Mishra, P., Koehler, M.J., & Zhao, Y. (2007). Communities of designers: A Brief history and introduction. In P. Mishra, M.J. Koehler, & Y. Zhao (Eds.), *Faculty development by design: Integrating technology in higher education* (pp. 1-22). Information Age Publishing, Greenwich, CT.

1

Indeed, the best books have a use, like sticks and stones, which is above or beside their design, not anticipated in the preface, not concluded in the appendix. — *Henry David Thoreau*

Communities of Designers: A Brief History and Introduction

Punya Mishra, Matthew J. Koehler, & Yong Zhao

Michigan State University

This is a book about technology integration in higher education. It documents the stories, in their own voices, of a group of faculty members and graduate students at Michigan State University as they struggled to learn about, and implement, technology in their own teaching. They did this through their participation in an ongoing project (five years and counting) that we call "communities of designers." This has been an eventful journey as the chapters in this book testify. If there is one important lesson we can learn from these chapters, it is that technology integration is not about technology alone, it is not just about boxes and wires and interfaces and software programs: Successful technology integration is a sociological issue, intimately connected to institutional cultures and practices, to social groups (formal and informal), and to individual intention, agency and interest. Most importantly, appropriate use of technology in teaching requires the thoughtful integration of content, pedagogy, and technology. This book attempts to offer not just a bird's-eye view of the communities of designers project, but also to help identify broad themes and issues that can inform discussions and policies of technology integration at other institutions.

The background

Integrating technology into instruction is one of the most important issues faced by institutions of higher education (Green, Campus Computing, 1998). The 2001 (Green, Campus Computing 2001) survey conducted by the Campus Computing Project showed that over 31 % of the respondents believed that assisting faculty with integrating technology into instruction was the single most important IT issue faced by two and four-year colleges. Other studies (Albright, 1997; Caffarella & Zinn, 1999; Parker, 1997; Schwieso, 1993) show that faculty does not often use technology in systematic or pedagogically sound ways.

These issues gain a greater significance when we consider that faculty members in colleges of education are responsible for preparing the next generation of K-12 teachers. K-12 teachers are under increasing pressure to meet state and national technology standards and mandates. However, faculty members at colleges of education are often under-prepared to offer their teacher education candidates the required experiences and knowledge to meet these mandates. For instance, the 2001 Campus Computing (Green, 2001) survey noted that faculty in colleges of education were often less prepared than their colleagues in science, business, engineering, mathematics, and occupational programs to integrate technology into their teaching. The relative lack of faculty preparedness around technology and consequent lack of technology integration means that teachers graduating from these colleges are often ill-equipped to integrate technology into their own teaching. This is particularly troubling when we consider recently implemented standards and technology competencies that all K-12 teachers are supposed to meet. It has been argued that institutions of higher education need to develop and implement similar technology competencies for higher education faculty (Rogers, 2000). However, merely requiring a set of skills or technology competencies for instructors does not in any way insure that technology will be used in the classroom, or that it will be used appropriately and effectively. Moreover, issues of academic freedom and the relative autonomy enjoyed by university faculty often prevent the strict implementation of such requirements.

There are certain fundamental problems faced by higher education faculty as they attempt to integrate technology into their teaching. We list some of them below:

1. *Lack of experience in teaching / learning with technology*— Most faculty members in higher education gained their knowledge and skills without educational technology, or at a time when educational technology was at a very different state than it is today. It is not surprising that many do not necessarily see the value of using technology for teaching, consider it irrelevant to good teaching, or see themselves as insufficiently prepared or skilled to use technology.

2. *The rapid rate of technology change*– Technology changes so fast, causing hardware, software, and knowledge to become outdated every couple of years. Training instructors on specific software packages is particularly troublesome, because any given software release is unlikely to be used just a few years down the road. Any attempt to keep educators up to date on the latest and greatest hardware or

software (especially if it focuses on specifics), is doomed to create outdated professionals.

3. *Inappropriate design of software* – Most software tools available today are designed for the world of business and work, not education (Zhao, 2003). Converting general-purpose tools created for the world of business (e.g., spreadsheet programs) for use in the world of classroom teaching is neither trivial nor obvious. Doing so requires teachers to have deep knowledge of their content area, pedagogy, and the constraints and affordances of various technologies. Of course, a teacher could decide not to repurpose tools, but then students would simply be learning technologies (for the sake of learning technology) instead of more pressing subject-matter concerns.

4. *The Situativity of Learning* – Teacher knowledge is situated and local (Ball & Cohen, 1999; Putnam & Borko, 2000; Zeichner, Melnick & Gomez, 1996). Teachers' knowledge about technology is also situated in the context where technology is used. This knowledge is not only about what technology can do, but also (and perhaps more importantly) what technology can do for them. General one-size fits all approaches to technology skill development only encourage inappropriate generic solutions to the problem of teaching. Although there are some useful all-purpose technologies (e.g., grade books, knowledge-management systems, etc), we argue that the full potential of technology can only be realized in the teaching of specific subject matter that is sensitive to the values, experiences, teaching styles, and philosophies of individual teachers.

