
2013

Developing a faculty learning community grounded in the science of how people learn: A Year-Long, Faculty-Led Teaching and Learning Seminar.

Alan Rudnitsky
Smith College, arudnits@smith.edu

Glenn Ellis
Smith College, gellis@smith.edu

Patricia Marten DiBartolo
Smith College, pdibarto@smith.edu

Kevin M. Shea
Smith College, kshea@smith.edu

Follow this and additional works at: https://scholarworks.smith.edu/psy_facpubs



Part of the [Education Commons](#), and the [Psychiatry and Psychology Commons](#)

Recommended Citation

Rudnitsky, Alan; Ellis, Glenn; DiBartolo, Patricia Marten; and Shea, Kevin M., "Developing a faculty learning community grounded in the science of how people learn: A Year-Long, Faculty-Led Teaching and Learning Seminar." (2013). Psychology: Faculty Publications, Smith College, Northampton, MA.
https://scholarworks.smith.edu/psy_facpubs/28

This Book Chapter has been accepted for inclusion in Psychology: Faculty Publications by an authorized administrator of Smith ScholarWorks. For more information, please contact scholarworks@smith.edu

DEVELOPING A FACULTY LEARNING COMMUNITY GROUNDED IN THE SCIENCE OF HOW PEOPLE LEARN

A YEAR-LONG, FACULTY-LED TEACHING AND LEARNING
SEMINAR

*Al Rudnitsky, Glenn W. Ellis,
Patricia Marten DiBartolo, Kevin M. Shea
Smith College*

This chapter describes a multiyear professional development effort undertaken by a learning and teaching center at a liberal arts college. As part of its founding mandate, the center helps faculty improve teaching by paying attention to the current literature about how people learn. This core commitment of our center is pursued through support of a year-long faculty seminar. Now in its fourth year, the seminar has had a significant impact on its faculty participants and their thinking about teaching and

We thank the teaching and learning seminar faculty participants for the insights and thoughtful reflections they shared with us over the past few years. Thanks also to Mary Dean Sorcinelli for feedback on earlier versions of this chapter. Finally, we thank the Sherrerd family and the Davis Educational Foundation for their generous support of this work.

learning. Moreover, the seminar has seeded a number of teaching and assessment initiatives at the college.



Smith College has initiated an effort to improve teaching and learning by sustaining faculty engagement with the learning sciences through a teaching and learning seminar. By “the learning sciences,” we mean the multidisciplinary efforts to understand better the learning process, in particular the learning process that leads to deep learning on the part of students. Also included in the learning sciences are developing ideas about how to design environments that support this kind of learning (Sawyer, 2006; Schwartz, Bransford, & Sears, 2005). Faculty members are introduced to these ideas as part of a community that meets regularly over the course of a year to discuss teaching in the context of each other’s practice.

The seminar is best understood in relation to professional development efforts sponsored and organized by Smith College’s Sherrerd Center for Learning and Teaching. The center, established in 2009, has a mission that explicitly recognizes three distinct areas of development:

- Craft knowledge (Bereiter, 2002a), which includes the skills, techniques, methods, and tools that can be used to structure and support pedagogy
- The human element of teaching, which includes support for the affective and social relationship realms of teaching and learning
- Theoretical knowledge, aimed at supporting the kind of teaching Sawyer (2004) refers to as “disciplined improvisation” and is explicitly grounded in the latest advances in the science of learning and teaching

The prominence of theoretical knowledge in the center’s mission reflects an underlying premise shared by the faculty who created the center that good teaching is inherently problematic, teaching can always be improved, and teaching takes place in a dynamic environment. It also recognizes that few college faculty have any formal education in pedagogy or learning theory and thus have neither shared knowledge nor the accompanying language for thinking and talking productively about teaching and learning. Without empirically and theoretically grounded ideas, instructional “innovations” tend to be implemented in surface and sometimes counterproductive ways. Innovations, even good ones, can become what Ann Brown (Brown & Campione, 1996, p. 292) referred to

as “lethal mutations.” Current calls for improving teaching in higher education also emphasize the role of the learning sciences (e.g., American Association for the Advancement of Science, 2011; Association of American Medical Colleges, 2009; Association of American Colleges and Universities, 2011).

