A Development Research Agenda for Online Collaborative Learning

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Although important, traditional basic-to-applied research methods have provided an insufficient basis for advancing the design and implementation of innovative collaborative learning environments. It is proposed that more progress may be accomplished through development research or design research. Development research protocols require intensive and long-term collaboration among researchers and practitioners. In this article, we propose guidelines for implementing development research models more widely, and conclude with a prescription for an online collaborative learning research agenda for the next five to ten years.

THE VISION

The vision of online collaborative learning is compelling. Learners, enrolled in a common unit of study for training, continuing professional development, or the pursuit of an academic degree, will work together online to solve complex problems and complete authentic tasks (Herrington, Oliver, & Reeves, 2003; Herrington, Reeves, Oliver, & Woo, 2004). Although they may never meet face-to-face, these highly motivated learners will form strong bonds that encompass productive teamwork, in-depth collaboration, and even lasting friendships. Through intensive engagement in the collaborative solution of authentic problems, the learning outcomes accomplished by these learners will be of the highest order, including improved problem-solving abilities, enhanced communications skills, continuing intellectual curiosity, and robust mental models of complex processes inherent to the performance contexts in which their new learning will be applied.

Another interpretation of this powerful vision can be found at the extensive online collaborative learning Website (http://clp.cqu.edu.au/) maintained by academic staff and students at Central Queensland University in Australia:

> By online, we mean that most learners are likely be geographically isolated, studying perhaps from home, but with full access to all of the necessary resources via their Internet connection. Materials (such as lecture notes) and processes (such as assignment submission) will be electronic, and interaction will be either synchronous (e.g., via chat-rooms or videoconferencing facilities) or asynchronous (e.g., via email or discussion lists). By collaborative, we mean that despite their differing locations, most learners will conduct most of

their learning in groups. Such groups are likely to be wholly virtual, in the sense that their component members may never meet face-to-face. They are, however, in all other respects very real, and group members will be highly reliant on others in the group for the quality of their learning. Depending upon circumstances, such groups may be formal or informal, small or large, homogeneous or heterogeneous. In such an environment where most learning takes place via group interaction, the instructor is likely to act more as a facilitator than as an active deliverer of knowledge. By learning, we mean that in group learning environments, less emphasis is likely to be placed on memorization, rote learning, and cramming for examinations, and more on real-world abilities such as communication, problem-solving, and articulation of solutions. (http://clp.cqu.edu.au/introduction.htm)

THE REALITY

Unfortunately, the reality of online collaborative learning is disappointing, at least in higher education, the focus here. There is little evidence that the developers of most online collaborative learning environments in postsecondary contexts have tried to reach, much less attained, the vision described above (Kearsley, 2000; Moore & Anderson, 2003; Phipps & Merisotis, 1999). While proponents of new technologies argue that we need "to break what has been called the credit-for-contact model" (Twigg, 2003, p. 125) of higher education in the United States, most online courses still seek to ensure that students will spend the 45–50 hr of academic contact time required in traditional 3-credit-hr, semester-long courses (Phipps & Merisotis). Although more than 80% of institutions of higher education in North America now offer some totally online or blended courses (Allen & Seaman, 2003), the majority of these courses appear to remain constrained by traditional assumptions about the processes of instruction rather than the development of constructivist learning environments as defined by Wilson (1996) and others.

For example, an adult education graduate program at a leading U.S. institution (http://www.coe.uga.edu/adulted/onlinemasters.html) recently graduated its first cohort of students enrolled in its completely online master's program. The developers of this program promote the equivalence of its online courses and its traditional face-to-face courses. According to the program's published description, the online curriculum does not differ in any substantive way from the on-campus version. Thus, rather than perceiving the development of an online degree program as an opportunity for innovative pedagogy, the faculty members involved in this program have intentionally aimed at replicating their preexisting instructional methods as nearly as possible.

