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Electronic Communications Education Via a Virtual Workshop

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Introduction

THE CORNELL THEORY Center is one of four National Supercomputing Centers. During the ten years of its operation, the center has built a strong history in educational materials and workshops. Historically, the majority of teaching has taken place onsite at the Cornell Theory Center (CTC). In an age where electronic communications and access to information by computer is growing rapidly, it makes sense for us to turn our efforts to distance education on the Internet.

We have designed and implemented a virtual workshop, a workshop where the participants are distributed across the United States (and occasionally further afield), learning by interacting with their own computers. In this paper we will describe our virtual workshop design and what we have learned from the first three hundred participants. The topics covered in our virtual workshop, by the nature of our mission, relate to technical, high-performance computing. We will not go into any detail about the contents of the workshop but describe instead the structure and implementation that we believe carry over to many other topics of education. The virtual workshop is a self-paced course. In addition to the on-line materials, we provide consulting support and access to our high-performance computer the IBM SP2.

Goal: Offer to a More General Audience

The virtual workshop was broadly advertised to both CTC users and the world at large. There was no charge for the workshop. Of the 290 applicants, 257 applicants were accepted, which was the largest number we felt we could support.

There were two questions of particular interest in moving to a general audience. The first was whether more participants would encounter access problems, given that most were not already CTC account holders (who would be more likely to have already resolved access problems), and given that they were widespread geographically (in particular, internationally).

The second was how active this audience would be, given that the course was self-paced and entirely voluntary. To answer this question, we collected information on use of modules, on participant involvement at the halfway point, and on CPU usage. CPU usage reflects how often they ran a program on our supercomputer.

Audience Activity

The final evaluations asked participants to report which modules they had completed. The responses echoed the drop in activity with progression along the sequence of modules. Of the 89 final evaluations, 60 reported completing the introductory MPI module. This number fell to 19 and 9 for the last two of the 11 MPI modules. Participants with long-term userids, who might have the most immediate benefit from the course, progressed the farthest into the materials. They represented 30 percent of those who reported completing the first MPI module, but almost 50 percent of those who reported completing the last two MPI modules. .

Goals vs. Accomplishments

To interpret the decrease in activity with progression into the modules, it is necessary to know whether the participants had any desire to complete those modules.

In general a large proportion of the group (34 to 40, out of 44) planned to complete each module, indicating that they were interested in the later modules. For the early modules in a topic sequence, the number of participants who planned to and completed the module was very high compared with the number who planned to but did not complete the module. This "planned and completed" number drops off with progression into the topic sequence.

CPU Usage

In designing the course materials, we placed particular emphasis on lab exercises to be completed on the IBM SP2, in the belief that hands-on work is necessary to understand fully the course material. To determine how many of the participants worked on lab exercises, rather than just read Web materials, we examined their CPU usage at the end of the workshop.

We could examine usage for only the 194 participants who did not have long-term CTC accounts. Of these, only 52 accumulated some CPU usage. If the same percentage of the 63 longer-term account holders worked on labs (probably an underestimate), the number doing lab exercises would be 69.

Summary of Results from Offering to a more General Audience

The sampling of activity from the Web server hits suggested that 74 percent of the participants accessed materials. The survey respondents who either had started, or planned to start, the virtual workshop, was 66 percent of the total participant group. These are rough indications of how many registrants participated to any extent in the course. The number participating per week was mostly likely much lower, with the Web server hits suggesting 23 percent of active participants. There was a decrease in activity with progression along the sequence of modules, despite preworkshop goals of completing those modules.

To some extent, these trends were expected for a general audience and a self-paced course: education is often a discretionary activity displaced by higher-priority or time-limited activities. However, increased audience retention should be a goal for successive virtual workshops. Any improvement to the virtual workshop should have an impact on this measure, not just those specifically targeting audience retention.

In general, participant activity or retention was not related to problems with Web access or SP access.

C o n s u l tin g

In expectation of a heavy consulting load, a two-tier support structure was designed. There were nine front-line consultants (with varying amounts of time committed) who monitored incoming e-mail and answered questions within their range of expertise. The remaining questions were forwarded to the module developers. Three developers requested to answer all questions on their modules.