In a recent review of the literature on faculty development, Amundsen and Wilson (2012) summarize the findings of other literature reviews on the same topic conducted over a thirty-year period. They concluded that earlier reviews produced little in the way of clear conclusions about what efforts result in effective faculty development. Amundsen and Wilson think the problem is that these reviews clustered heterogeneous professional development efforts by factors like duration or format (e.g., workshop, one-to-one consultations) and relied heavily on self-report outcome measures. In response, they conducted a review of 137 reports about faculty development published since 1995. Although they found little new from their own review, Amundsen and Wilson suggested that any potential findings were obscured because of the way the research was clustered. They offer a different scheme for categorizing professional development that is based on the nature of the goals pursued. In their reconceptualization, they identify six clusters of professional development: a skills focus, a method focus, a reflection focus, an institutional focus, a disciplinary focus, and an action research focus. Studies that fall into the skill, method, and institutional clusters emphasize outcomes. Studies that fall in the reflection, disciplinary, and action research clusters emphasize process.

An emphasis on outcomes, typical of a skill focus, often entails helping faculty develop a repertoire of tips, tools, routines, and instructional techniques that are often embedded in the latest technology. Examples of such tools range from the use of lecture clickers to the use of peer review as an effective tool in teaching writing. Teachers need craft knowledge, and supplying faculty a wide array of possible pedagogical tools and techniques is reflected in many professional development programs in higher education.

In contrast to outcomes, more process-oriented faculty development aims at developing a deeper understanding of teaching and learning. A process orientation conceptualizes the work of teaching as having to solve complex problems of design and making ongoing adjustments as teaching unfolds. This kind of teaching calls for a theoretical kind of knowledge—the kind of knowledge that Hatano and colleagues (Hatano & Inagaki, 1986; Hatano & Osuro, 2003) see as the basis for adaptive expertise.

Ken Bain (2004), author of *What the Best College Teachers Do*, makes a strong case for theoretical knowledge as he discusses the obstacles to good teaching:

Perhaps the second biggest obstacle (the biggest obstacle is harboring the belief that one either is or is not born with the ability to teach) is the simplistic notion that good teaching is just a matter of technique . . . Such ideas make enormous sense if you have a transmission model, but it makes no sense if you conceive of teaching as creating good learning environments . . . In short, we must struggle with the meaning of learning within our disciplines and how best to cultivate and recognize it. For that task, we don't need routine experts who know all the right procedures but adaptive ones who can apply fundamental principles to all the situations and students they are likely to encounter, recognizing when invention is both possible and necessary and that there is no single "best way" to teach. (p. 175)

Despite the recognition that theoretical knowledge is important, evidence indicates that higher education devotes more resources to the development of skills by way of workshops or minicourses highlighting the newest advances in instruction, technology, or assessment than they do to introducing faculty to current scholarship about learning and teaching (Levinson-Rose & Menges, 1981; Steinert et al., 2006; Stes, Min-Leliveld, Gijbels, & Van Petegem, 2010).

There have been notable professional development efforts that are process oriented. Faculty learning communities (FLC) are a well-established organizational approach to professional development that is both collaborative and reflective (Cox, 2001). These communities have been shown to be effective in initiating and supporting pedagogical innovation (Furco & Moely, 2012; Richlin & Cox, 2004). Smith College's teaching and learning seminar is an instance of an FLC, and its organization includes many of the developmental steps that Richlin and Cox (2004) recommended. These include applying for membership, having an opening and closing retreat, preparing for the start of the school year, and scheduled presentations by participants. Cox (2004) cites two kinds of FLC organization. One form of organization is by cohort (e.g., midcareer faculty). The other form of organization, and the one Cox advocates, is topic based and focuses for a year on a problem or theme (e.g., teaching research skills across the curriculum, teaching foreign languages). Many of the features and steps found to support the establishment of an effective FLC have been incorporated into the design of our teaching and learning seminar. There are aspects, however,

that distinguish it from many other FLCs. Among them is its explicit focus on ideas from the learning sciences and a commitment to the development of principle-based teaching. Seminar leaders are guided by the learning sciences in creating a set of readings and beginning discussion topics that initiate the work of the seminar. Also, rather than being topical, the seminar addresses a variety of problems or issues depending on the community's faculty participants. The liberal arts context of the seminar means that participants represent a wide range of liberal arts disciplines. The exploration of underlying principles of learning and teaching is enriched by the diversity of perspectives. The seminar represents the Sherrerd Center's first step in pursuing the principle-based part of its mission.

