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**New Technologies
and
Innovations
in
Agricultural Economics
Instruction**

edited by

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The Chalkboard and Alternative Teaching Media: Advantages and Disadvantages

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A mere two decades ago, there were no "alternative teaching media" in college classrooms. Most of us who are professors of economics and agricultural economics in today's college classrooms have as our models professors who used two fundamental teaching methods: exposition (lecturing) and exhibition (figures and math). Of course, professors used textbooks and outside readings to supplement classroom instruction, and there were the occasional handouts, with homeworks and exams providing for additional learning opportunities. However, classroom presentation techniques were pretty much limited to the lectern and the chalkboard.

Classroom techniques have changed dramatically in the years since most of us received our undergraduate and graduate training. The use of overhead transparencies in the classroom has gained wide acceptance in the past decade. Slides projectors are utilized by many instructors and are very popular in some disciplines, particularly so in biology, geography, and a number of the other physical sciences. Although in times past the occasional 8- or 16-MM film was shown in class, high quality video cassettes covering a multitude of topics are now readily available. Instructional computer labs have sprung up on most campuses, with students receiving hands-on instruction on data manipulation and analysis using a variety of statistical and mathematical software packages. Finally, as noted in the two previous

presentations, computers have entered our classrooms in force, bringing with them high-powered 3-D graphic enhancements of economic theory, instant data retrieval with graphs and charts portrayals, and networking capabilities allowing for up-to-the-minute market quotes and television and satellite program reception.

While it is true that many of those formerly "new" classroom techniques are now time-tested and have gained wide usage by professors and acceptance by students, it is also true that most of these methods are not without their detractors. The intent of this presentation is to provide an overview of alternative teaching media, hopefully doing justice to each in presenting advantages and disadvantages. I begin with general observations concerning what I call "non-board media" (overhead transparencies, slide projectors, computer images, and computer laboratory techniques). I then provide a listing of specific advantages and disadvantages for each type of teaching technology, followed by a similar list for chalkboard presentations. Because I feel that the chalkboard remains an excellent teaching device and also because I feel that we cannot wholly eliminate the chalkboard in university classrooms, I conclude with a list of methods for improving chalkboard instruction, and argue that the best interface possible is an interaction between chalkboard instruction and rear-projection computer enhanced images.

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Nonboard Media: General Advantages and Disadvantages

I classify non-board media into two categories, "projection media" and "nonprojection media." Projection media are those techniques which make use of a stream-of-light projection from one point in a classroom to a screen in the front of the classroom. These methods include overhead transparencies, slide projectors and computer projected images. Non-projection media include a number of computer laboratory techniques, but also include films and videos and computer and non-computer programmed instruction. There are some common elements associated with projection media, allowing for some generalizations with respect to advantages and disadvantages of methods within this category. Following a discussion of issues related to projection media in general, I elaborate on particular advantages and disadvantages of each type of technology in this category. Nonprojection media are more diverse, and are each covered separately.

Advantages Associated with Projection Media (General Items)

Throughout this presentation, I will follow the practice of first providing a list of advantages or disadvantages, and will follow that list with a discussion of each of the items in the list. The following seven items constitute my list of general advantages associated with overhead transparencies, slide projectors, and computer projected images:

1. Clarity, contrast, color
2. Accuracy
3. 3-D portrayals
4. Tables, charts, figures
5. Cleanliness
6. Instructor faces the audience
7. May allow for much larger class sizes

The first four items in this list are concerned with the content of projected images; the last three have more to do with the physical surroundings. There is no question but that projection media provide a better visual picture than a chalkboard presentation. The color on

projection images is more vivid, the contrasts are more pronounced, and the overall clarity is enhanced. Because these images are prepared in advance, accuracy is assured and hand-drawn or computer-generated three-dimensional images are possible. Large tables of numbers, pie and bar charts, and complicated graphs and figures can all be prepared in advance or copied from printed sources for use in the classroom.