In an analysis of the quality of instructional design in online learning environments, Naidu (2003) reported that Boshier et al., (1997) found that many Web-based courses "seemed to be overly driven by an obsession with statement of objectives, assessment of outcomes, and a hierarchical ordering of subject matter content, as opposed to a focus on building rich resource-based learning environments around enduring themes" (p. 354). Naidu further concluded that his more recent analysis of e-learning environments indicated that the quality of online learning today does not vary substantively from that found by Boshier et al. several years ago. This is in line with Kirschner and Kreijns (2004) who posited that one of the two major pitfalls of the design of online collaborative learning is, by the absence of a proper pedagogy for this, the application of traditional face-to-face pedagogy.

What explains the general failure to design and implement truly innovative interactive collaborative learning environments in postsecondary education? At least part of the problem can be attributed to how course management systems are currently being used to put courses online. Most online courses, including those in the online adult education master's program noted above, are delivered using commercial course management systems such as Blackboard® and WebCT®. The *affordances* (Norman, 1988) of these systems tend to promote thinking of online course design as a process of replicating traditional classroom instructional practices such as lecture notes, readings, quizzes, term papers, exams, and the like.

When Britto (2002) investigated faculty intentions and student perceptions of the pedagogical dimensions of WebCT™, he found that faculty perceived the benefits of teaching a course using WebCT™ as pertaining primarily to the convenience and efficiency of course administration and management, whereas students expressed

frustration that the online tools were not employed to support their learning more directly. Other studies have reported similar student frustration with online learning environments for reasons such as confusion about online instructions, failure to get prompt feedback from instructors, and persistent technical problems (Hara & Kling, 1999; Vonderwell, 2003). We are not suggesting that commercial course management systems inevitably promote mediocre collaborative online learning, and indeed, there is evidence that they can offer powerful communication tools for instructors and students who have reason and purpose for using them (Herrington et al., 2003). But instructors are unlikely to perceive the opportunities for pedagogical innovation without substantial development support.

Another plausible reason for the failure to adopt pedagogical innovations when moving courses and programs online is that faculty members are rarely given sufficient time to create completely different designs for online courses, and so they fall back on using the technology to replicate the instructional dimensions of traditional courses (Reeves & Reeves, 1997). The time demands of online teaching are hotly debated (DiBiase, 2000; Palloff & Pratt, 1999), but developing an innovative online course that includes strategic and planned use of the interactive communications capabilities of the technology surely takes more time than the one-semester course release that faculty members are often given for such a task.

Developing innovative collaborative online learning environments is not hindered only by the misapplication of course management tools or the lack of development time. We agree with Naidu (2003) that the challenge is more a conceptual one than a technological one. We perceive the primary problem as an inability of academic staff and instructional designers to think "outside of the box" when it comes to developing online courses. Rather than attempting "to make online courses even better than traditional classes" (Twigg, 2003, p. 116), many faculty members and other specialists involved in online course development seem to be content with converting traditional courses into an online format without pedagogical change.

Moving a course from one medium to another, for example, from the physical classroom to online, can take different instructional design paths, ranging from attempts to replicate the previous version in the new medium as faithfully as possible to radical changes in the design that take advantage of contemporary learning theories (Harasim, 2002; Wilson, 1996). As noted above, the more common approach used in higher education today is replicating the instructional design of traditional face-to-face courses in the online medium (Bonk & Dennen, 2003; Kearsley, 2000; Naidu, 2003). For example, lectures delivered in a traditional classroom are delivered online via PowerPoint™ with audio or streaming video, the identical textbook is used in both classroom and online versions of a course, and the same multiple-choice or short essay exams are used as the primary means of assessment.