Method

Faculty Participants

While the popularity of the seminar has not flagged since its inception in 2009, the seminar is kept intentionally small (usually ranging from nine to thirteen participants plus two group leaders) in order to foster cohesion and discussion. Since 2009, forty-two faculty and three staff members are participating or have participated in the seminar. The faculty members represent almost half (twenty of forty-five) of the departments and programs at the college (see table 8.1 for more detail) and every level of faculty rank—twelve participants at full, sixteen at associate, eight at assistant professor—and six lecturers or staff members. Compensation for year-long participation in the seminar is modest for participants (five hundred dollars) and leaders (one thousand dollars).

Seminar Organization and Core Readings

Consistent with our emphasis on idea improvement and adaptive expertise in the classroom, the structure and the readings of the seminar have changed each year to best meet faculty needs; nonetheless, an overall organization has taken shape with a number of core readings identified. The seminar begins with a half-day August workshop in which readings are used to introduce some of the big ideas in the seminar and to begin developing a shared language from the learning sciences. Recent readings include an overview of the learning sciences (Sawyer, 2006), an introduction to transfer-in and transfer-out—including assessment and implications for the classroom (Schwartz et al., 2005), and the changing role of education in a knowledge society (Bereiter, 2002a, 2002b).

Table 8.1 Department and Program Representation in the Sherrerd's Teaching and Learning Seminar, 2009-Present

Division	Number of Faculty Participating (% of total faculty participants)	Number of Departments and Programs with at Least One Faculty Participant	Departments and Programs Represented
Humanities	11 (24.44%)	7	Afro-American studies, Art, Classics, East Asian studies, East Asian Languages and Literatures, English, French, History
Social sciences	9 (20.00%)	5	Anthropology, Economics, Education and Child Study, Government, Sociology
Natural sciences	22 (52.38%)	8	Biology, Chemistry, Computer Science, Geosciences, Engineering, Mathematics and Statistics, Physics, Psychology

After the initial workshop, the seminar meets twice a month throughout the school year. Discussions in the fall semester meetings focus on shared readings about topics such as conceptions of teaching and learning (Bruner, 1996; Richardson, 2005), teaching as storytelling (Egan, 2004), idea-centered education (Bereiter, 2002a, 2002b), and knowledge building (Bereiter & Scardamalia, 2006; Scardamalia, 2002; Scardamalia & Bereiter, 2003, 2006).

Discussion emerges from topics with current relevance to the participants (e.g., designing effective midsemester student feedback) or arises from student discourse that unfolds over the course of the semester. At other times, discussion is seeded through the use of videos that address varied teaching and learning issues, such as the challenges of addressing misconceptions that students bring to the classroom (Schneps & Sadler, 2003) or the importance of students learning to formulate problems (Meyer, 2010).

The spring semester begins with a half-day workshop in January with more extensive preparatory readings such as Bain's *What the Best College Teachers Do* (2004) and other readings that explore fall semester topics in greater depth. At this point, the participants begin to take on more of a leadership role in the seminar discussions and largely run the subsequent bimonthly meetings, take turns leading discussions, and share their own classroom experiences and ideas they plan to try out in their upcoming classes.

The seminar recognizes the importance of developing the learning community, supporting its members, and sustaining extended discourse. Indeed, faculty members cycling out of the seminar in spring 2010 voiced an interest in continuing to maintain connections and opportunities for reflection provided by the seminar's regular meeting times. For this reason, all past and present participants are now invited to attend several meetings throughout the year. Although the topics vary, often past participants share in these meetings how they have applied ideas from the seminar. Examples include a faculty member who led her department in developing an assessment instrument to measure deep learning in psychology and several faculty members who shared online knowledge building student discourse from their classes.

