Lessons Learned by Comparing On-line Education Strategies Across Disciplines

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ABSTRACT

When choosing how best to employ educational technologies for on-line learning, there is much to be gained by examining the experience of educators in other disciplines. This paper presents four brief case studies in the disciplines of computer science and social work. Lessons learned by comparing these diverse experiences are discussed, including creating a community of learners, supporting asynchronous student communication, using synchronous on-line meetings, and providing social support. In addition, the experiences presented indicate that stereotypes of student capabilities and expectations may often be inaccurate, and revising one's views may be helpful in achieving better results in on-line education.

Keywords: on-line education, social work, computer science, case studies

1. INTRODUCTION

More and more frequently, educators are using internet-based learning tools to augment existing courses [8] to enhance the learning experience [11, 12]. Educators who are focused on distance learning are also redesigning courses for complete on-line delivery. Although the educational literature in many disciplines continues to grow with descriptions of these experiences, many educators confine their attention to writings within their own field. While both a course's objectives and the nature of its student audience play a big role in how best to employ educational technologies, there is much to be gained by examining the experience of educators in other disciplines. Often, despite significant real (or perceived) differences among student populations, valuable insights about on-line education can be transferred between fields.

In this paper, we summarize a series of on-line educational experiences in two unrelated fields: computer science and social work. The experiences are framed in the form of case study synopses, covering a broad spectrum from 100% on-line course delivery to simply using on-line tools to foster community interaction outside the scope of a particular course. Both the essential similarities and the critical differences among students and among educator goals are explored, and several lessons learned are presented. Trends in on-line tool usage are discussed, as well as issues surrounding the formation of on-line learning communities. Most importantly, comparing these experiences indicates that one's initial perceptions about and stereotypes of student capabilities and expectations may often be inaccurate, and revising one's views may be helpful in achieving better results in on-line education.

2. CASE STUDY SYNOPSES

To illustrate how on-line education strategies are used in diverse fields, we present several cases from our personal experience in teaching graduate students in both social work and computer science. Similar experiences have been reported with undergraduate students, although most undergraduate populations differ somewhat from their graduate counterparts.

2.1 On-line Delivery of a Graduate Software Engineering Course

CS 5744: "Software Design and Quality," is a graduate course at Virginia Tech [4]. This course serves students in both the Computer Science and Applications program and the Master of Information Technology program. This course requires that students have already completed a graduate-level introductory software engineering course. It aims to expose students to more advanced software design issues including software architecture [13] and to teach them fundamental quality assessment techniques.

Software Design and Quality is delivered completely on-line, with no face-to-face course meetings. Approximately one third of the students are full-time students residing on Virginia Tech's main campus, while two thirds are located in other areas—principally just outside Washington, D.C., although students from several other states and even the Virgin Islands have taken the course. Close to half of the students work full-time while trying to complete their MS part-time.

Design and assessment skills, which form the core content of Software Design and Quality, are best acquired through active learning [14]. Students must practice techniques, learn by watching others, analyze existing designs, and discuss and defend their opinions within a group. The course assignments, which include both individual and group work, are designed to promote these modes of learning.

Software Design and Quality draws students into the course through carefully chosen activities and through a recurring weekly schedule. Each week, students read assigned materials

individually and prepare a short written response to questions based on this material. At the end of each week, students meet on-line for a discussion session. In addition, students simultaneously pursue longer term assignments taking from three to five weeks. Two written design critiques are completed individually, and both a high-level software design project and the creation of a test plan are completed by three-person groups.

A variety of on-line tools are used to support Software Design and Quality. Blackboard is the web course management system used to provide many of the tools, including an electronic drop box for student submission of written work and a threaded discussion board for asynchronous communication among course participants. In addition, Blackboard's group support tools were the primary mechanism for enabling groups to work together on projects. Blackboard allows groups within a class to be designated, thereby allowing each group to be given its own private threaded discussion board, file sharing and exchange area, and text chat area. Together with Blackboard's tools, a course-wide e-mail list was used for broadcasting notices. The weekly discussion meetings were held using Centra One [3], a client-server application that supports multi-way audio meetings over the internet with good performance at modem speeds. Other tools could serve this purpose equally well [5]. By carefully laying out expectations at the start of the course and limiting meeting size to 30 or fewer participants (and holding multiple meetings each week to handle larger class sizes as necessary), a high degree of discussion participation can be achieved.