5. *An emphasis on "What" not "How"* – A potential guide to the development of technology skills in teachers are offered by the ever-burgeoning lists of state and national technology standards for teachers. In an attempt to codify, in standards, the knowledge that teachers need to have, there has been an emphasis on *what* teachers need to know, without paying much attention to *how* they are to learn it. An unfortunate consequence of this emphasis is the introduction of many skills-based interventions (e.g., workshops) targeting some of the things on the list. Teaching instructors how to use specific software and hardware configurations without also showing them how it applies to their own instruction, often leads to trial-and-error experimentation by teachers (Kent & McNergney, 1999). We argue that instruction methods, values, and goals need to be developed that lead to deeper understandings of technology integration.

6. *The time intensive nature of technology integration* — Faculty members are often overworked and keep a very busy schedule. They have little time or interest in learning about technology unless it is directly applicable to what they do. This demand for direct applicability can easily lead to a simplistic utilitarian response to giving faculty what they want—discrete technical skills in technology workshops. However, such workshops have rarely been found effective in promoting sustainable changes, nor have they been successful in actually attracting faculty. Thus, to develop a program that sustains faculty interest and results in significant changes, we need to have something that is both directly connected to the professional needs of the faculty, and rich and complex enough to enable intellectual engagement beyond simple skills. Part of the problem, we

argue, has been a tendency to only look at the technology and not at the broader context of use. It has become clear, over time, that merely introducing technology to the educational process is not enough. Rather, it is *how* technology is used that should become our primary focus (Carr, Jonassen, Litzinger, & Marra, 1998).

7. *The SEP syndrome* — A significant part of the problem of technology integration has been, what we have called (Koehler, Mishra, Hershey & Peruski, 2004) the "Somebody Else's Problem" (SEP) syndrome. Technology and pedagogy are often seen as being domains ruled by different groups of people — teachers and instructors, who are in charge of pedagogy; and technologists, who are in charge of the technology. Similar to C. P. Snow's (1959) idea of two cultures, teachers and techies live in different worlds and often hold curiously distorted images of each other. On one hand, the technologists view the non-technologists as luddites, conservative, resistant to change, and oblivious to the transformative power of technology. On the other hand, the non-technologists tend to view technologists as being shallowly enthusiastic, ignorant of education and learning theories, and unaware of the reality of classrooms and schools. Clearly, this gulf of mutual incomprehension needs to be bridged.

Undoubtedly, overcoming the above list of problems is no easy task. However, over the past five years at the College of Education at Michigan State University, we have developed a systematic program of research and development around technology integration in higher education that we feel does make several inroads towards addressing these issues. The approach, which we have called "Communities of design for faculty development," is the focus of this book.

Before describing the process of design communities, however, we briefly explain our underlying theoretical framework for teaching with technology that focuses on the role of different types of knowledge.

A Framework for Teacher Knowledge for Technology Integration

The question of what teachers need to know has received a great deal of attention recently. It has been argued that teaching is a complex activity that occurs in an ill-structured dynamic environment and requires the context sensitive and flexible access to different knowledge bases such as knowledge of student thinking and learning, and knowledge of subject matter (Glaser, 1984; Leinhardt & Greeno, 1986; Putnam & Borko, 2000; Shulman, 1986, 1987; Spiro, Coulson, Feltovich, & Anderson, 1988; Spiro, Feltovich, Jacobson & Coulson, 1991).

Shulman (1986) argued for a critical component of teacher knowledge that he called Pedagogical Content Knowledge (PCK). He argued that characterizing the complex ways in which teachers think about *how particular content should be taught*, requires teachers to develop "ways of representing and formulating the subject that make it comprehensible to others" (p. 9). Shulman did not include technological knowledge in his conceptualization of PCK, partly because, at that time, technologies had not become as integral a part of education as they have today. These new information technologies include both hardware and software, ranging from desktop machines to hand-held computers, from multimedia programs and educational games to the Internet. The rapid rate of evolution of these technologies distinguishes them from earlier, relatively stable technologies, and forces teachers to continually update their skills and knowledge as current technologies become obsolete. With these new technologies have come new challenges and requirements for their thoughtful application to pedagogy.

Over the past few years we have attempted to extend Shulman's idea of PCK to include technology (Koehler, Mishra, Hershey, & Peruski, 2004; Mishra, & Koehler, submitted). At the core of our argument is the idea that knowledge of technology cannot be treated as being context-free. Moreover, the prevalence of information technologies in classrooms today requires teachers to develop an understanding of how technology relates to pedagogy and content. Our approach is consistent with work done by other scholars in this area (see Keating & Evans, 2001; Lundeberg, Bergland, Klyczek & Hoffman, 2003; and Zhao, 2003 for similar arguments).

PCK has been described as representing "a class of knowledge that is central to teachers' work and that would not typically be held by non-teaching subject matter experts or by teachers who know little of that subject" (Marks, 1990, p. 9). Extending that to include technology we can define Technological Pedagogical Content Knowledge (TPCK) as follows: TPCK is a class of knowledge that is central to teacher's work. It is a form of knowledge that typically would not be held by technologically proficient, subject matter experts, by technologists who know little of the subject or of pedagogy, or by teachers who know little of that subject or about technology.

