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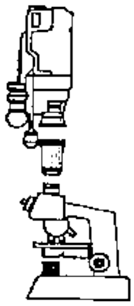

Videomicroscopy in the classroom

Gary Richardson
Toorak College, Mt. Eliza

Videomicroscopy is a technique which is becoming increasingly available to education. This article describes the various media used in conjunction with the microscope in practical classes and discusses the potential of videomicroscopy as an alternative in the light of the limitations of the present technologies.

The microscope has become firmly linked with biology and the sciences so much so that it is even used as a symbol for the subject by several firms. Every minimally equipped biology laboratory has a set of student microscopes. The use and care of this equipment form an integral component of most secondary biology syllabi, however several problems may be associated with the teaching of and skills associated with the use of this mechanism.

Large class numbers makes one-to-one interaction difficult. Misuse of the microscope, theft and loose components or disciplinary problems can often play havoc with what should be a rewarding experience for both student and teacher. Instructions often need to be given repeatedly before students can fully comprehend and put them into practice.

It might be suggested that as the teacher circulates among students, praise, correction, and adjustment can be made where necessary. Attention can be drawn to exemplary finds, but a student may become disillusioned as the rest of the class congregates around the microscope waiting for their turn. Subjects such as stained chromosomes lend themselves to this methodology, but the observation of living, moving, fleeting specimens is more difficult to accomplish with this form of instructional practice. Similarly, to the student intent on exploring the world of paramecium the discovery that one has spent a lesson studying euglena instead, can be very discouraging and somewhat devastating to the aspiring biologist.

Increasingly technology is being employed in order to overcome presentation problems in practical classes involving microscopy.

Projection and Biology

Projection microscopes contribute to active participation. Two types of projectors are in use today. The simple, older and more effective model projects the image on to a screen or wall in a darkened room. The device can be as simple as a screw on slide holder which is attached to a 35 mm slide projector lens. The primary disadvantage of this system is that even the more elaborate models of this mechanism require a totally darkened environment to ensure an intense image. Having the room in total darkness has its drawbacks. I remember too well the days of the 'Fish Tail Prac.' groping in the dark after a slippery goldfish that had just flipped off the microscope stage on to the carpet. The fish was not at all impressed by our earnest attempts to study its capillaries. As a teaching device this type of projection microscope has several other limitations too. The operation is significantly different from the students' microscope and cognitive transfer of the teacher's manipulation of the projecting microscope to the students is difficult.

The second type of projection microscope is more expensive, but less valuable for group presentation. A screen of translucent glass is attached to the eyepiece of the microscope and is illuminated from behind. The room can be lit, but the narrow angle of effective viewing and small size of the screen restrict the use to an effective audience of about eight.

Photomicroscopy

Photomicroscopy with film or videotape opens up a whole new perspective. The use of film falls into three categories: movie film, 35 mm transparencies and prints. Movie film is expensive but has the advantage over video of higher resolution and truer hues. Yet difficulty in production make this medium unsatisfactory for general secondary school use.

The development of the cheap but high quality SLR camera and films of faster speeds have made production of 35 mm transparencies and subsequent prints a reality within the grasp of most teachers. The thrust of most photomicroscopy classes and publications has been in the field of making photomicrographs. John (1983) suggests that teachers can build up their own collections of transparencies without the more tedious effort of preserving a microscope slide. Numerous books are available on this technique. Izzi and Mezzatesta (1981) elaborate on this idea, with students also photographing microscope slides and labelling the results in contrast to the tedious method of drawing and labelling the micro-organisms in practical classes. Research such as the study of Mikula and Lennox (1979) indicates that this method can result in better recall on tests. Similarly, the motivational advantages of student input with this medium has also been documented (eg Ali, 1984).

Transparencies are easily stored and projected to a large number of people on a large screen. Colours are true and resolution good. Prints can be displayed without the use of projection equipment. Yet few teachers seem to use this method. Certainly there is a cost factor. In addition, a time factor allowing for processing causes some uncertainty, in that results are unknown until after development. Reference to meticulous notes on technical variables (eg camera shutter speed, camera aperture, film speed, microscope light temperature, iris diaphragm setting, position of condenser, etc) is often necessary prior to expensive reshooting (John, 1983). Finally this medium lacks the capacity for motion.