The last three items constitute distinct advantages over chalkboard instruction. Cleanliness may be a small item, but there is no professor alive who is without scorn for chalk dust. New board technologies, such as dry erase boards help to diminish this problem. Facing the class is a big plus for projection media. The chalkboard instructor is constantly turning away from and back to the class. Students grow accustomed to this shortfall, but facing your audience is clearly preferable. Finally, larger class sizes are possible with projection media. Back-row students in large classes are hindered from seeing or reading chalkboard presentations. But multi-screen placements for slide projectors and big, bold print on overheads and computer images allow for good visuals for a larger number of students.

Disadvantages Associated with Projection Media (General Items)

Projection media are not without their disadvantages. The following eleven items constitute my (longer) list of general disadvantages associated with projection media:

1. Increased preparation time
2. Tendency to stay with old material
3. Pre-prepared materials only
4. One-panel
5. Darkened room
6. Equipment noise
7. Power/equipment failure
8. Students as "stenographers"
9. Less opportunity for absorption of material
10. Various levels of instructor-material detachment
11. Various levels of instructor-student detachment

The list of shortcomings above highlights one very strong aspect of projection technologies: one cannot easily fault the content of the images. The greater problems are contextual issues -- instructor preparation, classroom/equipment limitations, and learning styles. Whenever material is mechanically projected, increased preparation time is a necessary cost. Although the accuracy and visual attractiveness of preprepared materials offset this cost to some extent, it remains a cost nonetheless. Closely associated with costly preparation time is a tendency to stay with old material (such as last year's data or the previous edition's pie chart) so as to diminish that preparation time. A further related problem is the limitation to preprepared materials only. Presentations involving overheads, slides, and computer-driven images have a natural flow (and in most cases a limited physical setting) that can not easily accommodate spur-of-the-moment material. Flipping on the lights to use the chalkboard (for example, in response to a student's question) can seriously interrupt that flow.

The physical context of overhead projection is also limiting. In general, projected images are limited to one panel of material in a darkened room, with equipment noise and the potential for power outages or equipment failure always a problem. While the darkened room sometimes contributes to students nodding off (especially right after lunch) and the cooling fans make hearing difficult for students sitting near the projection equipment, these are shortcomings that can be tolerated. However, power or equipment failures can throw the entire lecture either out of whack or out the window. And even this insurmountable problem is only an occasional occurrence. The one-panel problem is the most serious shortcoming related to the physical space for projection media. This is particularly problematic for students in those disciplines where learning requires an assimilation of materials from a number of different sources (and economics is certainly one of these!). When concepts are interrelated or intertwined and require separate explanatory spaces, the limitation to one presentation screen is severe.

Although instructor preparation time and problems in the physical setting are distinct disadvantages associated with projection media, the greatest problem may be in learning styles, and in the extent to which learning actually takes place. The last four items in the list above are related to this issue. With projected material there is often a tendency for students to become "stenographers," to write into their notepads the printed information on the screen without really comprehending the content of the lecture. For many students, this becomes their sole venture, figuring that they will remember what else was said if they have the "bullet item" to remind them. Unfortunately, in choosing writing over listening students tend to miss additional instructor comments, and transcribed notes become nothing more than a collection of words or ideas. To circumvent this outcome many instructors distribute handouts of overheads (or prepare structured notes), or make their overheads available as "bound-notes" textbooks available at a local printing/copying shop. However, it seems to be true in many disciplines, and again particularly so in economics, that writing and drawing are important! In many cases, a student will not remember what he/she has not written down, and cannot reproduce a graph which he/she has not drawn in class and practiced at home. An associated problem is less opportunity for absorption of material. Instructors who use projected materials tend to follow a certain flow of lecture material as portrayed or highlighted by the projected images. That flow often may not offer ample opportunity for student digestion of material.

The greatest problem I see with projected materials in the context of student learning is detachment, both instructor-material detachment and instructor-student detachment. Detachment arises from the split concentration which necessarily results when the instructor and the material being presented are physically in separate locations in the classroom. Many instructors try to narrow that detachment gap by standing near the projection screen and using a pointer to highlight the item on the screen which they are discussing. Even in this case, however, there still remains the problem of moving back to the projection machine (overhead/slide projector or computer keyboard) to generate a new screen

of material (although the use of remote control slide advancement eliminates this problem when using slide projectors). Instructor-student detachment is generated by instructor-material detachment. With the split concentration in force, too much focus on the material leaves the student somewhat removed from the instructor. For many students, the key to learning is their relationship with the instructor. If this relationship is strained, learning is lessened. I will return to this detachment issue at numerous points later in this presentation as I discuss specific advantages and disadvantages associated with the various alternative teaching media.

