Use of Video Microscopy to Promote Collaborative Learning in Developmental Anatomy and Histology

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Introduction

For many years, laboratories at NCSU which utilize embryological or histological materials were taught in "traditional" fashion, requiring students to examine microscopic slides, make drawings of embryonic sections, and take notes on tissue structure. Although learning did take place in this learning environment, the students often found the material boring and the microscopic work tedious. Students worked alone, and student–instructor interactions were awkward and time consuming. As class size increased and scheduling became more difficult, laboratory time was decreased from two 3-hour sessions to two 2-hour sessions per week. It seemed that a new approach was needed to stimulate student interest, promote collaborative learning, and cover material in a shorter time period. Video microscopy with networked computers offered a potential solution to our problems, but needed to be compatible with the anatomy "wet labs" which used the same room. After a year of planning, we were able to renovate the laboratory to accommodate both computer-based and anatomy dissection activities.

Equipment

Our new laboratory provides two computer workstations per table with room for four students to work together in pairs. An initial design goal was to maintain a clear work surface. To this end, the tables were designed to house computers and keyboards beneath the table surface. Instead of monitors, we chose flat panel LCD displays that are mounted on arms attached to the table. The arms can swivel and extend to the center of the table, allowing students to position them in the most convenient location (Figure 1). Since the only computer equipment touching the tabletop is the base of the arms, the entire work surface is available for lab-specific equipment, student books and/or anatomy specimens. When "wet labs" are in progress, the two flat panel displays on each table are turned to face one another and the keyboard shelves are pushed in (Figure 2). Thus all computer equipment is protected from splashing liquids or physical injury (such as hitting the display screen with a dissecting pan). Power PC G3 and G4 computers and 15-inch flat panels were purchased from Apple Computer. The arms were customized for our flat panel displays by Innovative Office Products, Inc. (Easton, PA).

For microscopy exercises, each workstation contains a compound microscope equipped with a video camera (Figure 3). Nikon Eclipse E400 trinoc microscopes and Cohu single CCD, color cameras were purchased from Southern Micro Instruments (Marietta, Georgia). The cameras, used with Apple Video Player software, allow "live viewing" of microscopic images. Outfitting of the laboratory was completed by an instructor's computer on a cart (Figure 4) that may be attached to a Nikon stereomicroscope with video camera. All ten of our workstation computers plus the instructor's computer are tied into a local area network using AppleTalk over Ethernet. Outlet boxes are located beneath each workstation and the cables run through conduits under the floor. The instructor's computer has an additional connection to access the Internet. File sharing and other networked activities are enabled by Timbuktu software from Netopia (see www.netopia.com/software).