Videomicroscopy

Videomicroscopy, to coin a word, may provide a viable alternative. The present situation with television monitors, videotape recorders and often good quality colour cameras indicates that the time is ripe for wide implementation of this medium. It allows immediate display for effective teaching as well as being an archival resource.

Videotapes have had wide use in school science classes for some time. They are gradually replacing films and transparencies due to their ease of playback, low cost, ease of copying, flexibility and adaptability. But their use has largely been in a passive capacity. As the ease of production becomes more apparent, it may be predicted that students will take a more active role in the production of classroom materials. Carter (1978) warns however, against misuse of the facility. Such comments as 'how wonderful, a teacher could record a program once and never bother again', negates the role of student interaction and participation.

While this medium should not replace first hand experience, this does not mean that one should not archive classroom activities. Rare specimens, hard to preserve specimens and active moving specimens are ideal library subjects. The authority of television as a communication medium ranks highly with today's youth.

Videomicroscopy has already been contrasted with filming or photomicroscopy. The disadvantages are few but include the lack of resolution in production, the problem of hue control (especially critical in histology), the limited size of effective television monitors, and the lack of ultra-low light sensitivity available in filming by regulation of shutter speed and film speed. The cost of equipment is within the range of many schools as most schools already have the hardware and, in fact, running costs are very cheap in comparison to film. The advantages of videomicroscopy are numerous, perhaps the most important being the elimination of the 'uncertainty factor' or time lag for processing time. Simultaneous observation on the TV monitor during adjustment of controls allows for immediate feedback, with both positive and negative reinforcement, so that good results can be attained even by a novice.

Implementing videomicroscopy

The state of this art seems to be settling into a stage where overnight obsolescence and rapidly deflating prices are a thing of the past. Most schools need to purchase very little, particularly if the school already has a colour camera, monitor, VTR and tapes (optional for recording only) and a suitable microscope. Mounting the camera onto the microscope is the chief variable, and may require the purchasing of special adaptors or mounts. These adaptors can often be purchased from the camera supplier or microscope supplier (Scott, 1984). A camera mount such as the rack and pinion copy stand may be all that is required, providing it can be made light tight (Halse, 1984). The lens of the camera is removed so that the new set-up has the microscope acting as the camera lens (Gipps, 1984) or, from another perspective, the camera acting as the microscope's ocular. The microscope should be one which focuses by a moving stage rather than a moving body tube, and the weight of the camera should be considered, ie either supported by a strong enough microscope frame or by a camera support.

Deciding between a three tube and a one tube camera is an easy decision for a secondary teacher. The three tube costs around $5000 (without a lens), requires more light for operation, is more prone to damage from excessive light, but has somewhat better resolution and shows a broader spectrum of hues truthfully. In contrast, the single tube camera costs about $800 (with a lens) and many have a useful feature of positive/negative reversal. This adequate camera is most often found in secondary schools.

The microscope is probably the limiting factor in the quality of production. While the students' microscope can be adapted, a professional grade demonstration microscope for between $2000 to $3000 makes the effort more worthwhile. A students' microscope can be adapted to take a camera, without cost if stands and an adaptor are available, or a kit can be obtained for about $400. A good demonstration microscope, however, is a general asset to a biology laboratory. It is easier to use, probably has better resolution, higher magnification, a better light source, planar objectives for flatter field of view, a mechanical stage and may be adapted for polarised light and phase microscopy. One, such as the Olympus binocular series has binocular eyepiece and a phototube which adapts to a variety of cameras. The purchase of a suitable microscope can be a popular project for school fundraisers. It is a tangible piece of prestigious equipment which won't become obsolete or cheaper in the foreseeable future. The cost is similar to that of other science equipment and it is not unreasonable when compared to other items in the school budget.

Video is also useful to science beyond videomicroscopy in biology. A microscope fitted with polarising filters becomes essentially a 'petrographic microscope' which is being used more and more in the study of geology. The standard camera lens and Portapak are useful in ecology studies, geology field studies, geology field trips, and even in the recording of dangerous but spectacular chemical reactions. Buddhadev Baldwin and Spears (1983) in a study undertaken at Louisiana State University have even described techniques for setting up a more professional studio for recording of experiments.

In conclusion, the main value of this new technology is not to fascinate students. They accommodate, accept and even expect new technology The main value of the technology is to the experienced teacher always looking for ways of developing new, dynamic and stimulating teaching methods. It is with the teacher's enthusiasm that the technology becomes a real source of student response and learning.

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