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This issue's column by Professor Kevin Crowston is in response to Professor Peter Carr's column about the online Ph.D. that appeared in the last issue of Decision Line (Vol. 31, No. 3). Dr. Crowston summarizes the previous arguments and then discusses current research on the subject of applying computer-supported work to graduate education. For instance, he emphasizes the importance of face-to-face interaction for particular kinds of collaborative tasks. I hope you find this next entry in the debate about "online" versus "face-to-face" Ph.D. programs to be a stimulating and enlightening exercise as you contemplate the important questions surrounding the future of doctoral education.

The On-line Ph.D. as Computer-supported Work

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In response to a growing demand for "just-in-time education," numerous institutions now deliver part or all of their courses on-line—anytime, anywhere education. Athabasca University is one; my institution, another. Reflecting the initial demand from mid-career professionals unable or unwilling to give up lives and careers to move to campus for a year or more, these two efforts started with the Master's-level education. In his article (*Decision Line*, May 2000, Vol. 31(3)), Athabasca's Peter Carr discusses the possibility of expanding their offerings to include Ph.D.-level education. In this article, I wish to assess his arguments and to offer some caveats. (Caveats also apply to traditional undergraduate education, though for different reasons. At least part of the role of a traditional residential college is to give eighteen-year-olds a safe environment in which to mature into adults. A significant part of this experience is persistent peer interactions, extracurricular activities, and other non-class experiences that are not easily duplicated on-line. However, in the rest of this article I will focus on the case of Ph.D. programs.)

Carr notes that the Ph.D. is not simply a course (a fact new Ph.D. students often have difficulty understanding) and so cannot be delivered as easily as other degree programs. He instead situates the on-line Ph.D. as part of an "e-campus" providing on-line teaching and research. To assess this argument for a computer-supported campus, I will apply what is known about how

computer-supported communications affect other kinds of work.

Carr first argues that the basic physical resources needed to do a Ph.D. can now be reproduced on-line, with the possible exception of specialized equipment. For example, universities offer on-line classes, and there are numerous databases providing on-line literature, etc. Indeed, these on-line resources may be richer than those available on most campuses. The combined catalogue of on-line courses is likely more extensive than is offered on any single campus. On-line database offer more journals than many libraries can afford, though they lack older references and monographs. Carr's sole caveat may in fact be unnecessary: increasingly, scientists can interact with specialized scientific equipment via the Internet, as in The Space Physics and Aeronomy Research Collaboratory (<http://intel.si.umich.edu/sparc/>).

Secondly, Carr argues that the Internet can support contact between Ph.D. students and supervisors. One way to think about this relationship is that it resembles the one between telecommuting workers and their supervisors. In some ways, Ph.D. work seems well suited for telecommuting. The work "requires considerable periods of uninterrupted concentration" (O'Mahony & Barley, 1999, p. 130), and much of it can be performed with little direct supervision. On the other hand, Ph.D. students are yet to be "socialized to work autonomously" (O'Mahony & Barley, 1999,



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joined the School of Information Studies at Syracuse University in 1996. He received his Ph.D. in information technologies from the Sloan School of Management, Massachusetts Institute of Technology (MIT) in 1991. Before moving to Syracuse he was a founding member of the Collaboratory for Research on Electronic Work at the University of Michigan and of the Centre for Coordination Science at MIT. His current research focuses on new ways of organizing made possible by the extensive use of information technology.

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p. 130), another prerequisite for telecommuting. These caveats suggest that distance work may be more appropriate for advanced rather than beginning students. Also, some professionals avoid telecommuting because face-to-face contact is seen (sometimes correctly, Perlow, 1997) as necessary to achieve superior performance evaluations (O'Mahony & Barley, 1999). In an academic context, distance students may fear being less highly evaluated by faculty, translating into less support during the program and later when job hunting.

Finally, Carr mentions the need for immersion in a research culture. Implicit in this statement is the recognition that completion of a Ph.D. program is not a solitary undertaking but rather a group project. (This recognition underlies the common concern that a program lacks the "critical mass" needed to succeed.) Research suggests that computer-supported communications are useful for some kinds of group tasks but not for others. For example, groups take longer to reach consensus when communicating solely via computer-supported media (Sproull & Kiesler, 1991) and such media do not work well for tasks requiring reduction of equivocality. O'Mahony and Barley (1999) note that computer-supported media seem better for continuing established relationships than for beginning new ones. As they put it, "time together is important for developing relationships and establishing understandings that enable people to work together" (p. 137).

Athabasca's solution to delivering a research culture is the "on-line research institute." Applying the research evidence discussed above indicates that these institutes will be as good as or better than face-to-face interactions for some but not all kinds of tasks. Collaboration between researchers seems feasible if they already know each other and have agreed on the work to be done and the data to be collected (indeed, as Carr points out, the Internet is already used in these cases), but forming new groups and starting new projects seem likely to be much more difficult. Statistical data or questionnaires could probably be collected in an on-line institute, interviews might be attempted, but detailed ethnographic data collection is probably impossible. Providing research

stakeholders with access to research results seems feasible if the results are in the form of papers, but probably more difficult if the desired result is a changed understanding of a problematic situation.

While an on-line research institute may enable distance students to participate in certain types of research, it seems much more difficult to socialize new students in the research culture in the first place. I believe that this socialization is more important than Carr acknowledges and that at present, face-to-face interaction is the only way to achieve it. (Carr does plan some face-to-face retreats and on-line peer interactions.) O'Mahony and Barley (1999) suggest that for a group, time together may be important "because there are tacit aspects of work practices that are difficult to verbalize, because social cues that provide valuable information are lost, or because the essence of work is a social process" (p. 137). Examples of important but largely tacit knowledge include how to choose an interesting research topic or to write a grant application, which journals are most highly ranked and what kinds of research they like, how to deal with students, administrators and committees, and how to give or assess a job talk. Competence in these skills is crucial for success as an academic, though they are rarely formally taught. Instead these skills (along with a supporting set of norms and cognitive schema) are picked up from interaction with one's peers (e.g., Orr, 1987) or during legitimate peripheral participation (Lave & Wenger, 1991) in the research process. Interaction with more advanced students can be particularly helpful. While these interactions could happen on-line (perhaps even in the context of participation in an on-going research project), it may be difficult to motivate busy students to participate in what will seem like non-goal-directed conversations. Reliance on on-line interactions may also make peripheral participation more difficult (you are either on the mailing list or not). Again, these considerations suggest that an on-line Ph.D. may be more appropriate for advanced rather than beginning students, though the absence of advanced students may have negative consequences for the beginners.

Of course, awareness of the limitations of computer-supported communications should not blind us to their advantages (and

vice versa). For example, computer-supported groups are reported to have increased and more equal participation. An on-line doctoral seminar might therefore be an improvement over a traditional classroom, in which a small number of students tend to dominate. (On the other hand, O'Mahony and Barley (1999) note that this research has considered only well-defined small groups, so these results may not generalize to groups of individuals who have not met face-to-face.) It seems impossible to predict a priori how these various effects—increased discussion vs. increased difficult in sensemaking—will interact. The ultimate success of an on-line doctoral seminar (and on-line Ph.D.) likely depends on a host of as yet unidentified and unstudied factors. More generally, O'Mahony and Barley (1999) note that research on effects of digital telecommunications has tended to neglect intervening variables. Experiments such as Athabasca's will therefore help us understand the potential—and the limits—of on-line education and of computer-supported work more generally.

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