Finally, students were required to prepare all of the longer-term individual and group assignments in a web-ready format. All student work was posted (anonymously) in a "work gallery" where it was visible to everyone in the class. Later assignments required students to analyze and reflect on the work produced by their peers. For one design critique, students were required to choose a group design project from the work gallery. Similarly, for the second group project, groups were required to develop a test plan for some other group design produced earlier in the semester. The result is a highly interactive community that engages students in the class and draws them into group discussions [10].

2.2 On-line Support for a Graduate Programming Languages Course

CS 5314: "Programming Languages," is a graduate course at Virginia Tech. It is taken primarily by students working on an MS or PhD in computer science, and is offered as a traditional face-to-face course. This course has gradually incorporated more and more on-line support tools into its infrastructure. The goals of this course include providing students with a broad picture of the basic design issues and implementation issues faced by modern computer languages, and exposing students to current research problems and solution approaches in the field. The student population consists primarily of full-time CS graduate students in residence on Virginia Tech's main campus.

Four basic on-line tools now are used for internet-assisted teaching of this course. First, an on-line web site provides access to all of the course content (except the textbook), including all of the other on-line tools. Second, the full set of course notes are available on-line. The notes are formatted in HTML, and are accompanied by a detailed book-like index that promotes exploratory browsing of the materials. Third, a class e-mail listserv serves as the main communication mechanism. The listserv is supplemented with a hypermail-based threaded archive of past messages to the list. Fourth, an on-line submission and grading system is used to collect student programs.

One significant aspect of the Programming Languages course is the use of student presentations on current research developments in the field. Every student participates in two presentations, and all students are responsible for the material presented by others in the course. Questions based on student presentations do appear on the final exam for the course. A work gallery similar in spirit to the one used for Software Design and Quality is used to make all student presentation materials available through the course web site, together with an abstract provided by the presenters.

2.3 On-line Support for Graduate Social Work Practice Courses and Field Practicum Seminars

SOWK 631: "Practice I: Foundations," and SOWK 632: "Practice II: Groups, Families, and Communities," form an introductory social work practice course sequence for graduate students at Radford University. This pair of courses is designed to provide students with an overview of the basic knowledge and skills needed by social workers, and to discuss various models of practice. A central aspect of these courses is the discussion of actual client cases that students encounter, either on-the-job or while in a field placement concurrent with the course. Providing an adequate venue for students to share, discuss, and assess issues in client cases is vital to a successful learning experience.

To provide a mechanism for deeper, longer-lasting discussions of cases and other class topics, WebCT [16] was used to provide an on-line, out-of-class medium [7]. A threaded discussion board became the main focus of on-line support, providing a central location for discussing practice cases outside of the classroom. While this use of a non-graded discussion site provided positive benefits, students also began using the board for posting their own concerns about classes, internships, and issues they were working on in their field sites or professional work. In short, they co-opted the discussion board for their own communication needs. This aided in helping students from remote locations and with diverse job locations to stay connected with each other, providing more opportunities for sharing all aspects of their educational experience.

The success of discussion boards in the practice classes led to an expansion of on-line support into other courses. In particular, students in the two practice courses also take concurrent field seminars where they receive monitoring, evaluation, and support of their work in the field placement.

In the SOWK 641/642 "Field Practicum and Seminar" I and II courses, face-to-face meetings were replaced by a live on-line text chat session for discussing issues and cases associated with field placement in the field seminar. Chat was used because several students were commuting from over 100 miles away, had family obligations, or had difficulty getting adequate time off work.

The use of text chat was successful in this context; all students were able to log on and use the service, and discussions during the on-line meetings typically lasted over two hours. Before each chat session, students were e-mailed agendas and discussion topics. Twice students were requested to e-mail case synopses and discussion issues for the class to review prior to the on-line seminar. All agreed that chat forced them to add to the

discussion, pay attention, and process the work faster than in a regular class discussion.