Our model of technology integration in teaching and learning argues that good teaching requires a thoughtful interweaving of all three key sources of knowledge — technology, pedagogy and content (see Figure 1). We argue against simplistic conceptualizations of the relationships between content (the actual subject matter that is to be learned/taught), pedagogy (the process and practice or methods of teaching and learning), and technology (which include both commonplace technologies, such as chalkboards, and more advanced technologies such as digital computers and the Internet).

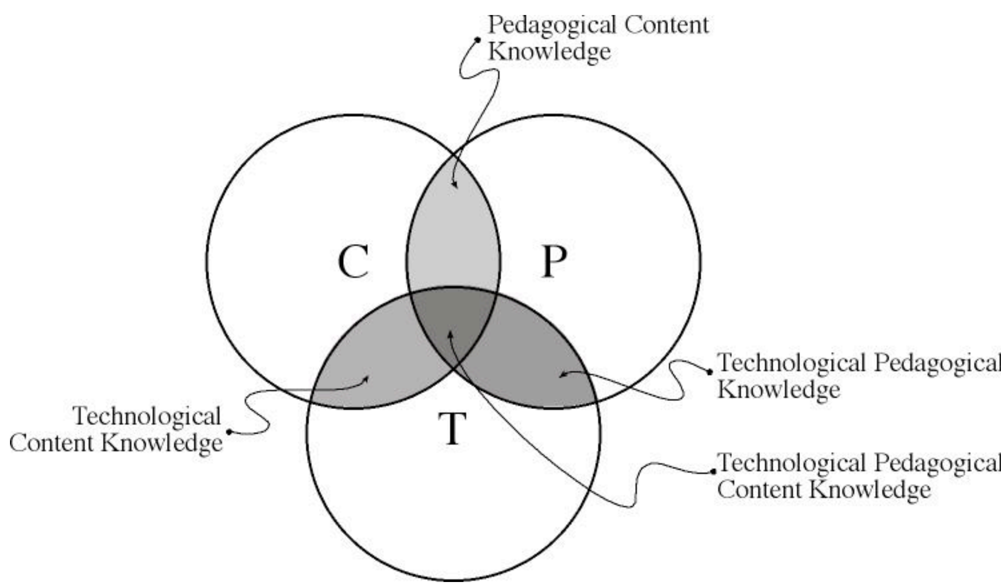

Figure 1. Three circles of knowledge (Content, Pedagogy and Technology) overlap to lead to four more kinds of inter-related knowledge.

One of the important aspects of our model is that it includes and extends Shulman's idea of PCK. As Figure 1 shows, PCK lies at the intersection of Pedagogical Knowledge and Content Knowledge. What our model adds is three other forms of knowledge (represented by three other intersections): Technological Content Knowledge (TCK) as the overlap between Technological Knowledge and Content Knowledge; technological pedagogical knowledge (TPK) at the intersection of Technological

Knowledge and Pedagogical Knowledge; and finally, Technological Pedagogical Content Knowledge (TPCK) at the intersection of all three.

The value of content and pedagogical knowledge is something most educators will understand right away (based on Shulman's pioneering work). However, the addition of technology as an independent knowledge base may seem more controversial to some. The traditional view of the relationship between the three aspects argues that content drives most decisions: the pedagogical goals and technologies to be used follow from a choice of what to teach. Matters are rarely that clear cut, particularly when newer technologies are considered. We argue that technologies often come with their own imperatives and constraints that can change or modify the manner in which content is covered and / or the process of pedagogy that may be most appropriate. The choice of a technology can often lead to changes in the way in which we conceptualize content and pedagogy.

We argue that viewing any of these components in isolation from the others represents a real disservice to good teaching. Teaching and learning with technology exists in a dynamic transactional relationship (Bruce, 1997; Dewey & Bentley, 1949; Rosenblatt, 1978) between the three components in our framework – a change in any one of the factors has to be "compensated" by changes in the other two. These interactions go both ways, deciding on a particular technological tool will offer constraints upon the representations that can be developed, the course content that can be covered and delivered, which in turn effects the pedagogical process as well.

Consider, for instance, the advent of online learning. Constructing an online course is more then merely moving lectures and assignments online. Choosing to teach via the Web has a ripple effect on both how the content is represented and how it is to be conveyed to the learners (the pedagogy). The argument here is not whether the change is good or bad, but rather that effective online teaching requires instructors to think deeply about the relationship between all three knowledge bases - not individually but in a co-evolutionary and co-constructed manner. The addition of a new technology reconstructs the dynamic equilibrium between all three elements forcing instructors to develop new representations of content and new pedagogical strategies that exploit the affordances (and overcome the constraints) of this new medium.

Similarly, changing pedagogical strategies (say moving from a lecture to a discussion format) necessarily requires rethinking the manner in which content is represented, as well as the technologies used to support it. To continue the argument, a change in the content to be taught (say from high school English to high school mathematics, or from middle-school biology to undergraduate biology) would perforce lead to changes in pedagogical strategies and technologies used.

We must add that separating these three components is not straightforward and at one level must be seen as an analytic act. Content, pedagogy, and technology are intimately related to each other and separating them out (as our model does) may be difficult to achieve in practice. Quality teaching requires developing a nuanced understanding of the complex relationships between technology, content, and pedagogy, and utilizing this understanding to develop appropriate, context specific strategies, and representations. Productive technology integration in teaching needs to consider all three issues not in isolation, but rather in the complex relationships in the system defined by the three key elements. Thus, our model emphasizes the complex interplay, connections, and interactions between these three bodies of knowledge, without privileging any of them specifically.