Central Principles of the Teaching and Learning Seminar

Based on the premise that teaching can always be improved, the teaching and learning seminar was designed to encourage discussions about learning, sustained over extended periods of time, among faculty from diverse disciplines. Fundamental principles about teaching and learning that shape seminar discussions came from readings within the learning sciences. These central principles include the following:

- Learners must learn what and how they think because different kinds of thinking lead to different learning outcomes. Ultimately learning depends on what learners do, not what teachers do.
- Learners' existing knowledge has a profound effect on their current thinking and learning.
- Effective learners are metacognitive in that they set goals for themselves and engage in self-monitoring and self-regulation.
- Learning is socially situated and mediated. It begins in participation with others through substantive discourse, and the edge of individual competence is marked by what a learner can do with support from others.

- Instruction is most productively conceived as designing complex learning environments that support good learner thinking, with recognition that evaluation and assessment exerts a powerful influence on the learning environment.
- Understanding and deep learning that allow for better knowledge transfer and preparation for future learning are privileged educational outcomes.

Many faculty participants come to the seminar already beginning to raise questions about their teaching and student learning. Over the course of the seminar, most begin to see how heavily didactic approaches to teaching often result in shallow, superficial kinds of student learning. In fact, the problem of knowledge transfer, both within and across courses, is often the impetus for faculty involvement in the seminar, as they become increasingly concerned about student learning across time and contexts.

This evolving understanding of teaching and learning is in keeping with the general direction of pedagogical reform in higher education. That is, the direction of reform is away from teacher-centered didacticism to a more student-centered constructivism. In most cases, moves away from teacher-centered pedagogy have typically emphasized putting students in more active learning roles, often working together in collaborative groups. Among the approaches reform recommendations employ are reenactment, problem-based learning, project-based learning, inquiry-based pedagogy, the use of case studies, and writing across the curriculum. All of these approaches represent movement in a progressive direction. Nonetheless, seminar readings and discussions have helped faculty identify ways this activity-centered teaching can be improved.

Much of the improvement centers on what faculty, through reading, discussion, and experience, have come to recognize as a weakness common to these approaches: students in an activity-centered learning environment tend to adopt a product rather than a learning orientation. Research (Bereiter, 2002a, 2002b; Bransford, 2000; Bruner, 1996; Doyle, 1983) indicates that students typically see their task as one of doing well in a course. When that means producing a good product or performance, then that is where students direct their efforts. Producing a good product can require learning, but the learning is often incidental to the more central production goal. In the interest of efficiency and effectiveness, students often rely on their own well-learned routines, skills, and knowledge. When working in groups, they tend to divide the labor rather than engage in extended collaborative discourse, thereby short-circuiting

the kind of intentionality, reflectiveness, and engagement that deep learning requires.

Through the teaching and learning seminar, many faculty have found the principles and ideas associated with knowledge building (Scardamalia, 2002; Scardamalia & Bereiter, 2006) an appealing conceptual framework for crafting powerful learning environments—environments that might help students develop a deeper understanding of core disciplinary concepts and principles. Knowledge building is a pedagogical approach that emphasizes the importance of ideas and collaborative discourse in helping students learn more deeply by asking them to work on idea improvement while grappling with interesting and important knowledge problems.

Ordinarily most school learning finds students working in belief mode (Bereiter & Scardamalia, 2006) wherein ideas are seen as fixed entities and student engagement is a matter of memorizing, resolving doubt, or making arguments for or against. In contrast, idea improvement is the essence of what Bereiter and Scardamalia (2006) call operating in design mode, where ideas are treated as conceptual artifacts, invented to serve a purpose, and as inventions, subject to improvement. As Scardamalia and Bereiter (2003) state, “Knowledge building may be defined as the production and continual improvement of ideas to a community, through means that increase the likelihood that what the community accomplishes will be greater than the sum of individual contributions and part of broader cultural efforts . . . If learners are engaged in process only suitable for a school, then they are not engaged in knowledge building” (p. 1370).

Given that faculty often engage in knowledge building as scholars within their respective disciplines, it is not surprising that the notion of idea improvement resonates with seminar participants. Most faculty see themselves as participants in a discourse community whose goal is to advance knowledge. Having students engage in the kind of thinking that occurs at a discipline’s cutting edge is often a stated goal for students, especially advanced students. A knowledge-building approach, with its emphasis on good discourse, idea improvement, and collective cognitive responsibility, advances this goal.