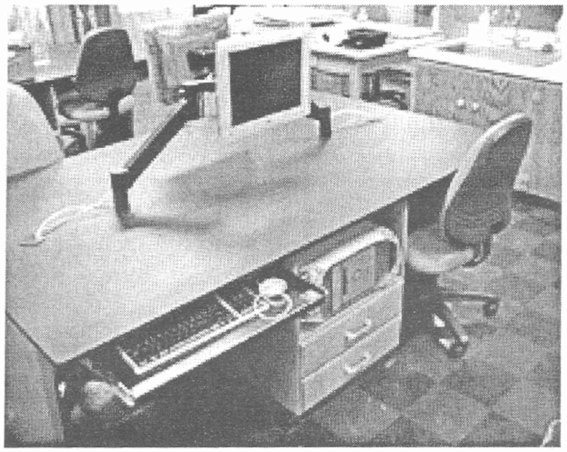

Figure 1

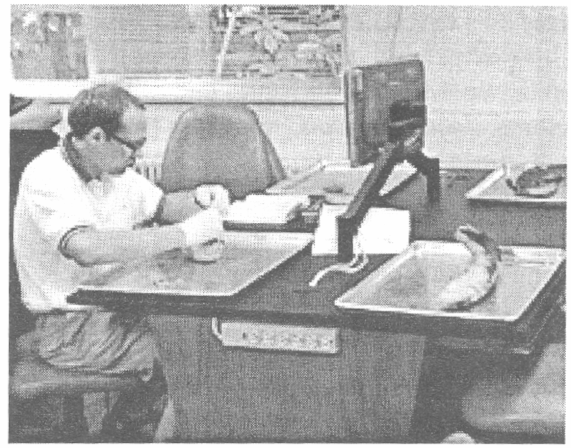

Figure 2

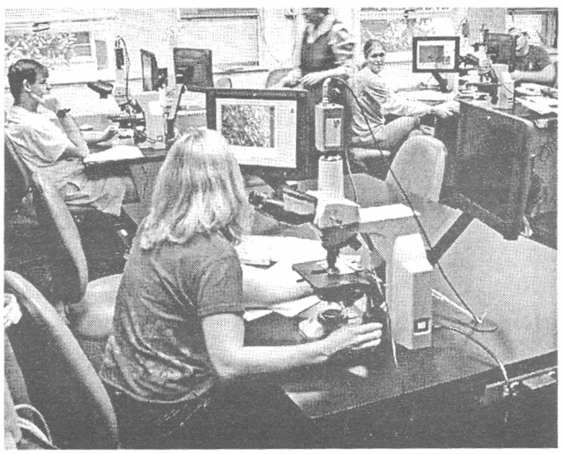

Figure 3

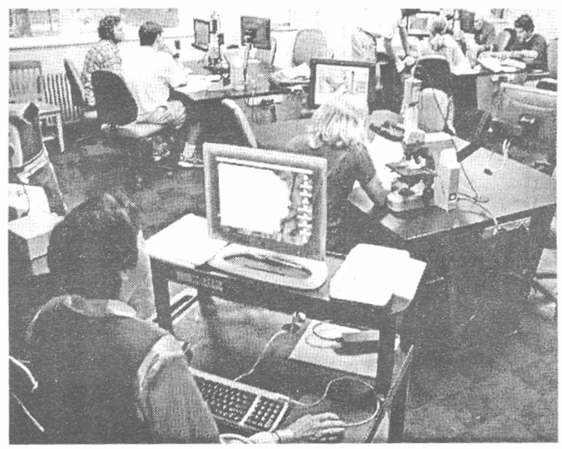

Figure 4

Results and Discussion

Student response to the new equipment has ranged from mildly complimentary to wildly enthusiastic. The students now work in pairs to locate and discuss structures on their slides. Since several people may view the displays together, students interact to a much greater degree than was previously possible (Figure 5). Student-instructor interaction has also increased; it is much easier for the instructor to point on the screen than to use a pointer in the microscope eyepiece when explaining a microscopic structure (Figure 6). Instead of drawing what they see on a slide, students now capture and save them on Zip disks (Iomega). Most of the students prefer looking at the display screen instead of into the microscope; complaints of headaches and eye problems are a thing of the past. The students are uniformly relieved that they are not required to draw, and the time previously spent drawing is now utilized in discussing (and learning) the material. Additionally, our new equipment provides the opportunity to make short video clips. Students use their workstations to capture and save clips of live fish and chick embryos with beating hearts and circulating blood. The ability to make videos of their embryos excites the students and enhances their critical observation of the specimens.