- b. Disadvantages
 - 1. Glare -- too bright!
 - 2. Instructor shadow blocks material on screen
 - 3. Image size and positioning (image off screen)
 - 4. Distorted screen (pear-shaped image)
 - 5. Entire screen not in focus
 - 6. Problems with small print or crowded text
 - 7. Difficulty in "pacing" presentation to student writing speed

Nonboard Media:

Additional Items Specific to Each Technology

Having discussed general advantages and disadvantages of projection media, the focus now switches to specific issues related to each of the alternative technologies. I first discuss further items associated with projection media, then move on to discuss advantages and disadvantages associated with films and videos, programmed instruction, and computer classroom and laboratory techniques. In this section, the advantages and disadvantages will be presented together and will not be grouped as separate sub-headings.

Overhead Projection

There are a number of items specific to overhead projectors that are less relevant to slide projectors and computer projection, or are applicable only in varying degrees. My list of these additional advantages and disadvantages associated with overhead projection includes the following items:

- a. Advantages
 - 1. Widespread usage and availability
 - 2. Portability (relative)
 - 3. Ability to edit "on-screen" and in color
 - 4. Easy to incorporate new material

Overhead projectors have become commonplace in many classrooms. Added to this already widespread usage is the availability of "compact" overhead projectors which can collapse to briefcase size for easy transportability. Since any white or light-colored wall can double as a screen, overhead projectors have a much higher degree of portability than most other media. The use of erasable color markers also makes for easy highlighting or editing of pre-prepared materials. With this capability, instructor-material detachment is somewhat lessened. And finally, although I argued above that, in general, there is a tendency not to incorporate new material when using projection media, it is also true that new material can be incorporated relatively easily with overhead projectors.

Most of the additional negative items associated with overhead projectors have to do with physical aspects of overhead projection. From the instructor perspective, the glare of the machine (whether the instructor is positioned at the machine or at the projection screen) and keeping the on-screen material free of the instructor's shadow are the most problematic. Getting all the material from an 8 1/2" X 11" sheet of paper onto the screen is difficult when the sheet is full or when the material is "landscaped" (sideways) on the sheet. Even when the material is properly displayed on the screen, the projection angle typically results in a pear-shaped image on the screen, and it is difficult to get the entire screen in focus, especially with older machines. Crowded text or small print often generate additional problems of legibility for students. And finally, there is the

common difficulty with preprepared material of "pacing" a presentation to the average student's writing speed.

Slide Projectors

Although slide projectors enjoy widespread popularity and usage in public presentations and scientific lectures, their usage in the classroom is less prominent. Specific advantages and disadvantages of slide projectors include:

- a. Advantages
 1. Off-campus examples
 2. Sharp, clear images
 3. Multi-screen capabilities
- b. Disadvantages
 1. Less widespread
 2. Darkest classroom setting
 3. Mesmerization
 4. Enormous preparation time and cost
 5. Camera/Photo processing -- lead time!
 6. Storing and transportation
 7. Proper order and positioning
 8. Difficulty in incorporating new materials
 9. Consistency over an entire course
 10. Lack of prompting or cues to instructor

As noted earlier, slide projectors have enjoyed phenomenal success in certain disciplines, especially in those disciplines where clear portrayals of "real-world" elements are essential. In economics these off-campus examples may include business settings and practices or actual market operations (such as action in a trading center). Slides project very clearly and thereby allow students to get a fairly good perspective on outside events and locations. That said, however, current video technology which allows for high-quality personally or professionally prepared productions could easily displace slides in the future. Finally, the multiscreen capabilities associated with certain projection machines is a major step forward from the one-panel limitation of most projection media.