Over the three months of the workshop 2 3 8 questions were received. Questions per week ranged from 5 to 32. For February, the month in which the most questions (and the most substantial questions) were received, 93 hours were spent on consulting by front-line consultants and by the three developers mentioned above. This level was well within the time originally allocated for consulting. Figures are not available for time spent consulting by other module developers.

We were also interested in how many participants took advantage of consulting, and to what extent. We found that only 72 participants (out of 257 total participants, and 170 participants who were likely to have been active) used e-mail consulting.

Goal: Revise and Expand Materials

The trial workshop Web materials were revised, and new materials on MPI were added for this virtual workshop. It was in this area that the course received its most positive feedback. The mean overall ratings for the individual modules (compiled from the module evaluation forms) ranged from 3.67 to 4.33, where 1 = very poor and 5 = very good. The overall mean was 4.01.

Goal: Impose Stricter Guidelines for Format of Web Materials

For the trial workshop, all materials used a layered format, where one layer served as an outline into more detailed information. For this virtual workshop, we required that this layer also double as presentation foils. This was done to minimize staff effort for developing and maintaining materials.

There were two approaches to layering the materials. One was to provide links wherever individual points needed expansion. So, one page might have none or many links. In the second approach, the presentation layer had one link per page, which accessed the corresponding material in a continuous discussion layer, For these materials, participants could read the presentation layer until they encountered material of particular interest, and then switch to the discussion layer; or they could simply read the discussion layer. The modules that received the highest overall ratings included modules using both of these approaches.

In the final evaluation form, we obtained information on how the modules containing presentation and discussion layers were used, and information on participants' reactions to this format. Very few participants used only the presentation layer; the rest of the evaluations were split between using both layers and using just the discussion layer. The mean response to the question "Was this module organization helpful for you in navigating through the materials, or in focusing your study efforts on the sections of particular interest to you?" was 2.01, where 1 = very helpful and 5 = not at all helpful. The mean response improved with increased prior experience (from none to advanced): 2.50, 2.00, 1.72, 1.71.

Given the positive response to the layered module structure, we will continue to require this for new virtual workshop modules. We believe that different topics might be better suited to different approaches to layering, and therefore we do not intend to standardize either of the

formats described above. The improved mean response from higher experience levels suggests that the presentation layer is being used to skim over familiar materials.

Goal: Experiment with the Use of a MOO

A MOO is a text-based, object-oriented, multi-user environment within which any number of people can interact, both with each other and with the environment. Activity is organized into "rooms" in which participants can speak to other occupants. Objects, such as bulletin boards, notes, and recorders, provide additional structure or functionality.

The VWMOO was still in development when the course started, and was not available until the last third of the workshop.

The original rationale for establishing a MOO was to provide a forum for interparticipant communication, and also for concurrent communication between participants and instructors (as either an alternative or supplement to e-mail consulting). A semi-automated training session on the VWMOO, informal office hours covering course materials, and group discussions on the virtual workshop format and distance education were offered.

The VWMOO received very little activity. Only 10 of the 89 respondents to the final evaluation indicated that they had used the VWMOO. Self-motivated interparticipant communication did not occur, and office hours were poorly attended (maximum attendance was five participants). Most successful was the use of the VWMOO for informal, extended consulting. Reasons cited for not using the VWMOO were its late availability, insufficient notification of classes, and the primitive interface.

The VWMOO will be available from the start of the next virtual workshop, notification of classes and office hours will be improved, and we hope to move eventually to a Web interface. Broader issues include how to integrate the VWMOO into the course materials and how to provide more structure to VWMOO activities.

Overall Effectiveness

There were three questions on the final evaluation form that aimed if to quantify the overall effectiveness of the virtual workshop format:

How well do you believe your parallel programming learning goals have been met by participating in this workshop?

Would you say you learned more or less from the virtual workshop than you would expect to learn from a face-to-face workshop?

Would you say you learned more or less from the virtual workshop than you would expect to learn from an introductory textbook with exercises (but outside a class)?