2.4 Fostering an On-line Community

Success with on-line tools in the social work practice classes at Radford led to an applied research project focused on fostering an on-line community of learners within the graduate social work program.

Since social work students had taken over discussion boards for the practice courses to discuss broader issues about the graduate program, student life, and work life, WebCT was used to provide a forum specifically for this purpose. All graduate students, faculty, and staff in the program were allowed access for sharing information, providing postings of upcoming events that would interest students on a calendar, and maintaining a discussion board for departmental or student issues such as registration, course work, field, and so on.

Evaluation results indicated that students made greater use of the forum than faculty. The discussion board was the most used feature, with the topics ranging from curriculum issues to event announcements to personal issues and achievements. Students who used the site wanted the site maintained and considered it a valuable resource. They reported a greater sense of community with the department and with each other. They also noted that it helped to increase their knowledge of departmental matters.

3. LESSONS LEARNED

Despite the obvious differences between social work and computer science, there are striking similarities in the case studies summarized here. Both disciplines are applied fields, requiring an eclectic array of skills and knowledge. Both programs serve non-traditional students who are returning professionals, often balancing work, family, and education. Such students often have a strong motivation to learn and to pursue course objectives on their own. Both social work and computer science also require the development of skills that enhance critical thinking. Students need to apply concepts, develop a sense of professional practice, and learn to critically evaluate their work as well as the work of others. As a result of these similarities, the graduate education efforts summarized here share similar goals and objectives. When combined with the observed differences, several lessons emerge.

3.1 Creating a Community of Learners

Successful course work in both professions requires collaboration, professional behavior, critical thinking skills, and a desire for life-long learning. Creating a cohesive community of learners helps develop these behaviors and attitudes. Students need to learn how to work in groups with dissimilar colleagues. They need to learn the importance of sharing information with each other and they need to have a place to do that beyond the classroom. By interacting with each other and each other's work, they learn to critically analyze situations, cases, and information.

While the graduate social work program at Radford University is relatively small (70-90 students across two campuses), most students are non-traditional, commuting, busy people who spend relatively little time on campus getting to know each other or the faculty. Nevertheless, social work practice requires collaboration, not only among social work colleagues, but also with colleagues in related helping professions. In fact, the core of the profession is relationships—you cannot successfully practice social work with people with whom you do not have a relationship. Therefore, creating a community of learners requires building relationships before students can be expected to work successfully together. Providing on-line sources that keep students up-to-date about opportunities for interaction, seeking student input on departmental matters, providing information on university functions or departmental requirements, and providing information about each other, along with a place to interact is crucial to the success of individual students becoming professional social workers.

Similarly, in computer science, forming a strong sense of community is important, both for professional development and for keeping students engaged in courses. In the Software Design and Quality course, discussion boards played an important role for students who were working full-time, just as in the social work courses. In addition, the use of an on-line work gallery was an effective tool for promoting student interaction. The use of synchronous weekly meetings using Centra One gave students time to discuss issues "live" with each other, just as the live text chat sessions in the social work field seminar did. In short, fostering a sense of community and adding social value beyond individual educational goals is an important objective for many on-line courses.

3.2 Supporting Asynchronous Student Communication

Asynchronous interaction does not require students to be on-line simultaneously and allows them to participate at times convenient for their schedules. E-mail lists and threaded discussion boards are the most common mechanisms used for this purpose, although dynamic web page content, including "blogs" (weblogs) offer exciting possibilities as well.

Despite the fact that social work students are often viewed as being more people-oriented than computer-savvy, the students described here readily and quickly took up on-line tools in class, particularly discussion boards. The fact that many of them work full-time at very distant locations, while simultaneously balancing family, work, and student life, means that they were an ideal target for an alternate means of sharing experiences and discussions with each other.

