendations and from that group selected twenty-two participants representing a range of experiences. Criteria for selection included published research articles and/or funded projects by NSF

or similar organizations. (For economic reasons, they did not select international participants.)

Authors were asked to provide a description of the model's strategy for educational improvement, audience, balance of content and skills, primary method of teacher learning, and discussion of whether the model is a face-to-face, online, or blended program. (The terms *hybrid* and *blended* are used interchangeably in this book.) They were also asked to provide information about

- the types of infrastructure and technology required by the model
- the degree of commitment required of participants
- how the model ensures high-quality enactment
- research and evaluation of the model and the results
- the intended versus enacted models by participants
- whether the model is intended for local professional development or the larger education community (or both).

In addition, authors were asked to consider the adaptability (how readily a model can be modified to fit local conditions without losing its effectiveness), scalability (the extent a model can be implemented in many types of settings with varying levels of resources), inclusivity (accessibility across cultures, technical divides, diversity, physical challenges, and a host of other equity issues), and sustainability (over time in terms of resources) of the model. During the summit, authors presented papers that were then discussed in small groups and revised.

The book is designed so that it need not be read cover to cover, although certainly that is the best way to achieve an overall perspective on the current state of professional development and teacher learning for STEM education. The chapters are grouped into four parts: "Courses," "Curriculum Support," "Resources and Strategies," and "Summary Insights." In the appendix, we provide discussion questions for readers and those who may be using this book as part of a course.

As part of the introductory section of the book, in chapter 1 Barry Fishman considers possible futures for online teacher professional development and connects these trends and the latest research into what makes for more effective professional development in general with models presented in this volume. Often, a look forward is included as the last chapter in a book such as this, but we have decided to place it first so that readers can consider the models in relation to Fishman's forecast. His chapter concludes with

comments on the research methods commonly employed to examine outcomes related to online teacher professional development and how a shift in these methods may lead to more scalable and sustainable designs to support teacher learning online.

Part I, "Courses," presents four exemplary models of courses designed for teacher professional development. In chapter 2, Susan Doubler and Katherine Paget describe Talk Science, a web-based professional development course that helps teachers support strategic and purposeful classroom discussions in which students build coherent lines of reasoning based on their own ideas. The course, which uses four types of videos, takes place over a three-month period as participating teachers implement the Inquiry Curriculum, a multigrade study of concepts and practices key to understanding the particulate model of matter.

In chapter 3, Glenn Kleiman and Mary Ann Wolf discuss how the MOOCs for Educators (MOOC-Eds) initiative has achieved impact and scale. This initiative was designed to explore whether MOOC-like approaches could be adapted to address the professional development needs of many educators, including teachers, instructional coaches, and school and district administrators; incorporate research-based principles of effective professional development; and provide scalable, accessible, cost-effective professional development.

Ruth Schoenbach, Cynthia Greenleaf, Willard Brown, and Heather Howlett describe in chapter 4 an online course designed for high school science teachers by WestEd, a nonpartisan nonprofit research, development, and service agency based in San Francisco. The iRAISE (Internet-based Reading Apprenticeship Improving Science Education) course, which is focused on disciplinary literacy, is based on the Reading Apprenticeship instructional framework, a pedagogical approach that has been developed over a twenty-plus-year history of iterative research and development with communities of practitioners. The chapter addresses the aims and questions that guided the "translation" of a sixty-five-hour, yearlong, ten-day face-to-face professional development sequence into an all-online, mostly synchronous course, as well the strengths and challenges of this approach.

In chapter 5, Robert Steiner and his colleagues from the American Museum of Natural History describe the professional development program Seminars on Science, which began in 1998 as the development of hybrid offerings that take advantage of in-person opportunities at the museum and elsewhere. The authors also discuss the development of MOOC versions of

the courses as well as the future prospects for online and blended teacher professional development at the museum.

Part II, "Curriculum Support," begins with chapter 6, by Abigail Levy and Arthur Eisenkraft, who write about the Active Physics Teacher Community formed to help teachers using the Active Physics curriculum. This professional development model assists teachers in preparing for their classes each day by providing them with formal instruction directly related to the lessons they are teaching; in sharing their knowledge, experiences, successes, and challenges with other teachers using the same lesson plans and curriculum; and with comparing the effectiveness of their teaching with the effectiveness of others' teaching, thereby allowing them to use data to inform their instruction and modify their strategies appropriately.

In chapter 7, Jacqueline Miller and Katherine Paget discuss the Electronic Teacher Guide (eTG), a professional development model that was developed as a proof-of-concept exemplar to determine whether a print guide for an inquiry-based, educative curriculum could be redesigned as a cybertool that would have the potential to transform and improve teacher learning. The eTG prototype can also provide a model for science curriculum developers and publishers for supporting teachers' "move" into the digital classroom.

Barbara Zahm and Ruta Demery describe in chapter 8 CyberPD, a cyberlearning professional development model readily and inexpensively distributed to districts implementing Project-Based Inquiry Science, an NSF-funded middle school science curriculum. The pedagogical elements in CyberPD include driving questions, learning by design, sustained inquiry, and engagement in scientific reasoning and practices. These key elements are not separate but are synergistic and common across all thirteen units and facilitate science learning at scale.

In Part III, "Resources and Strategies," chapter 9, by Al Byers and Flavio Mendez, provides an overview of the resources available through the NSTA Learning Center, where more than 170,000 teachers spend many hours completing self-directed on-demand web modules, take formal online courses with university partners, participate in web seminars and virtual conferences, and share online digital resource collections and professional insights through moderated discussion forums. This model currently has more than 90,000 personally uploaded resources, 14,000 teacher-generated public collections, and 60,000 user-generated posts on more than 5,800 topics across its public and private forums. The chapter shares the center's challenges and successes and offers insights into how NSTA's platform may be

configured for the needs of individuals as well as for entire school districts and institutions of higher education.

In chapter 10, Kim Frumin and Chris Dede describe the important role of moderators in online professional learning communities, as documented by research on the College Board's online AP Teacher Communities (APTCs) in high school biology and chemistry. Of the many forms of professional development that the College Board offers, participation in the APTCs has the largest positive, direct, and statistically significant association with both teacher practice and student outcomes.[14] The value of an online community lies in its ability to enable the rich and open exchange of ideas, experiences, and resources among its members. Based on theory and research, seven guidelines and other methods are presented that moderators can use to support the changes in behavior and knowledge sharing to which an online community aspires.

Raymond Rose details in chapter 11 strategies and resources that can help providers of online and blended teacher professional development meet their legal obligations for accessibility by people with disabilities, including existing standards for quality and accessibility and a course review process against these published standards.

In the final part of the book, "Summary Insights," Steven Schneider and his colleagues discuss in chapter 12 five cases of online professional development approaches designed at WestEd. The authors recount the multi-threaded story of how WestEd's traditional, face-to-face delivery is evolving into a variety of online approaches, summarized in a conceptual framework that spans various types of professional development. The details help articulate how these approaches evolved, lessons learned in their implementation, the role of facilitators, and why online or blended formats were considered most advantageous.

Finally, to close the volume, Chris Dede and Arthur Eisenkraft delineate core tensions in improving the models described in this volume, set out an aspirational vision for the next five years, and recommend next steps for various stakeholders.

As coeditors, we've learned much from each of the author's contributions, as well as from their participation in and interactions at the Online Teacher Professional Development Summit. We hope you find this book an equally rewarding experience in terms of the enthusiasm and insights it offers.