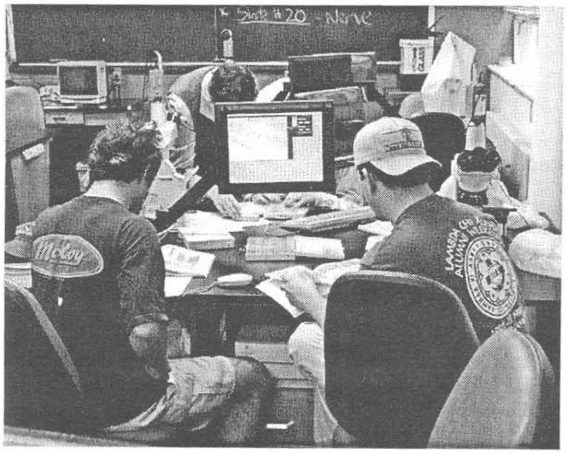

Figure 5

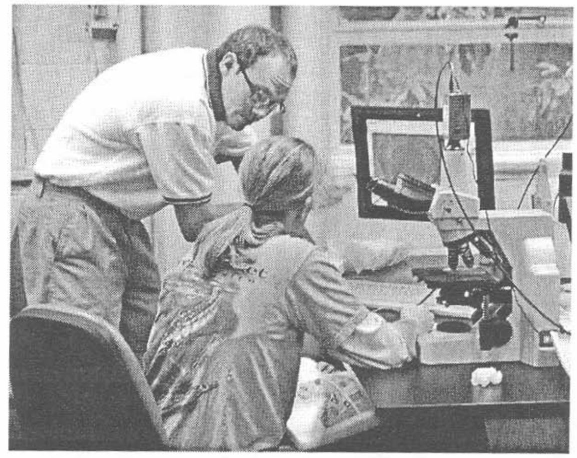

Figure 6

Following instructions on their lab handouts, students label their images using Adobe Photoshop. Depending on the length of the exercise, the labeling is done either during the laboratory period or outside of class in one of the College computer labs. Since the images are on Zip disks, they may be used outside of class for "homework" assignments or for review of the material. A brief lecture on using Photoshop is given early in the semester, and students have little or no problem in learning the basics of this program. In fact, some students already own PhotoShop and do their labeling at home. The instructors in the course check the labeled images periodically and assign a grade of satisfactory/unsatisfactory. They also use PhotoShop to correct mistakes and/or write notes on the images. For examples of student work and grading with PhotoShop, see our web site: www2.ncsu.edu/unity/lookers/project/bbprojects/able.

Networking of our computers provides additional opportunities for student interaction and collaborative learning. During laboratory exercises, students may view each other's screens and/or send images to one another via Timbuktu. Thus if one student finds an interesting structure, his screen may be viewed by all students on their own computers. If only one student in the class locates a rare structure, he may send his images to the entire class to be saved on their disks. Alternately, the instructor may use Timbuktu to give an introductory lecture with all students viewing the instructor's screen on their display, or may send students unusual images to label or discuss. This arrangement alleviates the need for a projector in the room and provides each student a close-up, unimpeded view of the presentation. The network is also utilized for student presentations. When studying histology, student pairs are each assigned a specific organ or part of an organ system to present in a subsequent class period. Each student team is responsible for capturing images at several magnifications, labeling important features, and relating organ structure to function. During presentations, students use their own computer which is viewed by the class via Timbuktu. This format allows students to remain seated at their workstations and use the mouse to point to structures during their talk. The atmosphere is informal and leads to questions and discussion by the other students and instructors. Any mistakes (such as mislabeled structures) can be corrected with PhotoShop during the presentation. At the end of the presentations, each student team sends their images to the other class members so that all students have copies of the complete organ system on their disks. Presentations may also include images obtained via the Internet. Several interesting presentations on histopathology from Internet resources have been given by students receiving honor's credit for the laboratory course. Video excerpts from student presentations may be viewed at our web site.

Although we are quite pleased with our laboratory design, the room renovation and networking was expensive. The advent of wireless technology now provides a better way of achieving the same goals. As an example, the general biology laboratories at NCSU have just completed installation of Airport wireless base stations and G4 computers with wireless Ethernet cards (Apple Computer). This set up allows the same activities using Timbuktu as described above, but without the expensive under-the-floor cabling that tethers computers to a specific location. Additionally, we anticipate that video cameras with a digital interface will soon be a better option than the analog interface that we currently use. A digital interface avoids conversions between digital and analog, thus producing a higher quality image. The "firewire" interface (IEEE1394) has become a common digital interface, and we are evaluating firewire cameras such as the Sony V300 and V500 for future use.

Acknowledgements

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