To foster best social work practice, the focus is on building relationships. This requires interactive discussion, not just reading of disjointed posted information. With an e-mail list, a participant normally reads messages in the order they arrive, piecing each one into a growing mental picture of the discussion. This approach does not make it easy to review the responses of colleagues and trace the evolution of thinking on a given topic that is crucial in understanding a person unlike oneself, a skill that is necessary for good social work practice [9]. However, providing an archive of the discussion does allow busy students to "catch up" on controversial discussions when they are able and also to think about their views and responses to difficult postings. Stopping to think about one's response is another valuable skill needed in good social work practice.

In contrast, many computer science graduate students, who are usually seen as very technologically literate and savvy, often preferred e-mail listservs to discussion boards. This was true in Virginia Tech's Programming Languages course, for instance. This student preference likely is due to long-established habits of electronic communication: why use a new tool, if one already deals with e-mail every day? Unfortunately, students tend to use e-mail lists differently than discussion boards, perhaps also because of established habits. In Programming Lan-

guages, for example, the e-mail list was used for two main purposes: distribution of class-wide announcements from the instructor, and students asking specific, task-oriented questions, including clarifications on what is required in an assignment, or how to resolve a specific issue in a given language. While such peer-to-peer learning is valuable, threaded discussion boards often lead to many simultaneous free-form discussions of issues, rather than simple, targeted questions that are answered within a few replies [1]. As a result, discussion boards seem to be more effective at promoting community.

3.3 Synchronous Meetings On-line

Synchronous communication requires all students to be "electronically present" on-line at the same time, although they need not be physically in the same location. Regardless of the tool or technology used, synchronous meetings seem to play an important role in developing critical thinking and analytical skills in the case studies presented. Further, synchronous on-line meetings do provide complementary benefits to asynchronous communication mechanisms like threaded discussions.

For social workers, getting rapid feedback to ideas, cases, and difficult situations by a faculty liaison is second in importance for learning only to the on-going field placement supervision provided by practitioners. In the Field Practicum and Seminar courses, text chat was used to hold synchronous on-line meetings. Such meetings allowed the faculty liaison to elicit the ideas and knowledge that non-traditional students possessed when their more traditional colleagues had less life experience and work experience from which to draw. At Radford University, text chat turned out to be a great tool for providing peer support to students placed in field assignments far away from the campus, while other direct questions could simply be e-mailed to the faculty liaison for feedback.

For computer science students, synchronous meetings were also vital. The discussion-oriented nature of the weekly on-line meetings for the Software Design and Quality course was similar in spirit to that of a literature study course, or to the case-focused discussions in a medical or law class. Unlike the text-only format of typical chat tools, using Centra One allowed something closer to a conference call on the internet—with as many as 30 callers. All students were required to use headsets equipped with boom microphones. Even cheap headsets provided a significant improvement in audio quality over typical desktop microphones. In practice, microphone quality was a much more important factor in the quality of session audio than connection speed.

Just as in the social work courses, synchronous meetings were critical in computer science for allowing students to learn from each other, analyze issues on the spot, defend their choices, clarify issues raised by the course materials, and contribute their own experiences. As with social work, more experienced, non-traditional students often brought unique insights to discussions about how class content related to real experiences "on the job." At the same time, discussing these issues live in a group helped the entire class to have a better understanding of the topic under discussion.

3.4 Providing Social Support

While students pursuing on-line education programs clearly require additional attention to social issues to ensure they do not become disconnected or isolated from the remainder of the class, even when augmenting face-to-face classes, similar concerns arise. Universities are coming to recognize that for students to succeed academically, they require social support. In particular, students may face many extra-curricular issues, including balancing the family, work, and school aspects of their lives, making sense of work-related events, and even dealing with geographic separation. Social work students and computer science students both require attention to social support needs, although there may be differences in the nature of this support and how it is provided. The social work courses discussed here focused on how to keep students working together as a community, while the computer science courses focused on how to draw students out of their competitive, individual styles, and into more active community interactions. Providing support also encourages women and racial minorities to succeed.