TPCK and Faculty Development: The Communities of Design Approach

Current research on teacher learning, teacher adoption of technology, and cognitive sciences as well as our own experiences suggest that the ability to teach with technology is much more complex than mere acquisition of mechanical skills. Viewing teacher knowledge for technology integration as being a transaction between the three factors of content, pedagogy, and technology has significant implications for teacher education and teachers' professional development. We argue (Mishra, & Koehler, 2003; Mishra & Koehler, submitted) that an overemphasis on skills-based training (e.g., workshops) puts too much focus on the Technology (the "T") in our model, without developing knowledge about its relationships to Content and Pedagogy (the "P" and "C" in our model). In short, the development of flexible understanding of and generative ability to use technology requires intensive, meaningful, and authentic interactions with technology.

In order to go beyond the simple "skills instruction" view offered by the traditional workshop approach, it is necessary to teach technology in contexts that honor the rich connections between technology, the subject matter (content), and the means of teaching it (the pedagogy). This suggests a possible restructuring of professional development experiences for instructors so that they might develop the kind of nuanced understandings called for in our TCPK framework. Our approach to professional development is called, *Communities of Designers,* and is based on an active engagement with authentic problems of pedagogy. By participating in these communities of design, teachers build something that is sensitive to the subject matter (instead of learning the technology in general) and the specific instructional goals (instead of general ones).

Therefore, every act of design is always a process of weaving together components of technology, content, and pedagogy.

In a traditional workshop or technology class, teachers are trained to use the latest tools with the hope that they can apply them to their practice. In contrast, in the *Communities of Design* approach, teachers focus on a problem of practice and seek ways to use technology (and thereby learn about technology) to address the problem. Because their explorations of technology are tied to their attempts to solve educational problems, teachers learn "how to learn" about technology and "how to think" about technology. Hence, teachers go beyond thinking of themselves as being passive *users* of technological tools and begin thinking of themselves as being *designers* of technology; i.e. they learn to use existing hardware and software in creative, novel, and situation specific ways to accomplish their teaching goals.

This conception of proficiency and its attainment suggests several principles that have guided the development of the *Communities of Designers* approach:

Principle 1. Teachers' ability to use technology must be closely connected to their ability to teach; that is, good-teachers-with-technology must first be good teachers. Their understanding of technology must be grounded in their understanding of teaching and learning in subject-specific and learner-specific contexts. Promoting such understanding is a high priority and strength of our teacher preparation program; we should build on it.

Principle 2. Technology, like language, is a medium for expression, communication, inquiry and construction that can help teachers solve pedagogical problems in classrooms. The most effective environment for teachers to learn to teach with technology is one that provides ample opportunities to engage in authentic uses.

Principle 3. The implementation of technology is the reinvention of technology. The realization of technological potential in educational settings is socially constructed and highly situational. Therefore, teachers should actively participate in the construction and reinterpretation of technology in their own teaching within a visible community of practice and inquiry that is both dedicated to and engaged in standards-based teaching and learning.

Principle 4. The relationship between technological innovation and established educational practices is dialogical. Technological innovation pushes pedagogical change, but it is also selected and redefined by existing pedagogy. Technological innovation should be anchored in thoughtful pedagogical practices while serving as a catalyst for change. Thus, an effective environment should encourage the exploration of the dialogical process between pedagogy and technology.

Building on these principles, and our experience and success in using design-based approaches to foster teacher knowledge, we developed the *Communities of Designers* approach. In a nutshell, a design community is a group of individuals (teacher education faculty, educational technology specialists and students, pre-service teachers, and in-service teachers) working collaboratively to design and develop technological solutions to authentic pedagogical problems faced by the teacher education faculty. The essence of this approach lies with four key words: *community*, *design*, *products/solution*, and *authentic problems*.

"Community" defines the social arrangement of the approach. A community, especially a purposefully constructed one, should include individuals with a diversity of expertise and expectations, making it possible for all members to contribute to and benefit from community activities. Within the context of social constructivism (Cole, 1996; Vygotsky, 1978) or constructionism (Harel, 1991; Harel & Papert, 1991), design projects lend themselves to sustained inquiry and revision of ideas.

"Design" specifies the activity dimension of the approach. Thus, building upon ideas grounded in situated cognition theory (Brown, Collins, & Duguid, 1989), learning is contextualized in the process of doing – solving an authentic problem of practice. Design-based activity provides the rich context for learning, sustained inquiry, and revision and is well-suited to develop the deep understanding needed to apply knowledge in the complex domains of real world practice. This emphasis on design is informed by long-standing research on the use of design for learning complex and interrelated ideas (Perkins, 1986; Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991; Brown, 1992; Harel & Papert; 1990, 1991; Kafai, 1996), with many theoretical and pragmatic connections to project-based learning (Blumenfeld, Marx, Soloway, & Krajcik, 1996; Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991; Dewey, 1934; Papert, 1991; Roth, 1995; Roup, Gal, Drayton, & Pfister, 1993). In constructing a product/solution, the learning of a design community is located at the intersection of theory and practice, technology and pedagogy, and designer and audience. Design communities also can transform members by encouraging them to take control of their own learning, as they take the necessary steps towards reaching the solution to their authentic problem.