Outcomes

Evaluation Data from Three Cohorts of Participants

We surveyed the first three cohorts who participated in the Teaching and Learning Seminar between 2009 and 2012 and received responses from

nineteen of the thirty participants. We asked about ideas from the seminar that had an impact on their thoughts about teaching and learning, changes they made in their classes, and differences in student learning and engagement after making changes.

The seminar affected individual faculty participants in a variety of ways. Faculty reported that they are lecturing less, having students complete self-directed projects and get more prepared for class, focusing less on content and more on big, central questions, and empowering students to take ownership of their own learning. One participant stated that she “takes risks . . . and jettisons a lot of busy work to leave more time for deeper learning related to the central themes,” while another focuses on trying “to get students to do a better job coming up with ideas and exploring questions that don’t have obvious answers.”

One of our goals was to help faculty develop a more sophisticated conception of teaching focused on results from the learning sciences. Indeed, sixteen of the nineteen respondents mentioned learning science concepts that had an impact on their thoughts about teaching and learning, including knowledge building, idea-centered teaching, collective idea improvement, knowledge transfer, understanding prior knowledge, bringing research into the classroom, encouraging half-formed thoughts, being transparent, and efficiency versus innovation.

Sixteen faculty implemented significant teaching changes based on their participation in the seminar. For example, they designed more challenging assignments, were mindful of preparation for future learning, and highlighted subtlety and complexity of problems. Many also reported highlighting the importance of student-formulated questions and working in groups on real problems. Overall, faculty focused on getting students to participate in learning through knowledge-building assignments or the use of online discourse communities to enable sustained conversations outside of class.

Overall, faculty believed that students were learning more, despite the fact that some students struggled to change existing ideas and accompanying habits about teaching and learning. Faculty believed that students who did embrace the changes gained a better understanding of what it means to do research (even at the introductory level of the curriculum) and had better ideas about how knowledge is created and advanced in different disciplines. One participant reported that students were more willing to discuss concepts and problems and that there was a richer exchange of ideas in class. This was a key point, with many faculty reporting improved in-class discussions. Outside class, course changes “fostered a greater engagement and independence in my students.”

Others commented that students and recent alums were “articulating the connections between their learning and their careers after Smith,” “I have been getting increasing feedback from students that their level of conceptual understanding feels deeper,” and “last spring’s transformed colloquium was certainly one of the most successful I have ever taught. Students from the course have continued to be in touch all summer whenever they encountered ideas which related to it.”

Reflections on the Seminar

Faculty reflections on the teaching and learning seminar were positive, some enthusiastically so, with only two respondents unhappy with their experiences in the seminar. Participants have also been forthcoming with critical feedback, in keeping with our philosophy that all teaching can be improved. Four participants were unhappy with what they saw as too great a focus on knowledge building. With the formation of a (now) grant-funded group pursuing knowledge building, the seminar has made an effort to represent a range of thinking and pedagogical ideas. The seminar needs to be a place that can give birth to collaborative faculty efforts like those of the knowledge-building group. At the same time, the seminar needs to be careful not to focus too narrowly. Other faculty “struggled with how to apply the big ideas from the seminar to the practicalities of teaching.” This is a concern and a constant reminder of how difficult principle-based teaching is.

Participants who were most positive reported, “The ongoing nature of the seminar [beyond the initial year] is also extremely valuable as these ideas and their implementation take time,” “I have and continue to grow a lot in my approach to teaching and in how I understand the process of learning. I know there’s a long way to go, so having an ongoing group at Smith is very important,” and “I appreciated meetings and the opportunity to talk to colleagues across disciplines about their challenges and successes.” We do not know whether there is a critical mass at which point the nature and pace of this work changes. The evidence points to a growing conversation among faculty. We think this is a good thing.