A more radical approach would involve moving away from traditional university course activities (lectures, demonstrations, discussions, textbook readings, exams, etc.) to a large scale online simulation in which a single authentic task or project becomes the focus of the learning environment. Herrington et al. (2003) have defined ten design principles for developing and evaluating this type of authentic task-based collaborative learning environment:

1. Authentic tasks must have real-world relevance (e.g., Brown, Collins, & Duguid, 1989; Cognition and Technology Group at Vanderbilt, 1990a; Jonassen, 1991; Resnick, 1987; Winn, 1993; Young, 1993).
2. Authentic tasks must be ill defined, requiring students to define the tasks and subtasks needed to complete the activity (e.g., Bransford, Vye, Kinzer, & Risko, 1990; Brown et al., 1989; Cognition & Technology Group at Vanderbilt, 1990a; Winn, 1993; Young, 1993).
3. Authentic tasks must comprise complex activities to be investigated by students over a sustained period of time (e.g., Bransford, Vye et al., 1990; Cognition & Technology Group at Vanderbilt, 1990b; Jonassen, 1991).
4. Authentic tasks must provide the opportunity for students to examine the task from different perspectives, using a variety of

resources (e.g., Bransford, Vye et al., 1990; Cognition & Technology Group at Vanderbilt, 1990b).

5. Authentic tasks must provide the opportunity to collaborate (e.g., Gordon, 1998; Lebow & Wager, 1994; Young, 1993).
6. Authentic tasks must provide the opportunity to reflect and involve student beliefs and values (e.g., Gordon, 1998; Myers, 1993; Young, 1993).
7. Authentic tasks must be integrated and applied across different subject areas and extend beyond domain-specific outcomes (e.g., Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990; Bransford, Vye et al., 1990; Jonassen, 1991).
8. Authentic tasks must be seamlessly integrated with assessment (e.g., Herrington & Herrington, 1998; Reeves & Okey, 1996; Young, 1995).
9. Authentic tasks must yield polished products valuable in their own right rather than as preparation for something else (e.g., Barab, Squire, & Dueber, 2000; Gordon, 1998).
10. Authentic tasks must allow competing solutions and diversity of outcomes (e.g., Bottge & Hasselbring, 1993; Bransford, Sherwood et al., 1990; Bransford, Vye et al., 1990; Duchastel, 1997; Young & McNeese, 1993).

Weigel (2002) described another innovative model for online courses that takes advantage of the pedagogical affordances of online learning based on advances in situated learning theory (Brown et al., 1989). He recommended the construction of virtual, collaborative spaces, called "knowledge rooms" where learners can engage in "deep learning," that is, "learning that promotes the development of conditionalized knowledge and metacognition through communities of inquiry" (p. 5).

To realize the vision of powerfully effective online learning, more than a mere shift from one medium to another is required. Instructional methods must be enhanced to take advantage of what cognitive scientists and others have revealed about how people learn (Bransford, Brown, & Cocking, 2000) in coordination with the affordances of online technologies. Obviously this is not an easy transition. Cuban (2001), after analyzing the application of technology to instruction at Stanford University, an elite postsecondary institution that has enjoyed strong technological support for two decades, concluded:

> Dominant teaching practices remained largely constant in the years of greatest penetration of new technologies. Lecturing still absorbs more than half to two thirds of various departments' teaching practices, especially for undergraduates. Seminars, an innovation that was introduced at the turn of the last century, have become integral to graduate instruction and have penetrated the last two years of undergraduate coursework. These traditional forms of teaching seem to have been relatively untouched by the enormous investment in technologies that the university has made since the 1960s. That individual professors of various departments and schools turned to the case-study method, project-based teaching, problem-based learning, and other innovative approaches, using computer simulations and applications, goes without saying. That such faculty constituted a tiny minority of the entire faculty is just as clear. (p. 129)

What are the impediments to more widespread uptake of innovative and effective approaches to online teaching and learning? There is ample research that demonstrates alternative approaches that can be taken. For example, in studies by the authors (Herrington et al., 2003; Herrington et al., 2004), online learning environments that used complex collaborative tasks as a central pedagogical approach were investigated to determine the characteristics of authentic activity that facilitate a whole course unit of study being encapsulated within a single complex task. We have also sought to determine the factors that contribute to the successful adoption and implementation of such courses. Our research has revealed a number of highly innovative and successful approaches that use the affordances of the online environment in ways that would be difficult or impossible if attempted in a weekly, face-to-face, on-campus mode. The learning environments use imaginative and realistic methods to facilitate collaboration at a distance, in a manner not unlike that commonly found in business projects and social communications using the Internet, e-mail, and text messaging.