Whereas products/solution stresses the goal-oriented psychological dimension, authentic problems addresses the motivational challenge, giving the driving force behind the work of the community. "Authentic problems" that teacher education faculty face and have to work on provide the connection between what the faculty may learn and what they actually do. These problems also provide the opportunity for the faculty to explore technology as a solution to teacher education problems in a situated manner (Barab & Duffy, 2000; Marx, Blumenfeld, Krajcik, & Soloway, 1997; Pea, 1993). Teacher knowledge, including knowledge about how to use technology, is situated and local (Ball & Cohen, 1999; Borko & Putnam, 1996; Cochran-Smith & Lytle, 1993; Lampert & Ball, 1999; Putnam & Borko, 2000; Zeichner, Melnick & Gomez, 1996). The knowledge is not only about what technology can do, but also (and perhaps more importantly) what technology can do for them. The process of learning to use technology is thus a translation process whereby teachers understand the meaning and implications of a technology and translate it into a solution for a local problem. Moreover, they need opportunities to apply what they are learning in a variety of contexts over time—including classroom contexts—in order to develop sufficient confidence and skill to adapt new ideas to future situations (Bosch & Cardinale, 1993; Brown, 1992; Willis & Mehlinger, 1996). They also need opportunities to grapple with authentic pedagogical issues related to standards-based subject matter teaching, and explore potential technological responses to those issues (Rosaen, Hobson & Khan, 2003). It is, thus, essential for teachers to engage in experimenting with technology in response to authentic problems that they are likely to encounter in their teaching.

Consistent with other research in this area (Barab & Duffy, 2000), design team participants contend with authentic and engaging ill-structured problems that reflect the complexity of the real world (Pea, 1993; Marx, Blumenfeld, Krajcik, & Soloway, 1997). Learners have to actively engage in active practices of inquiry, research and design, in collaborative groups (that include higher education faculty members and graduate students with an interest in educational technology) to design tangible, meaningful artifacts as end products of the learning process (Blumenfeld et al., 1991). The actual process of design is the anchor around which learning happens. This evolving artifact is also the test of the viability of individual and collective understandings as participants test theirs, and others', conceptions and ideas of the project. Learning in this context involves becoming a *practitioner*, not just learning about *practice* (Brown & Duguid, 1991). We see learning by design as the foundation for building a beginning repertoire (Feiman-Nemser, 2001) where repertoire is defined as "a variety of techniques, skills, and approaches in all dimensions of education that teachers have at their fingertips" (Wasley, Hampel, & Clark 1997, p. 45).

Implementing Communities of Design

The approach was first implemented in 1999 when the Dean of the College of Education asked two of the authors (Mishra and Zhao) to offer a course for faculty development. The result combined faculty development with a regular masters course in educational technology. Prior to the beginning of the course, the Dean issued a call for proposals to the teacher education faculty, to which over 20 faculty members responded. Six faculty members were selected to participate in the program. The selection criteria included the significance of the problem proposed, the potential impact of the finished solution, and the potential impact on the faculty at large. Six faculty members then joined the class. Six design teams were formed around each of the faculty members. The students enrolled in the class were asked to select a design team to join according to their own interests. The problems the design teams worked on were diverse but all significant and real. They included: the design of a website for teaching an introductory teacher preparation course; developing strategies for using classroom digital video for training collaborating teachers in K-12 districts to work with pre-service teacher interns; developing a database of lesson plans for learning elementary level science; the design of technologies for literacy instruction and evaluation in elementary reading; and, an online course on immigrant issues for pre-service teachers and development of a web-based interface for pre-service teachers to construct and share their teaching videos.

The results of the first faculty development course appeared to be very positive in a number of ways. First, the faculty developed a deeper and more flexible understanding of technology. Many of them describe the experience as transformative. Second, the teams produced products that were subsequently used in the teacher education program, which is a good indication of technology integration and transformed teaching practices. Third, the participating graduate students learned more about the complexity of technology integration and teacher education.

Capitalizing on the success, the College decided to continue and expand the program to faculty in other departments within the College. The College has offered the program every year for four years since the first one. By every measure, the faculty development course has become an integral part of the faculty development plan in the college and part of the educational technology masters' program. For example, this effort was a key means for helping the college develop faculty skilled at teaching online as part of the new online masters' program (e.g., Koehler et al. 2004).

Later, with support from the US Department of Education's PT3 grant, we took the *Communities of Designers* approach even further. As part of our efforts, we set up opportunities for faculty to pursue year-long funding for design projects that integrated technology into the college, the teacher education program, or into the surrounding educational communities. We were widening the scope of problems that could be investigated through the design approach, which provided longer and more kinds of support than could be delivered during a semester long course, in essence. We were expanding the role of the various participants (graduate students, teacher education students, teachers in the schools, and other partners could be part of the team). Over the past five years, over 30 faculty members have led these communities of designers and the work continues today.

