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The Importance of Professional Development and Teacher Learning for Educational Improvement: Investments by NSF's DRK-12 Program

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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[1]. 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.

Thus, building teacher capacity is the chief means for improving classroom instruction and, in turn, student achievement.[2] 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 and learning 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 that drive investments in NSF's DRK-12 portfolio.

The key distinctions between the terms *professional development* and *teacher learning* 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 funded by NSF's DRK12 program fall on a continuum, with mandated, formal professional development at one end; voluntary, informal teacher learning at the other; and many approaches somewhere in between. In my opinion, 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

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[1] This paper draws on the Introduction and Conclusion in Dede, C., Eisenkraft, A., Frumin, K., and Hartley, A. (Eds). (2016). *Teacher Learning in the Digital Age: Online Professional Development in STEM Education*. Cambridge, MA: Harvard Education Press.

[2] H. Borko, J. Jacobs, and K. Koellner, "Contemporary Approaches to Teacher Professional Development," in *International Encyclopedia of Education*, ed. P. L. Peterson, E. Baker, and B. McGaw (New York: Elsevier, 2010), 548–556; L. Darling-Hammond et al., *Professional Learning in the Learning Profession: A Status Report on Teacher Development in the United States and Abroad* (Palo Alto, CA: National Staff Development Council and the School Redesign Network, Stanford University, 2009.

ownership by providing some autonomy while accomplishing lasting impacts via expert modeling of innovative practices and teacher-led discussions about overcoming challenges in implementation.

In professional development for transformative shifts in instruction, participants must not only learn new skills but also "unlearn" almost unconscious beliefs, assumptions, and values about the nature of teaching, learning, and schooling.[1] 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.

Educational approaches must change dramatically to prepare students for work and life (as opposed to further schooling) in the modern era.[3] 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 in the 21st Century*, the National Research Council describes "deeper learning" as the instructional strategy needed to achieve these ambitious goals.[4] 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

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[3] C. Dede. *The Role of Technology in Deeper Learning. Students at the Center: Deeper Learning Research Series* (Boston: Jobs for the Future, 2014).

[4] National Research Council, *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century* (Washington, DC: National Academies Press, 2012).

- *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.

The continuing development of new, powerful digital media is enabling powerful approaches to deeper learning by students – and teachers. The evolution of mobile devices, wireless broadband, and social media is enabling 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 co-creating learning resources.

For any model of professional development, four themes are important: scalability, adaptability, sustainability, and inclusivity/accessibility. Scalability refers to the extent a model can be implemented in many types of settings and populations with varying levels of resources, not just in contexts similar to where it was first developed. Adaptability refers to how readily a model can be modified to fit local conditions without losing its effectiveness. Sustainability refers to how a model is designed to be self-sustaining over time in terms of resources. Inclusivity refers to accessibility across cultures, technical divides, diversity, physical challenges, and a host of other equity issues. The DRK12 portfolio of projects is investing in various models for achieving those four goals.

The interactions among these four themes illustrate tradeoffs in designing professional development. For example, raising the price aids with resources for inclusivity and sustainability, but undercuts accessibility. Digital media requiring internet bandwidth, like video and electronic teacher guides, can increase adaptability and scalability but undercut some types of inclusivity/accessibility. Bootstrapping is

required to get professional learning communities to scale because their adaptability and sustainability is limited at the beginning when they are small in size. Narrowly focused professional development aids teachers in adapting what they are studying, but the limited scope can restrict scale and sustainability. These and other tradeoffs illustrate the complexity of designing and evolving online and blended professional development.

Three core tensions in evolving a model of professional development are: incremental learning versus design for transformation; tensions among stakeholders' agendas; and customization versus generalizability. Incremental learning versus transformational learning is a continuum rather than a dichotomy. At one end of the spectrum, professional development may focus on small enhancements to instructional strategies teachers are already using. In contrast, at the transformational end of the continuum, teachers may be asked to "unlearn" most aspect of their practice (as discussed earlier) and learn different methods of instruction and assessment. Typically, DRK12 projects are working towards transformation, but teachers are often seeking more incremental learning.

Tensions among stakeholders can lead to different perceived goals of professional development, including disjunctions between incremental and transformational learning. For example, in communities of practice based primarily on peer learning but enriched by experts, giving teachers what they need (e.g., deep knowledge about what scientific inquiry is) as opposed to what they want (a simple-steps lab to do the next morning with their students) is sometimes a challenge. That said, the richest forms of professional learning acknowledge these tensions and richly combine theoretical and research-based insights with the wisdom of practice. These can foster ownership by practitioners through providing some autonomy, while also enabling deep impacts on instruction via expert modeling of innovative practices coupled with teacher-led discussions about overcoming challenges in implementation.

In terms of customization versus generalizability, professional development models face several types of challenges related to adaptability. Some challenges stem from translating student activities learned in professional development for use in specific classrooms under the constraints of that setting. Other challenges come from the need to modify professional development models for different subjects and for teachers who are working at various grade levels. Some models emphasize combining online experiences with face-to-face work among local colleagues as a way of tailoring professional development to a specific setting. In general, blended models that can adjust the mix of online and face-to-face to match the needs of a particular context are more adaptable than online only or face-to-face only models. In addition, professional development about a specific curriculum builds teachers' knowledge of strategies for adaptability, since that is the focus of what they are learning. Also, moderating teacher learning communities to be responsive to their participants and to be driven by participants' priorities fosters adaptability of learning across a range of contexts.

Overall, the DRK12 portfolio is exploring alternative ways of realizing the opportunities and overcoming the challenges discussed above. From these investments may emerge models of professional development and teacher learning that fulfill the criteria of scalability, adaptability, sustainability, and

inclusivity/accessibility. To accomplish this through design-based research, inherent challenges of incremental learning versus design for transformation tensions among stakeholders' agendas; and customization versus generalizability must be overcome. Modern digital media are providing many mechanisms for accomplishing these goals. As a result, new models of online and blended professional development and teacher learning may achieve a major leap forward in enabling personalized, powerful professional learning.