While graduate social work students often come from a background of competition and individualism (most were not social work undergraduates), they often choose the field of social work because of their desire to work with others. Thus, it is a matter of providing opportunities for students to develop social supports rather than convincing them of the usefulness of developing them. Modeling good social support is also necessary of social work faculty. By providing opportunities and ways to interact with faculty, we model the importance of developing good supportive relationships and provide the practical ways to juggle busy lives. The success of on-line discussion mechanisms in the social work case studies is a byproduct of this need. It is also a possible reason why students so readily "took over" class discussion resources to talk about work, family, and surviving in the department.

While computer science students are also competitive and individualistic, they tend to run greater risks of becoming isolated, particularly in classes that are purely on-line. As a result, they must be actively encouraged to form ties with the remainder of the class. In addition to providing appropriate communication and interaction channels, social support is encouraged by choosing activities that draw students into interaction with each other and keep them doing so regularly. In Software Design and Quality, on-line discussion meetings and the threaded discussion board helped in this respect. In addition, the use of the work gallery played a valuable role, particularly for students who were very task-oriented. Requiring students to write assignments knowing they will be viewable by the entire class rather than just the instructor, and then requiring them to read, evaluate, and work with the assignments of other students, added a powerful community aspect to all of the assignments.

In the case studies presented here, supporting and encouraging the formation of a learning community seems to be central to providing the necessary social support needed by students.

3.5 Breaking Stereotypes

Experience with the courses described here indicates that premature stereotyping can handicap educators. For example, social work educators have resisted using technology in teaching because it is thought that students learn best by the human interaction achieved only in small courses face-to-face. In contrast, the use of on-line discussion boards and chat sessions in the case studies significantly enhanced the depth and quality of the exchanges between students, allowing them both to learn more and to become more engaged in the course.

Similarly, social work educators are often guilty of believing that good practice skills can only be learned in the context of interpersonal relationships and that on-line learning should be limited to non-practice courses. Despite this, social work stu-

dents showed a willingness to acquire new computer skills and little hesitation at adapting to on-line course tools in this context [12]. Web-based course tools seemed to pose little barrier to students. At the same time, the flexibility they provided in terms of location for participation and required travel was a welcome relief to the logistical headaches that working students regularly face.

Just as on-line discussion boards were successful in social work classes, one might expect computer science students to take to them naturally. Instead, however, computer science graduate students in the case studies presented here did not take to discussion boards, as discussed in Section 3.2. Unlike students who are new to computer technology, CS students may have strongly established preferences and biases that weigh against such a mechanism. In our experience, this same trend is visible in undergraduate CS students at Virginia Tech. However, Virginia Tech's Department of Computer Science recently added a department-wide threaded discussion server that is used for numerous classes as well as for social purposes and non-class-related topics. Because this service is used heavily in freshman classes, there is a visible change in their predisposition toward threaded discussion use in preference to e-mail for class topics as students move through the program. Although it is too early to tell if similar trends are developing in our graduate population, discussion boards have gradually seen increased usage in the Software Design and Quality course over the past four years, although they are still underutilized by this population.

One might also presume that social work graduate students would have more difficulties with computer access, while computer science students would naturally have readily available access. In practice, access was an important issue for both populations. The group that posed the most surprising access issues was actually full-time, on-campus computer science graduate students. At Virginia Tech, the majority of such students are international and do not own their own computers. Without system administration privileges, they cannot install new software on laboratory equipment, which often makes it difficult for them to have access to the same capabilities as other students. In social work, although both poverty and rural locations have limited access for many students in the past, in the last few years, students have been more likely to have a personal computer and internet connection at home for personal needs that they then use for course work.

4. CONCLUSIONS

In terms of educational challenges, we are more similar than different. Once one gets past the hype surrounding on-line education, it is clear that it provides benefits when properly applied [2, 6, 11, 15]. Educators should be working together with unique interdisciplinary styles to find the best ways to deliver education on-line. Discussing our similarities and differences will assist educators in developing the best approach for the objectives they need to achieve with the population who needs to meet those objectives. In particular, journals should be more willing to accept work on on-line education from outside their discipline. Social workers rarely check journal articles from non-social science abstracts. Computer scientists and engineers rarely check journals from the social sciences. Conferences and other venues that allow educators to share experiences and lessons learned across disciplines will help educators broaden their perspectives on technological issues that are becoming more important every day.

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