Implementing a *Community of Designers* breaks down into four stages that each design team experienced over its lifecycle: identifying participants and problems, forming communities, providing leadership and support, and working on the problems. We briefly describe the four stages below.

1. *Inviting proposals and identifying authentic problems*. Key to the success of this approach is to identify authentic problems. To identify potential participants and authentic problems, the Dean issued an open call for proposals to all of the faculty members at the college. The call described the program and invited interested faculty members to propose the problems they face and would like to work on in the faculty development program. The call made it clear that prior technology proficiency was not a requirement. What was considered important was the significance and authenticity of the problem, as well as its potential for exploring technology as a solution. Later, as the PT3 grant developed, additional design teams were supported by a similar proposal and awarding structure led by the grant leaders.

2. *Forming communities*. The faculty member served as the head of the design community. Other members of the community included experts in educational technology, who were often graduate students in educational technology or graduate assistants who had expertise in using technology. In addition, depending on the situation, pre-service and in-service teachers, who were often the potential audience of the design products, were also included in the design community.
3. *Providing leadership and support.* One or two educational technology faculty members were often needed to provide overall leadership and serve as resources to all the design communities at any given time. Other general support included graduate students and undergraduate students with special expertise in technology. These students often served as consultants to design communities.
4. *Working on the problems.* Once the design community was formed, members of the community began to explore technology as a solution to the problem over a period of time, during which they may have attended classes led by the educational technology faculty and or consulted with the educational technology faculty and other technology specialists. This was where the bulk of the professional development really happened, where the participants encountered the boundaries and intersections of content, pedagogy, and technology.

We have learned some significant lessons over the past five years, most of which will be revealed in the chapters that follow. We have also used these communities of designers as sites for research. This has resulted in a series of publications and conference presentations, as well as the theoretical framework that guides our work today. That said, there are some key meta-lessons that might be useful to present here. One of the most important lessons we have learned is to base the design team idea on an authentic pedagogical problem as identified by faculty members who teach these courses. We have also learned that it is important to trust the faculty members and not monitor them too closely. The fact that these are concerns raised by faculty members is an automatic motivator. Moreover, design problems often changed and mutated as the design teams learned more about the work they were engaged in. Trusting the faculty members and design teams meant that we were open to their re-conceptualizations and redesigns. We have learned that going hand in hand with trusting the faculty members is the need for strong institutional support-both financial and technological. Finally, we have learned that it is important to have a good mix of people in the design teams. Our design teams were quite eclectic in nature, including technology novices, technology experts, graduate students, faculty members, in-service teachers, pre-service teachers, and in certain cases, K-12 students. We have found that each of these stakeholders brings a different perspective to the design process, enriching it and making the solutions more robust and applicable.

This is not to say that all design teams were successful and that all technology projects were completed without frustration or even completed at all (at least as originally envisaged). This will be revealed in the chapters that follow.

About the Chapters

This book is a collection of reflective papers on the experiences and learning of some of the faculty members who participated in the faculty development program. Even though their accounts all document and analyze the design community approach, the authors have diverse backgrounds, interests, viewpoints, and authentic problems they engaged in. Each chapter helps to add detail to the *Community of Designers* framework, and highlight the nuances as well. Collectively, the chapters reinforce two main themes. First, faculty development does not happen in a vacuum. Rather, it is connected to pedagogical problems and concerns faculty members face as they attempt to integrate technology in their teaching. Second, a focus on community indicates that technology integration is a sociological issue rather than a psychological one or a technical / administrative one.

The next seven chapters that follow are quite different from each other – as they should be reflecting contextual and local influences on the design of technology for teaching and learning. Each of these chapters is a reflective piece on one (or more) community member's experience in learning about technology, particularly as it played out through their participation in the design community experience. Each of the authors brought an immense body of scholarly and practical experience with pedagogy in the area of higher education to their design communities. Each of the chapters that follow explores and documents their learning and changes in thinking about pedagogy and technology through their participation in the design communities. That said, each chapter broadly follows the following framework:

1. The chapters start with a description of *the authentic problem the project intended to address*. Too often technology integration is driven by the imperatives of the technology—cool tools in search of a solution. A key aspect of our approach is that the prime driving force for learning and implementing technology have been authentic pedagogical problems identified by practicing teacher

educators. Thus, the first part of the chapter addresses why the individual project was important, the problem it attempted to address.

2. The next section of the chapter offers an *analysis of the various roles of participants in the community.* It describes the nature and process of collaboration with other stakeholders and participants, and how the community facilitated (or did not facilitate) the design/problem solving process. Technology integration cannot take place in a vacuum. Nor can it occur by just one individual acquiring technical knowledge. It often requires collaboration with other people. For instance, we know that different design teams formed different kinds of communities. Most of them included graduate students, other faculty members, technology-experts, practicing teachers, interns, and so on. Of course, all this happened within a broader college and university level institutional context. The support offered by these teams, groups, institutions, and individuals was both material (such as laptops, software, money etc.), and intangible, though no less important (such as faculty development courses, summer support, informal consultancy, and so on).
3. The third section of the chapters provides *documentation and analysis of the process of seeking a technology solution*. This section usually offers a description of the process of developing a technological solution to the original problem. Learning a new technology can often be quite frustrating and time consuming. Too often descriptions of technology integration do not describe the "actual" process of technology development and integration. This section describes the nature of problems faced (technological, structural, social), how they were overcome, and what technologies were learned and used. Some of the

chapters talk not just of the ideas that the faculty started with, but also ideas that were discarded. The descriptions are not just of what worked, but also what did not, and how these disruptions, disturbances and contradictions led to learning.