The courses investigated in our research involve a variety of discipline areas and authentic scenarios, such as:

- A semester-long course on North American fiction, where students studying novels written by writers such as Hemingway, DeLillo, Atwood, and Esquival are given the role of editorial board members of an online scholarly journal, to which they submit book reviews and articles based on their study of the literature.
- A course on coastal and marine systems, where students are required to understand, analyze, and interpret data, and draw conclusions as to whether the water quality within a marina is different from that in the ocean outside, and if so, whether or not the construction of the marina is to blame.
- A course on business writing, where students learn business communication skills by accepting "temporary employment" in a virtual recording company, where they prepare a report on benefits to the company from the introduction of an internal newsletter.
- An introductory biology course where students "travel" to a remote lake in Siberia where several microorganisms are found that cannot be classified, and the students are assigned to groups to analyze the specimens and prepare a report on whether or not a new life form has been discovered.
- A course on qualitative and quantitative research methodologies, where students work virtually in a graduate research centre to investigate the closure of a rural school and prepare a report concerning the impact of the school closing on the local community.

Such learning environments not only represent pedagogical innovation as delineated in the ten design principles listed above, but also capitalize on the rich affordances of online learning environments, by simulating real-world tasks that require collaboration and communication, often at a distance, using communication technologies entirely appropriate to the jobs required in the scenarios.

However, while learning environments such as these are theoretically sound, there is insufficient guidance available to assist instructors in fully realizing the potential of the authentic activities approach. Complex tasks, by their very nature, create great diversity of outcomes, and it is often difficult to foresee the design, implementation, and maintenance challenges that will inevitably arise. In our research, we have noticed that the teachers using these approaches have a deep commitment to the educational philosophy of authenticity, and a capacity for hard work above and beyond the usual level required (or recognized) for the development of an online course. The problems they encounter are complex and not easily solved, ranging from institutional factors (such as restrictive university policy, the costs of development, and the unreliability of technology infrastructure), to personal teaching factors (such as the necessity to learn a new teaching role), and to learning issues (such as the level of support and guidance needed by students, and how to help them deal with their inevitable anxieties).

Because this is new territory, academic staff members are left without appropriate guidelines in often difficult circumstances. One issue that frequently causes instructors to abandon an authentic complex task as the key design concept in an online course is the difficulty some students have in accepting the parameters of a context or scenario, or their inability to "suspend disbelief" to enable them to become fully engaged in a life-like situation. When this happens, instructors often think that the learning environment is not working because it is too complex, and respond by simplifying the requirements or providing a more rigid step-by-step structure. Further research is showing that this difficulty in becoming fully engaged in the authenticity is not an uncommon student response initially, and rather than abandon the approach altogether, a better strategy is to provide additional design features and teacher-peer support in the early weeks of the course (Herrington et al., 2003, 2004). Similarly, when teachers facilitate collaborative group tasks in online environments and group tensions emerge (as they inevitably do), rather than abandon collaborative work because it is too difficult, a more effective approach is to support group engagement with guidelines, protocols, choices, and other forms of scaffolding for collaboration.

At this stage in the development of online collaborative learning environments, there is a clear need to further the understanding of the

more effective and successful approaches and their relationships with underpinning theoretical principles and technological affordances (Anderson, 2003). There is a huge gap between the theoretical ideal and the practical realization of these innovative approaches, and effective models, principles, and guidelines are needed by faculty members, instructional designers, and academic administrators who are prepared to challenge the dominant teaching practices in higher education today.

THE NEED FOR NEW RESEARCH

Research is one approach to meeting the types of challenges described above, but not the kind of research that has dominated education technology for the past 50 years. Instead, there is an urgent need for development research (Van den Akker, 1999) to provide design guidelines for enhancing collaborative online teaching and learning. As explained below, development research is distinctly different from the experimental research methods that have long been applied in our field (Ross & Morrison, 2004). Although there is renewed enthusiasm for experimental research designs among some educational researchers (cf. Feuer, Towne, & Shavelson, 2002), we do not believe that this is the most fruitful path for a design field such as educational technology.

