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# Matching Process Support Technologies to Learning Requirements:VLab -Virtual Laboratories for Distributed Team Software Development

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# Matching Process Support Technologies to Learning Requirements: VLab - Virtual Laboratories for Distributed Team Software Development

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## THE PROBLEM

Organizational work increasingly demands the completion of complex tasks by distributed teams. Traditional college instruction emphasizes measurable, individual learning. In this environment students do not learn the skills needed to perform complex, distributed, team tasks. Current learning approaches must change to meet the needs of the work force of the future. Obstacles to changing traditional learning approaches include:

1. There are few reference models that provide guidance on how to integrate complex team-oriented tasks into the learning process.
2. The physical arrangement of learning is based on scheduled and formal, once-a-week, or twice-a-week interaction among students and instructor. Such an arrangement cannot address the needs of students who must interact on a more frequent, irregular basis, ask the instructor for help when they reach a learning boundary on a complex task, and share project-related information with each other.
3. The usual problems that student teams encounter in finding opportunities to meet are exacerbated for the physically challenged and the growing number of non traditional, urban city students who commute and must work to pay educational expenses.

## APPLYING ANY-TIME, ANY-WHERE PROCESS SUPPORT TECHNOLOGY

In fiscal year 1994, Temple University was awarded an instrumentation and laboratory grant from the National Science Foundation to create virtual laboratories for students working in software development teams. Fixed location, computer-based laboratories limit access and do not support team efforts at off-campus work sites. "Virtual laboratories" will provide any time-any place support for software development teams using leading edge technologies such as groupware running on portable, wireless local area networks interconnected with wide area networks.

The following sections are organized along the dimensions of time and place. While we will support any time/any place software development, our discussion will focus on the more innovative aspects involved in supporting: Same Time/Same Place; and Same Time/Different Place.

## SAME TIME/SAME PLACE

When student project development teams can meet face-to face, effective laboratory support needs to be provided where and when the team can meet. This could be a room on campus, the end-user work site, an accessible public place, or a team-member's home. In addition to the limitations of a central laboratory, an open laboratory of 20 to 25 computers is not conducive to supporting team work. It is difficult to have open discussions without interfering with, and being inhibited by, others in the laboratory.

Each student work team of four will be provided with highly portable LANs. Students will be able to set up their LAN at any time/any place to work in common on their project. They will have full access to the server and client. They will experiment in private and be given the opportunity to fail (and learn) in private without interfering with other students or the normal limitations which must be placed on students who share a common central resource. In some sense, this extends the already accepted practice of loaning individual computers, i.e., here we are providing separate LANs to support individual teams.

## SAME TIME/DIFFERENT PLACE

More frequently, students will be able to meet at the same time, but not be able to meet in the same place. Many of these opportunities will be ad hoc and precipitated by an emerging problem. The difficulty of meeting is exacerbated for the physically challenged - many times they can not easily get themselves dressed and obtain transportation. Some, depending on where they are residing, have limitations of when they can be away from their residence. In addition, when students are at the work site working with their clients, it is impractical for advising faculty to be there physically. We will provide "virtual co-location." The critical elements to achieving this are:

1. Sufficient information channel richness for interactive problem solving among team members [Daft & Lengel, 1986].
2. A common focus, for example, a shared whiteboard on a common computer screen.
3. A common version of the shared work, for example, the same version of the data model at all locations.
4. Students, and/or faculty and clients maintaining an audio channel (phone) while working on common screens and common documents. Desktop video conferencing when appropriate.

## DIFFERENT TIME/DIFFERENT PLACE

This asynchronous communication is limited to work which does not require immediate feedback and limited information channel richness [Daft & Lengel, 1986]. Email has served in this capacity and will be provided to students here as well. Also, bulletin boards and distribution of documents will be supported. Lotus Development Corporation has awarded a grant to provide Lotus Notes to all students and faculty involved in the project.

## INTEGRATING SOFTWARE TECHNOLOGIES FOR SOFTWARE DEVELOPMENT TEAMS

Innovative software development is messy, dynamic, complex, group problem solving over time [Boddie in Abdel Hamid, 1990; Nosek, 1991]. Current CASE tools by themselves are inadequate to support such a process [Nosek et al, 1992]. We are integrating three major group support technologies: A "communication-rich" tool for group problem solving (GroupSystems provided through a grant by Ventana Corporation), a tool to provide distributed communication and collaborative documentation capabilities (Lotus Notes), and CASE technologies which support group work.