Additional Assessments of Seminar Impact on Participants

DEVELOPMENT OF A KNOWLEDGE-BUILDING COMMUNITY FOR FACULTY PARTICIPANTS The teaching and learning seminar has created an opportunity to participate in a collaborative learning environment for its faculty participants. They grapple with new ideas and philosophies while

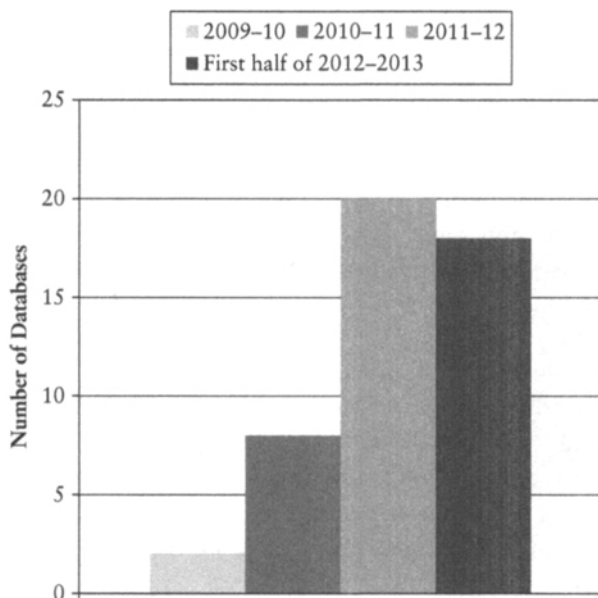
attempting to implement similar models in their own classes. The learning sciences highlight the importance of sustained discourse for idea improvement, and our faculty cohorts report the value of discourse with their peers as they strive to improve their conception of teaching and implement strategies to enhance student learning. One participant commented that “a significant component of these seminars is . . . the fact that a group of interested and thoughtful colleagues gets together to talk about these ideas in a sustained way. I’ve learned and been inspired by my fellow teachers.” Another stated, “The seminar was worthwhile in deepening the quality of my own thoughts about teaching and better grounding them in evidence from research.” These outcomes highlight the value of the learning environment created as part of the teaching and learning seminar and demonstrate outcomes we hope we will see among students in our classes.

DEVELOPMENT OF KNOWLEDGE BUILDING ACROSS THE CURRICULUM As a result of collaborative discussions within the context of the teaching and learning seminar, four faculty members realized their shared desire to provide greater support for student- and idea-centered teaching initiatives across campus. Together with the Sherrerd Center, they launched an effort to pursue and ultimately received grant funding from the Davis Educational Foundation to support the development of these pedagogies across the curriculum. Our first cohort of eleven Davis fellows and four faculty teaching mentors has begun its work. Beginning with a series of day-long workshops in summer 2012 and continuing throughout the academic year with biweekly meetings, these fellows have committed to a significant course revision that privileges idea-centered learning and outcomes. All mentors and fellows are previous teaching and learning seminar participants or leaders who were inspired to put into action the ideas cultivated by the seminar.

Most of the faculty pursuing knowledge building use Knowledge Forum (KF), software that helps to foster and capture student discourse. Faculty use of KF databases is an additional measure of how many courses are involving students in idea-centered pedagogy. KF is now being used by twenty faculty members (all former or current teaching and learning seminar participants) in over thirty courses (see figure 8.1).

SCHOLARSHIP OF TEACHING AND LEARNING To date, former seminar participants have published a peer-reviewed journal article and given eight presentations at conferences or universities (see DiBartolo, 2011; DiBartolo & Rudnitsky, 2012; DiBartolo, Rudnitsky, & Shea, 2012;

Figure 8.1 Growth in Knowledge Forum Databases in Sustaining Student-Centered Learning



Ellis, DiBartolo, & Yu, 2012; O'Sullivan, 2012; Shea, 2011, 2012a, 2012b, 2012c). This work has involved five faculty members and one undergraduate student. Moreover, ideas from the teaching and learning seminar created some interest in building discipline-specific assessments that would examine deep learning, including transfer of knowledge and preparation for future learning. Thus far, two departments on campus (Chemistry and Psychology) are working to develop direct assessments of learning that look across courses at students' understanding of the core principles and practices of the discipline (i.e., to think like a psychologist or chemist). So far, these faculty groups have shared their data only within the college, but we anticipate they will seek a broader audience in the near future.