Changing the mental models of researchers from those that are primarily experimental to those that are developmental is not an easy task, especially given the prevalence of media comparison studies using experimental methods in the field of educational technology for many decades. Saettler (1990) found evidence of experimental comparisons of educational films with classroom instruction as far back as the 1920s, and comparative research designs have been applied to every new educational technology since then, including programmed instruction (Lockee, Moore, & Burton, 2004), instructional television (Seels, Fullerton, Berry, & Horn, 2004), and computer-based instruction (Orrill, Hannafin, & Glazer, 2004). However, for decades the results of such media comparison research studies have usually been "no significant differences" (Clark, 1983; Lumsdaine, 1963; Mielke, 1968; Schramm, 1977). Not surprisingly, much of the existing research related to collaborative online learning continues in the same vein, that is, comparing online courses with traditional classroom courses (Cheng, Lehman, & Armstrong, 1991; Koory, 2003; MacDonald & Bartlett, 2000).

Recently, Bernard et al. (2003) reported a comprehensive meta-analysis of 157 empirical comparisons of distance education courses with face-to-face instruction courses between 1985 and 2003. Although not all the distance education courses in the studies analyzed were online, many were. Altogether they found more than 1,000 comparison studies in the research literature, but the majority of the studies did not meet their criteria for inclusion in the meta-analysis. Earlier reviews have found that comparison studies are often flawed by problems such as specification error, lack of linkage to theoretical foundations, inadequate literature reviews, poor treatment implementation, major measurement flaws, inconsequential learning outcomes for research participants, inadequate sample sizes, inaccurate statistical analyses, and meaningless discussions of results (Reeves, 1993). Bernard et al. (2003) reported a very small, but statistically "significant, positive mean effect size for interactive distance education over traditional classroom instruction on student achievement" as well as a small, but statistically significant, "negative effect for retention rate" (p. 2). Further analysis indicated that synchronous communication and two-way audio and video were among the conditions that contributed to effective distance education. While this meta-analysis is excellent, its findings, as well as those derived from other related meta-analyses (Cavanaugh, 2001; Machtmes & Asher, 2000), fall far short with respect to specifying design guidelines for online collaborative learning.

To provide design guidelines for developing and implementing effective online collaborative learning environments, there is an urgent need for what some call development research (van den Akker, 1999) and others refer to as design research (Bannen-Ritland, 2003; Design-Based Research Collective, 2003; Kelly, 2003). Design or development research:

- Focuses on broad-based, complex problems critical to education.
- Involves intensive collaboration among researchers and practitioners.
- Integrates known and hypothetical design principles with technological affordances to render plausible solutions to these complex problems.
- Conducts rigorous and reflective inquiry to test and refine innovative learning environments as well as to reveal new design principles.
- Requires long-term engagement that allows for continual refinement of protocols and questions.
- Maintains a commitment to theory construction and explanation while solving real-world problems.

Van den Akker (1999) stated that, "Methods of development research are not necessarily different from those in other research approaches" (p. 9). Although this is usually the case, there are major differences between the philosophical framework and goals of these different approaches. Figure 1 illustrates the differences between research conducted with predictive goals and that inspired by development goals.

Van den Akker clarified the differences illustrated in Figure 1:

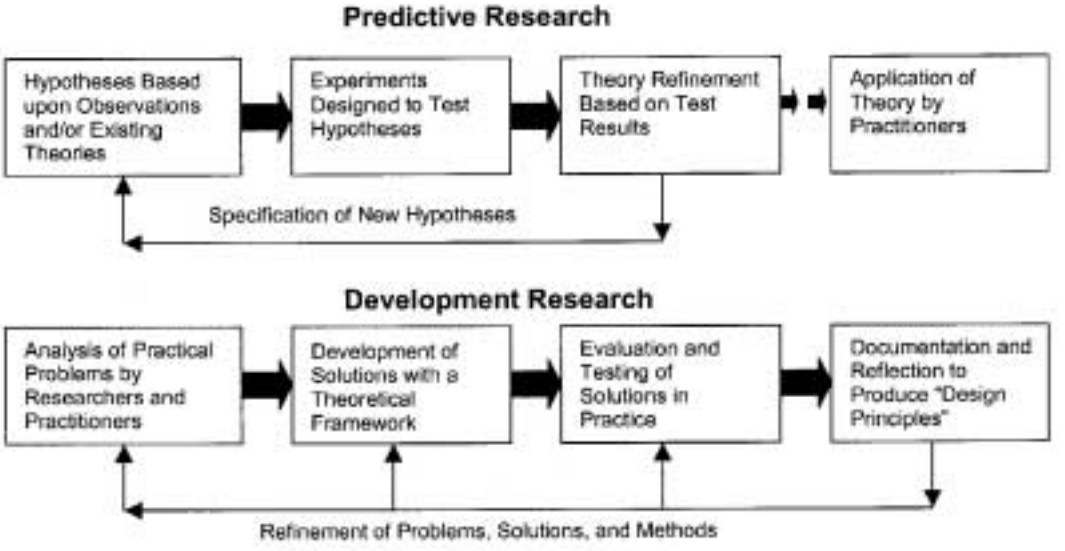
> More than most other research approaches, development research aims at making both practical and scientific contributions. In the search for innovative "solutions" for educational problems, interaction with practitioners . . . is essential. The ultimate aim is not to test whether theory, when applied to practice, is a good predictor of events. The interrelation between theory and practice is more complex and dynamic: is it possible to create a practical and effective intervention for an existing problem or intended change in the real world? The innovative challenge is usually quite substantial, otherwise the research would not be initiated at all. Interaction with practitioners is needed to gradually clarify both the problem at stake and the characteristics of its potential solution. An iterative process of "successive approximation" or "evolutionary prototyping" of the "ideal" intervention is desirable. Direct application of theory is not sufficient to solve those complicated problems. (pp. 8–9)

Is development research the only viable approach to research related to online collaborative learning environments? Certainty not. Educational technology researchers should select the methods that are most appropriate to their overall research goals and specific research questions. However, we doubt that the increasing popularity of studies with interpretivist goals using qualitative methods will have the levels of impact on practice that are needed. Perhaps this can be excused given that the proponents of qualitative approaches make few claims to generalizability (Denzin & Lincoln, 2003). Nevertheless, in light of the lack of transfer to practice of the results of both experimental studies and qualitative investigations (Lagemann, 2000; National Research Council, 2002), a development research agenda is worth considering if educational technology researchers wish to advance the design of online collaborative learning.

Development research is not just for educational technologists, instructional designers, computer scientists, and others in fields most heavily engaged in the development of online collaborative learning. Faculty members in all disciplines can contribute by engaging in the "scholarship of teaching" intended to optimize the roles of human teachers and digital technologies in higher education (Shulman, 2001). Not enough is known about the demands of online teaching on faculty and learners, nor do we understand the most effective alignments of educational objectives, content, subject matter expertise, instructional methods, technological affordances, and assessment strategies for online collaborative learning. Despite a rosy future predicted by some (Duderstadt, Atkins, & Van Houweling, 2002; Pittinsky, 2003), the current state of knowledge in this area is woefully inadequate, and research findings to date are often contradictory. Active participation in development research and the scholarship of teaching across the entire academic spectrum is warranted. Development research requires that faculty members:

- Define a pedagogical outcome and create learning environments that address it.
- Emphasize content and pedagogy rather than technology.
- Give special attention to supporting human interactions and nurturing learning communities.

Figure 1 ☐ Predictive and development research approaches in online collaborative learning.



- Modify learning environments until the pedagogical outcome is reached.
- Reflect on the process to reveal design principles that can inform other instructors and researchers, and future development projects.