Parallel Programming Goals

On a scale from I to 5, where 1 = completely and 5 = not at all, the mean rating for how well participants' parallel programming goals were met was 2.43. Participants with long-term CTC accounts had the most positive mean response: 2.13, as compared with 2.58 for corporate participants and 2.38 for academic participants. This could relate to the greater progress into the

materials made by the CTC users. Advanced parallel programmers had the most positive mean response: 1.64, as compared with 2.60, 2.37, and 2.83 for the three lower experience levels.

On the final evaluation form, the participants were asked for "additional comments or explanations you have regarding your learning goals and the effectiveness of the workshop in helping you to achieve them."

Both external and internal factors were cited. Broadly categorized, the external factors were insufficient time to commit to the workshop (21 respondents), shifts in job priorities and associated learning goals (3), instability in the home system (2), and slow network response (1).

VW vs. Face-to-Face Workshop

For the comparison with face-to-face workshops, on a scale of 1 to 5 where 1 = learned much more and 5 = learned much less, the mean response for all participants was 3.09. There was no marked variation with group or experience level.

VW vs. Textbook

For the comparison with a textbook, on a scale of I to 5, where 1 learned much more and 5 = learned much less, the mean response for all participants was 2.32. There was no marked variation with group, but the intermediate experience levels returned better ratings (2.15 and 2.11) than either the lowest or highest experience level (2.55 and 2.70).

Summary of Overall Effectiveness

The "goals met" rating of 2.43 indicates that participants did benefit from the virtual workshop, but did not achieve all their goals. It is reassuring to note that external factors were a significant cause, that many participants did express satisfaction as to having their goals met, and that the reaction to the individual modules was very positive.

We would have been (obviously) more pleased if the comparison with face-to-face workshops had been tipped in favor of the virtual workshop, since it aims to provide the same level of support as a live workshop, with the added benefit of no travel.

Since the Web materials were very well received, the key to improving this rating might be to encourage use of all course resources. As discussed earlier, a substantial number of participants did not use the SP, did not submit consulting questions, and did not use the VWMOO.

Another approach would be to add small interactive exercises throughout the modules; this could be anything from quizzes to short labs to Java-based demonstrations.

Conclusions

The winter 1995 virtual workshop succeeded very strongly in achieving three goals: scaling the workshop, adding material, and designing guidelines for the structure of materials. Although one goal, experimenting with the use of a MOO, was not fully implemented for this virtual workshop, our limited experience has provided valuable insight into how this tool can be used. Active participants were generally satisfied with the course, based on the module and final evaluations.

This was CTC's first experience with self-paced, over-the-network training offered to a general

audience. We gained a realistic understanding of participants' commitment levels, and the factors that influence this. We intend to retain the self-paced format, as we believe this meets the needs of the widest possible audience, and is a good match to the over-the network approach in general, and to the use of Web-based materials in particular. We expect that improvements in format and materials can increase audience retention and activity.

We will fine-tune the VW format. In particular, we will change our communication patterns with participants. For the next virtual workshop, we will ask participants to complete a biweekly survey. This will provide us with information needed to schedule activities and resolve problems; it will provide the participants with an opportunity to assess their progress, and will remind them of available services. In addition, we will provide the participants with "tips" at the beginning of the workshop, which will stress the importance of lab exercises, and we will more strongly advertise support activities.

Among the other improvements and additions, we plan to add multiple choice quizzes that will allow participants to assess how well they have learned the material. We will also be experimenting with a Webbased chat facility in addition to the VWMOO.

The virtual workshop is a flexible, accessible, and convenient educational tool for programmers and researchers of all experience levels. Future experimentation with format, presentation, and tools is needed to determine how to best meet individual needs, and how to strike a balance between motivating remote participants and preserving their independence.

A c k n o w l e d g m e n t s

At the time of writing, the group involved in the development of the content and web-based technologies for use in the virtual workshop are Dora Abdullah, Lynn Baird, Kathy Barbieri, Doug Elias, Mike Hammill, Caroline Hecht, Steve Hotovy, Steve Lantz, Roslyn Leibensperger, Susan Martin, Susan Mehringer, Stacy Pendell, Nikki Reynolds, David Schneider, Xianneng Shen, Cat Starkey, and John Zollweg; without their work this paper would not have been possible.

The Smart Node program is one of the outreach programs of CTC that comprises one hundred educational establishments that receive training from CTC and that provide consulting to their own sites.