Discussion

Our experiment with a sustained faculty development seminar based on the science of teaching and learning has fostered positive change at the individual, departmental, and college levels. Outcomes include changes in pedagogical practices and the way faculty think about teaching. Some

faculty have pursued the scholarship of teaching and undertaken initiatives that support putting theory into practice, in particular, a grant-supported effort to investigate idea-centered pedagogies. Several departments have implemented creative summative assessments of their student majors based on discussions initiated in the seminar and focused on higher-order capacities and learning outcomes. In addition, the college revised its student course evaluation form to align more with learning science principles by including short-answer questions focused on student learning and moving away from traditional quantitative questions.

Our model for this seminar, similar to a faculty learning community, should be amenable to implementation at a variety of institutions. We anticipate that many colleges have groups of faculty eager to explore the learning sciences with supportive, motivated, and inspiring colleagues. Like us, the ultimate destination for these group discussions will be unclear. In fact, each institution will likely give rise to participants whose deliberations will lead them in unique directions. Nonetheless, we are convinced that long-term faculty engagement with the ideas from the learning sciences will ultimately transform our academic institutions into more vibrant teaching and learning communities for our faculty and, most important, our students.

REFERENCES

- American Association for the Advancement of Science. (2011). *Vision and change in undergraduate biology education: A call to action*. Washington, DC: Author.
- Amundsen, C., & Wilson, M. (2012). Are we asking the right questions? A conceptual review of the educational development literature in higher education. *Review of Educational Research*, 82, 90–126.
- Association of American Colleges and Universities. (2011). *The LEAP vision for learning: Outcomes, practices, impact, and employers' views*. Washington, DC: Author.
- Association of American Medical Colleges. (2009). *Scientific foundations for future physicians*. Washington, DC: Author.
- Bain, K. (2004). *What the best college teachers do*. Cambridge, MA: Harvard University Press.
- Bereiter, C. (2002a). *Education and mind in the knowledge age*. Hillsdale, NJ: Erlbaum.
- Bereiter, C. (2002b). Liberal education in a knowledge society. In B. Smith (Ed.), *Liberal education in a knowledge society* (pp. 11–34). Peru, IL: Carus Publishing Company.

- Bereiter, C., & Scardamalia, M. (2006). Education for the knowledge age: Design-centered models of teaching and instruction. In P. A. Alexander & P. H. Winne (Eds.), *Handbook of educational psychology* (2nd ed., pp. 695–713). Mahwah, NJ: Erlbaum.
- Bransford, J. D. (Ed.). (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.
- Brown, A. L., & Campione, J. C. (1996). Psychological theory and the design of innovative learning environments: On procedures, principles, and systems. In L. Shublean & R. Glaser (Eds.), *Innovations in learning: New environments for education* (pp. 289–325). Mahwah, NJ: Erlbaum.
- Bruner, J. (1996). *The culture of education*. Cambridge, MA: Harvard University Press.
- Cox, M. D. (2001). Faculty learning communities: Change agents for transforming institutions into learning organizations. In D. Lieberman & C. Wehlburg (Eds.), *To improve the academy: Resources for faculty, instructional and organizational development*, Vol. 19 (pp. 69–93). San Francisco, CA: Jossey-Bass.
- Cox, M. D. (2004). Introduction to faculty learning communities. In M. D. Cox & L. Richlin (Eds.), *New directions for teaching and learning: No. 97. Building faculty learning communities* (pp. 5–25). San Francisco, CA: Jossey-Bass.
- DiBartolo, P. M. (2011). *In pursuit of deep learning: Using knowledge building to teach research methods*. Paper presented at the meeting of the Consortium on High Achievement and Success Faculty Forum, Smith College, Northampton, MA.
- DiBartolo, P. M., & Rudnitsky, A. N. (2012). What happens when a college instructor meets the learning sciences. *International Journal of University Teaching and Faculty Development*, 2, 155–180.
- DiBartolo, P. M., Rudnitsky, A., & Shea, K. (2012). *Knowledge Forum: Facilitating development of idea-centered learning environments*. Workshop presented at the New England Faculty Development Conference Consortium, East Greenwich, RI.
- Doyle, W. (1983). Academic work. *Review of Educational Research*, 53, 159–199.
- Egan, K. (2004). *An imaginative approach to teaching*. San Francisco, CA: Jossey Bass.
- Ellis, G. W., DiBartolo, P. M., & Yu, Y. (2012). *Designing learning environments that prepare students for the knowledge age*. Workshop presented at the Association of American Colleges and Universities conference, Seattle, WA.
- Furco, A., & Moely, B. E. (2012). Using learning communities to build faculty support for pedagogical innovation: A multi-campus study. *Journal of Higher Education*, 83, 128–153.