A PROPOSED RESEARCH AGENDA

What questions should be pursued over the next 5–10 years to advance the state-of-the-art of online collaborative learning? Since 1990, the Campus Computing Project (Green, 2001) has conducted an annual survey of more than 600 colleges and universities in the United States concerning the role of information technology in teaching, learning, and scholarship. According to the summary of the 2001 survey results, respondents across all sectors of higher education identified "assisting faculty integrate technology into instruction" as the single most important instructional technology issue confronting their campuses "over the next two or three years" (np). A recent survey of college administrators (Allen & Seaman, 2003) indicated that "nearly one-third of . . . academic leaders expect that learning outcomes for online education will be superior to face-to-face instruction in three years, and nearly three-quarters of them expect learning outcomes for online education to be equal to or better than face-to-face instruction" (p. 3). Similarly optimistic predictions can be found in recent books authored by a former university president (Duderstadt et al., 2002) and the CEO of a popular course management system (Pittinsky, 2003). But while these and other academic and corporate leaders may see a rosy future for online learning in higher education, professors and their students seem much less certain of this brave new world of the virtual university (Cuban, 2001; Hara & Kling, 1999; Noble, 2001; Reeves, 2002, 2003).

Academic staff members are under increasing pressure to design online courses in ways that help students to achieve higher order outcomes, such as thinking like experts, and developing robust mental models of complex processes. But most of them are unable to accomplish this without substantial instructional design support. Instead of long-term support, the best many faculty members get is a workshop or two about their institution's particular course management system. Although many of the technological affordances of Blackboard™, WebCT™, and other course management systems can support the collaborative engagement of students in solving complex problems or undertaking authentic tasks, few instructors capitalize on these possibilities in their use of these tools.

Perhaps this mismatch relates to the beliefs instructors have about learning and technology. For example, some instructors conceive of technology as primarily something that their students can learn *from* whereas others conceive of technology as something that their students primarily learn *with* (Jonassen & Reeves, 1996). The former conception is more common than the latter. The foundation for the *learning-from* approach is educational communications, that is, the deliberate and intentional act of communicating content to students with the assumption that they will learn something from these communications. The instructional processes inherent in the from approach to using media and technology in higher education can be reduced to a series of simple steps:

1. Exposing students to messages encoded in media and delivered by technology.
2. Assuming that students perceive and encode these messages.
3. Requiring a response to indicate that messages have been received.
4. Providing feedback as to the adequacy of the response.

In contrast, the theoretical foundation for the *learning-with* approach is cognitive tools that have been intentionally adapted or developed to function as intellectual partners to enable and facilitate critical thinking and higher-order learning (Lajoie, 2000). Examples of cognitive tools include databases, spreadsheets, semantic networks, expert systems, communications software such as teleconferencing programs, online collaborative knowledge construction environments, multimedia-hypermedia construction software, modeling tools, and computer programming languages. In the cognitive tools approach, media and technology are given directly to learners to use for representing and expressing what they know. Learners themselves function as designers using media and technology as tools for analyzing the world, accessing and interpreting information, organizing their personal knowledge, and representing what they know to others.

The learning-from approach to using media and technology dominates higher education in both traditional and online classrooms. The learning-with approach appears ideal for online collaborative learning and it is being explored in a few innovative projects (Herrington et al., 2003, 2004; Schank, 2002). But it is not in evidence in most university courses at this time, especially in online contexts where teacher-centered, learning-from models are predominant (Sammons, 2003). Development research focusing on enabling the learning-with pedagogy in online collaborative learning environments is recommended. Such research may yield guidance about online scaffolding and other support strategies for instructors seeking to foster collaborative learning in this way.