Too often design is seen as the application of abstract scientific principles to technology, what Schon (1983) has called "the myth of technical rationality." However, as these chapters reveal design is a messy and complex process. It is not a linear movement towards a specific goal, but rather a zig-zag process in which goals and plans are in a constant state of negotiation. These chapters show that design is most fruitfully seen as a dialogue between constraints and tradeoffs, between theoretical and pragmatic concerns, and between the artifact being created and the evolving conceptions of the designers. There is a constant play between the triad of content, pedagogy, and technology, and the best solutions are ones that respect the imperatives of all three.

4. Finally, the chapters end with a *final reflection and summing up of the process by the author/participant*. This section provides a description of where things stand today and tentative descriptions of where they see it going in the future.

The last two chapters in the book are by Dr. Bertram "Chip" Bruce and Dr. Martin Oliver. Dr. Bruce has been partially involved with the project (he was an external evaluator on the part funded through the PT3 grant) and offers an insider/outside perspective on the chapters. Dr. Martin Oliver was not involved in the project and provides an "outsider's" view of the project.

We hope that you have as much fun and learn as much from reading these chapters as we had in living through these experiences.

References

Albright, L.P. (1997). The information technology imperative for higher education: A report. *Library Acquisitions: Practice and Theory,* 21(3), 268 – 270.

Ball, D. L. & Cohen, D. K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In G. Sykes & L. Darling-Hammond (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 3-32). San Francisco: Jossey Bass.

Barab, S. A., & Duffy, T. M. (2000). From practice fields to communities of practice. In D. Jonassen & S. Land (Eds.), *Theoretical foundation of learning environments.* (pp. 25 – 56). Mahwah, NJ: Lawrence Erlbaum Associates.

Blumenfeld, P. C., Marx, R. W., Soloway, E., & Krajcik, J. (1996). Learning with peers: From small group cooperation to collaborative communities. *Educational Researcher, 25*(8), 37-40.

Blumenfeld, P.C., Soloway, E., Marx, R., Krajcik, J., Guzdial, M., & Palincsar, A. (1991) Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist, 26* (3&4), 369-398.

Borko, H., & Putnam, R. (1996). Learning to teach. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 673-708). New York: Macmillan.

Bosch, K. A., & Cardinale, L. (1993). Preservice teachers' perceptions of computer use during a field experience. *Journal of Computing in Teacher Education, 10*(1), 23-27.

Brown & Duguid (1991): Organisational learning and communities of practice: Towards a unified view of working, learning, and innovation. *Organisational Science, 2*(1), 40-57.

Brown, A. L. (1992). Design experiments: theoretical and methodological challenges in creating complex interventions in classroom settings. *The Journal of the Learning Sciences*, 2(2),141-178.

Brown, J.S., Collins, A. & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Bruce, B. C. (1997). Literacy technologies: What stance should we take? *Journal of Literacy Research, 29* (2), 289-309.

Caffarella, R. S., & Zinn, L.R. (1999). Professional development for faculty: A conceptual framework of barriers and supports. *Innovative Higher Education,* 23(4), 241 - 254.

Carr, A., Jonassen, D., Litzinger, M.E., & Marra (1998). Good ideas to foment educational revolution: The role of systematic change in advancing situated learning, constructivism, and feminist pedagogy. *Educational Technology,* 38(1), 5-14.

Cochran-Smith, M., & Lytle, S. L. (1993). *Inside/outside: Teacher research and knowledge* . New York: Teachers College Press.

Cole, M. (1996). Cultural psychology: A once and future discipline. Cambridge: Harvard University Press.

Dewey, J. (1934). *Art as experience.* New York: Perigree.

Dewey, J., & Bentley, A.F. (1949). *Knowing and the known*. Boston: Beacon.

Feiman-Nemser, S. (2001). From preparation to practice: Designing a continuum to strengthen and sustain teaching. *Teachers College Record, 103*(6),1013-1055.

Glaser. R. (1984). Education and Thinking: The role of knowledge. *American Psychology*, 39(2), 93-104.

Green, K.C. (1998). *The 2001 National Survey of Information Technology in US Higher Education*. [Online] Available: http://www.campuscomputing.net/summaries/1998/index.html

Green, K. C. (2001). *The 2001 National Survey of Information Technology in US Higher Education*. [Online] Available: http://www.campuscomputing.net/summaries/2001/index.html

Harel, I, & Papert, S. (1991). *Constructionism*. Norwood, NJ: Ablex.

Harel, I., & Papert, S. (1990). Software design as a learning environment. *Interactive Learning Environments, 1(*1), 1-32.

Harel, I. (1991). *Children designers*. Norwood, NJ: Ablex.

Kafai, Y. (1996). Learning design by making games: Children's development of design strategies in the creation of a complex computational artifact. In Y. Kafai & M. Resnick, (Eds.), *Constructionism in practice: Designing, thinking and learning in a digital world* (pp. 71-96). Mahwah, NJ: Lawrence Erlbaum Associates.