## RESEARCH ISSUES

The availability of this any-time any-where process support technology in VLab can overcome some of the above obstacles to learning reform, for example, student-to student and faculty-student interaction is no longer limited by time and space barriers. However, we know very little about applying these technologies to the learning process. In a given course, learning processes are different over time, material covered, instructor style, and student style. There is a need to cost effectively match the requirements of the learning process to the available process support technology. For example, using expensive video interaction to communicate symbolic material such as formulas may be ineffective. A shared whiteboard may be a better solution. Moreover, these new technologies create opportunities for change. For example, rethinking the role of interaction among faculty and students so that learning is timely, meaningful, and equally shared. There is a need to document the potential effects of process support technologies on the learning process.

## PROJECT OBJECTIVES

1. Match process support technologies to the fundamental requirements of learning.
2. Apply process support technology to teach students how to work in distributed teams that solve complex tasks.
3. Provide the underlying knowledge needed to create new learning models that take advantage of new process support technologies.
4. Identify limitations of current process support technologies to enhance learning.
5. Evaluate the cost/benefits of applying process support technology to learning.
6. Develop a model to guide the adoption of process support technology.

Figure 1 presents our research framework. Table 1 presents a sample of important research goals that will be matched to process support technology and evaluated with specific measures.

## RESEARCH-IN-PROGRESS

1. Pilot testing of various architectures is in progress.
2. In cooperation with Bell Atlantic, who is providing
3. some funds and equipment, pilot testing of CDPD (Cellular Digit Packet Data) will be conduced this Spring to test WAN functionality.
4. Software development project classes working on real-world problems have been completing interactivity logs throughout the semester. These data will be used to validate theoretical models (Daft and Lengel, 1986; McCarthy and Monk, 1994) and provide guidance on the employment of the most cost-effective technology.
5. Full-scale testing planned for Fall 1995.

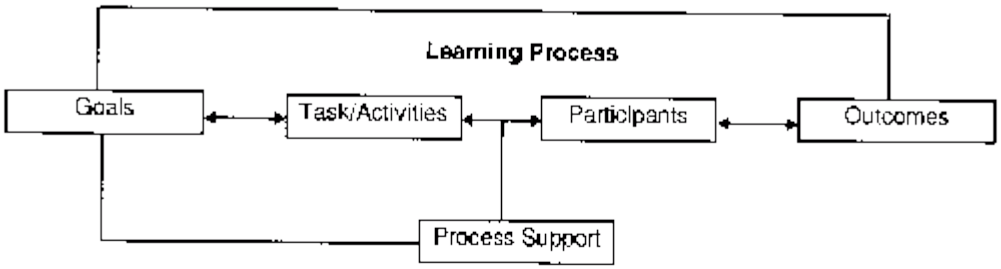


FIGURE 1: RESEARCH FRAMEWORK

| Goal | Process Support | Outcomes |
|---|---|---|
| Increase access to people | Wireless communications; Desktop conferencing (e.g., *Intel Proshare*) | Count contacts |
| Increase access to technology | Wireless communications; notebook computers | Log Usage: Time and Location |
| Increase interactivity | Desktop conferencing, E-Mail, and Bulletin Boards (e.g., *Lotus Notes, SMART 2000*) | Count frequency of interaction on a topic |
| Increase information sharing | Document Sharing, GroupCASE (e.g., *Lotus Notes, System Architect*) | Count volume of information shared |
| Improve task definition | Group Decision Support (e.g., *Vision Quest*) | Test students on how well they feel tasks are defined |
| Shared understanding of task | Group Cognitive Mapping (e.g., *COPE*) | Test students on task understanding |

TABLE 1: SAMPLE RESEARCH GOALS

## SUMMARY AND FUTURE DIRECTIONS

Organizational work increasingly demands the completion of complex tasks by distributed teams. Traditional college instruction does not develop the skills that the work force of the future will need. VLab is one effort to match the learning requirements of the non-traditional student engaged in distributed software development with process support

technology. What we learn in VLab should improve our understanding of how to better match process support technology with learning requirements and provide guidance for these kinds of problems within and outside academia.

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