Just as development research should be done in close collaboration with teaching practitioners, it can also engage learners themselves in the process. Crook (2002) reported on a survey of students in the United Kingdom indicating that although most of them believed that online universities were inevitable in the future, none of them expressed a desire to study at a virtual university, and "many vigorously dismissed the whole virtualization prospect" (p. 155). Meanwhile, many authorities seem to assume that learners will automatically embrace collaborative learning. For example, Duderstadt et al., (2002) wrote:

> In these new learning paradigms, the word student becomes largely obsolete, because it describes the passive role of absorbing content selected and conveyed by teachers. Instead, we should probably begin to refer to the clients of the twenty-first century university as active learners, since they will increasingly demand responsibility for their own learning experiences and outcomes. (p. 64)

Will today's passive classroom students easily transform themselves into tomorrow's active online learners? Will the "communities of inquiry" advocated by Weigel (2002) evolve and thrive? Will authentic tasks become integral to collaborative online learning environments (Herrington et al., 2003)? These desirable results are unlikely to occur unless students themselves have played significant roles in the design and refinement of online collaborative learning environments though long-term development research. This is an ideal task for graduate students in fields such as educational technology

and computer science, but students in virtually any discipline can and should participate.

If the hopeful vision of online collaborative learning with which this paper began is to be realized, fundamental changes in our methods of research and development are recommended. The kinds of design and development research described by Van den Akker (1999), Bannan-Ritland (2003), and others hold great promise. But other things are needed. For starters, the conceptualization of learning theory as something that stands apart from and above instructional practice should be replaced by one that recognizes that learning theory can be collaboratively shaped by researchers and practitioners in context. This shift in our way of thinking about research and theory as processes that can be *use-inspired* is taking place in other scientific fields as well (Stokes, 1997).

Second, we need to remember that educational technology is a design field and that design knowledge is the primary type of knowledge sought in our field. Design knowledge is not something that educational researchers derive from experiments for application by teachers. Design knowledge is contextual, social, and active (Perkins, 1986). Educational technology is a design field, and thus, our paramount research goal should be solving teaching, learning, and performance problems, and deriving design principles that can inform future development and implementation decisions. Our goal should not be to develop esoteric theoretical knowledge that we think practitioners should apply whenever we get around to throwing it over the walls of the classroom to them. This has not worked for more than 50 years, and it will not work in the future.

Third, the reward structure for scholarship must change in higher education. Educational researchers should be rewarded for participation in long-term development research projects and their impact on practice rather than for the number of refereed journal articles they publish. Faculty in all disciplines should be provided time for participation in development research, reflection, and continuous professional development.

Finally, additional financial support is needed for the types of long-term development research initiatives called for in this paper. Private funding bodies such as the Alfred P. Sloan Foundation (http://www.sloan.org/main.shtml) and the Spencer Foundation (http://www.spencer.org/) as well as government agencies such as the National Science Foundation (http://www.nsf.gov) and the Australian Research Council (http://www.arc.gov.au/) have funded a large number of projects designed to advance the prospects for collaborative online learning in higher education. Unfortunately, few of these initiatives have been sufficiently integrated with long-term development research agendas.

A FINAL WORD

The exploration in this paper of the current state-of-the-art of online collaborative learning has demonstrated that there are a number of factors that impede instructors and instructional designers from making the best use of technologies and collaborative settings in their learning environments. For example, although we have argued that new research is needed, it is also apparent in some settings that it is not a lack of sufficient research guiding implementation of learning settings, but that instructional designers and instructors often fail to apply the results of the existing research to the design of today's online collaborative learning environments. This is in many ways analogous to the field of health, where medical research has long established the benefits of diet and exercise, and yet for a variety of reasons, so many people continue to live very unhealthy existences through poor food and lifestyle choices. In a similar way, many developers and users of online learning make poor choices about instructional design.

The inability of many instructors, designers, and others to know how and when to apply research findings, provides a strong supporting argument for development research. Development researchers can be viewed as analogous to dieticians or personal trainers that some people hire to help them improve their health. Just as many people cannot get healthy without professional assistance, many instructors need educational technology researchers to work with them side-by-side to address the challenge of develop-

ing powerful collaborative online learning environments. In the process, not only are local design difficulties resolved, but there is the added payoff of design principles that can be applied to future problems. As the New Age saying goes, it's a "win-win" situation, one that acknowledges the fundamentally important connection between the development of theory and the improvement of instructional design and student learning. □

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