Keating, T. & Evans, E. (2001, April). *Three computers in the back of the classroom: Pre-service teachers' conceptions of technology integration*. Paper presented at the annual meeting of the American Educational Research Association. Seattle, WA.

Kent, T. W., & McNergney, R. F. (1999). *Will technology really change education?: From blackboard to web*. Thousand Oaks, CA: Corwin Press.

Koehler, M.J., Mishra, P., Hershey, K., & Peruski, L. (2004). With a little help from your students: A new model for faculty development and online course design. *Journal of Technology and Teacher Education 12*(1), 25-55.

Lampert, M., & Ball, D. L. (1999). Aligning teacher education with contemporary K-12 reform visions. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the_learning profession: Handbook of policy and practice* (pp.33-53). San Francisco: Jossey-Bass.

Leinhardt, G, & Greeno, J.G. (1986). The cognitive skill of teaching. *Journal of Educational Psychology, 78*(2), 75-95.

Lundeberg, M.A., Bergland, M., Klyczek, K., & Hoffman, D. (2003). Using action research to develop preservice teachers' beliefs, knowledge and confidence about technology. *Journal of Interactive Online Learning*, 1(4), http://ncolr.uidaho.com/jiol/archives/2003/spring/toc.asp

Marks, R. (1990). Pedagogical content knowledge: From a mathematical case to a modified conception. *Journal of Teacher Education, 41*(3), 3-11.

Marx, R. W., Blumenfeld, P. C., Krajcik, J. S., & Soloway, E. (1997). Enacting project-based science: Challenges for practice and policy. *Elementary School Journal*, 97(4), 341 - 358.

Mishra, P., & Koehler, M. J. (submitted). Technological Pedagogical Content Knowledge: A framework for integrating technology in teacher education.

Mishra, P., & Koehler, M. J. (2003). Not "what" but "how": Becoming design-wise about educational technology. In Y. Zhao. (Ed.). *What teachers should know about technology: Perspectives and practices* (pp. 99-122). Greenwich, CT: Information Age Publishing.

Papert, S.(1991). Situating constructionism, In S. Papert and I. Harel (Eds.), *Constructionism* (pp. 1-11). Norwood, NJ: Ablex.

Parker, D. R. (1997). Increasing faculty use of technology in teaching and teacher education. *Journal of Technology and Teacher Education,* 5(2 & 3), 105-115.

Pea, R. D. (1993). Practices of distributed intelligence and designs for education. In G. Salomon (Ed.). *Distributed cognitions* (pp. 47-87). New York: Cambridge University Press.

Perkins, D.N. (1986). *Knowledge as design*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Putnam, R.T. & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher, 29*(1), 4-15.

Rogers, D. (2000). A paradigm shift: Technology integration for higher education in the new millennium. *Educational Technology Review 1*(13), 19-33. [Online]. Available: http://dl.aace.org/6256

Rosaen, C. L., Hobson, S. & Khan, G. (2003). Making connections: Collaborative approaches to preparing today's and tomorrow's teachers to use technology. *Journal of Technology and Teacher Education 11*(2). 139-172.

Rosenblatt, L.M. (1978). *The reader, the text, the poem: The transactional theory of literary work*. Carbondale, IL: Southern Illinois University Press.

Roth, W.-M. (1995). *Authentic school science.* The Netherlands: Kluwer Academic Publishers.

Roup, R., Gal, S., Drayton, B., & Pfister, M. (Eds.). (1993). *LabNet: Toward a community of practice*. New Jersey: Lawrence Erlbaum Associates, Inc.

Schon, D. (1983). *The reflective practitioner.* London UK: Temple Smith.

Schwieso, J. (1993, February). Staff usage of information technology in a faculty of higher education: A survey and case study. *Educational & Training Technology International: ETTI,* 30(1), 88-94.

Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. Harvard Educational Review. 57(1). 1-22.

Snow, C. P., (1959). *The two cultures and the scientific revolution. The Rede lecture*. New York: Cambridge University Press.

Spiro, R.J., Coulson, R.L., Feltovich, P.J.,& Anderson, D. K. (1988). Cognitive flexibility theory: Advanced knowledge acquisition in ill-structured domains. In V. Patel (Ed.), *Tenth Annual Conference of the Cognitive Science Society* (pp. 375–383). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Spiro, R.J., Feltovich, P.J., Jacobson, M.J., & Coulson, R.L. (1991). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. *Educational Technology,* 31(9), 24-33.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Wasley, P., Hampel, R. , & Clark, R. (1997*). Kids and school reform*. San Francisco: Jossey-Bass.

Willis, J. & Mehlinger, H. (1996). Information technology and teacher education. In J. Sikula, T.J. Butter & E. Guyton (Eds.), *Handbook on research in teacher education* (pp.

978-1029). New York: Simon and Schuster Macmillan.

Zeichner, K, Melnick S. & Gomez, M. (1996) *Currents of reforming preservice teacher education*. New York, NY: Teachers College Press.

Zhao., Y. (Ed.) (2003). *What teachers should know about technology: Perspectives and practices*. Greenwich, CT: Information Age Publishing.