- Hatano, G., & Inagaki, K. (1986). Two courses of expertise. In H. Stevenson, H. Azuma, & K. Hakuta (Eds.), *Child development and education in Japan* (pp. 262–272). New York, NY: Freeman.
- Hatano, G., & Osuro, Y. (2003). Reconceptualizing school learning using insight from expertise research. *Educational Researcher*, 32, 26–29.
- Levinson-Rose, J., & Menges, R. J. (1981). Improving college teaching: A critical review of research. *Review of Educational Research*, 51, 403–434.
- Meyer, D. (2010). *Math class needs a makeover*. Retrieved from http://www.ted.com/talks/dan_meyer_math_curriculum_makeover.html
- O'Sullivan, R. (2012). *Using "Knowledge Forum" to promote discussion and group work*. Paper presented at the Second Annual National Conference on Teaching Economics, Boston, MA.
- Richardson, J.T.E. (2005). Students' approaches to learning and teachers' approaches to teaching in higher education. *Educational Psychology*, 25, 673–680.
- Richlin, L., & Cox, M. D. (2004). Developing scholarly teaching and the scholarship of teaching and learning through faculty learning communities. In M. D. Cox & L. Richlin (Eds.), *New directions for teaching and learning: No. 97. Building faculty learning communities* (pp. 127–135). San Francisco, CA: Jossey-Bass.
- Sawyer, R. K. (2004). Creative teaching: Collaborative discussion as disciplined improvisation. *Educational Researcher*, 33, 12–20.
- Sawyer, R. K. (2006). The new science of learning. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 1–16). Cambridge: Cambridge University Press.
- Scardamalia, M. (2002). Collective cognitive responsibility for the advancement of knowledge. In B. Smith (Ed.), *Liberal education in a knowledge society* (pp. 67–98). Peru, IL: Carus Publishing Company.
- Scardamalia, M., & Bereiter, C. (2003). Knowledge building. In J. W. Guthrie (Ed.), *Encyclopedia of education* (pp. 1370–1373). New York, NY: Macmillan Reference.
- Scardamalia, M., & Bereiter, C. (2006). Knowledge building: Theory, pedagogy and technology. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 97–115). Cambridge: Cambridge University Press.
- Schneps, M. H., & Sadler, P. M. (2003). *A private universe: Minds of our own*. Cambridge, MA: Harvard-Smithsonian Center for Astrophysics.
- Schwartz, D. L., Bransford, J. D., & Sears, D. (2005). Efficiency and innovation in transfer. In J. Mestre (Ed.), *Transfer of learning: Research and perspectives* (pp. 1–51). Charlotte, NC: Information Age Publishing.
- Shea, K. M. (2011). *Knowledge building: Application of the science of teaching and learning*. Paper presented at the New England Faculty Development Consortium, College of the Holy Cross, Worcester, MA.

- Shea, K. M. (2012a). *Empowering students to learn chemistry: My journey to improvisational student- and idea-centered teaching*. Paper presented at University of Central Florida, Orlando.
- Shea, K. M. (2012b). *Empowering students to learn chemistry: My journey to student and idea-centered teaching*. Ed Mellon Lecture presented at Florida State University, Tallahassee, FL.
- Shea, K. M. (2012c). *Getting new faculty and their mentors to talk about teaching and learning*. Workshop presented at the AALAC meeting, Northfield, MN.
- Steinert, Y., Mann, K., Centeno, A., Dolmans, D., Spencer, J., Gelula, M., & Prideaux, D. (2006). A systematic review of faculty development initiatives designed to improve teaching effectiveness in medical education. *Medical Teacher*, 28, 497–526.
- Stes, A., Min-Leliveld, M., Gijbels, D., & Van Petegem, P. (2010). The impact of instructional development in higher education: The state-of-the-art of the research. *Educational Research Review*, 5, 25–49.