The list of disadvantages associated with slide projectors is long, and has led many instructors to abandon or to never experiment with slides. Although it is difficult to quarrel with the crispness and clarity of the projected slide image, slides clearly enjoy less widespread usage than overhead projectors. The remainder of the disadvantages may explain this outcome. Slides typically require the darkest classroom setting and may account for more students sleeping or (at the least) being mesmerized by the material. My colleague, Paul Wilson (University of Arizona) maintains that "economics is not a spectator sport." Students need to be actively involved in learning economics, and a slick slide show might possibly enhance interest while retarding learning. A number of other physical characteristics inhibit the popularity of slides. Extensive use of slide projection requires enormous preparation time, high camera purchase and photo processing costs, and a good deal of instructor lead time. In addition, storing and transporting slides is cumbersome, obtaining or retaining the proper slide order and positioning is difficult, and incorporating new materials means replacing one or more slides or adjusting each slide in the carousel. It is also difficult with slide presentations for an instructor to maintain consistency over an entire course. On a lighter note, the lack of prompting or cues often results in an awkward moment when a forgotten slide make a "surprise" appearance.

Computer Projection

Computer projection is among the newest and most promising technologies to hit college classrooms in recent years. Computer-enhanced images make use of computer hardware and a variety of data manipulation and graphics software packages to generate two- and three-dimensional images which are projected onto a screen through a high resolution video projector. Although the potential advantages I list are relatively few in number, these benefits are sufficiently powerful as to warrant further consideration by any instructor in a college classroom setting:

- a. Advantages
 - 1. Accuracy, color, etc.
 - 2. Current examples: today's data plotted...
 - 3. Simulates speed and pattern of Instructor drawing
 - 4. Permits sequential development of diagrams
 - 5. May be very effective for the "video generation"

- b. Disadvantages
 - 1. Start-up and ongoing costs
 - 2. Difficulty of incorporating new material
 - 3. Additional power/equipment failure
 - 4. High level of instructor-material detachment

Although accuracy and other enhancement traits are advantages associated with many preprepared materials, the options available with today's software packages are unmatched. With computer graphics in economics courses, curves can be drawn which perfectly reflect the appropriate properties, elaborate functions can be solved and graphed, intersections and tangencies can be accurately placed, and current data can be plotted and analyzed on the spot. In the previous paper Debertin reports that computer graphics in his course simulates the speed and pattern of the instructor drawing graphs at the chalkboard, and permits the sequential development of diagrams, again mimicking the classroom presentation. In a class all its own, computer projection may be very effective for the "video generation."

The most obvious disadvantage associated with computer projection is the cost involved. These costs include actual budget expenditures on hardware and software acquisition, the opportunity costs of time for the instructor in learning the system, and ongoing costs in preparing or modifying each lecture. Incorporating new material is in many ways not as difficult as with slides, but it still involves drawing new sets of graphs and rewriting the

master program. Unless one is extremely well versed in the computer system and its software, power or equipment failure has yet another degree of uncertainty. Finally, there can be a high level of instructor-material detachment, since the fascination associated with the computer-generated displays (especially the 3-D graphics) can overwhelm the instructor's contribution.

Films and Videos

Although 8- and 16-MM films have been available for classroom viewing for decades, recent advances in videocassette technology and availability have taken this technology many steps forward. Films and videos are grouped together because they share many of the same characteristics. However, films are projection media of an "old technology" sort, and the general problems associated with other production media also apply to films. Videocassettes are the new technology, and are preferred to films in almost every sense except in the size of the projected image. The following list of advantages and disadvantages thus applies more to videos than to films:

- a. Advantages
 - 1. Off-campus materials
 - 2. Improvement over still images
 - 3. Diminished preparation time
 - 4. Course content in Instructor's absence
 - 5. Student interest

- b. Disadvantages
 - 1. Limitation to available materials or on-site productions
 - 2. Linkage of video material to classroom concepts
 - 3. Limited screen size
 - 4. Equipment mobility
 - 5. Complete instructor-material detachment

As noted earlier, videos can be contrasted with slides. Both of these media serve to bring outside materials into the classroom, but videos are a dramatic improvement over slides, both in the advantage of moving film over still images and in

the availability of an audio track for narration. When videos are brought in from professional sources (public or private sector), there is a dramatic decrease in instructor preparation time -- in fact, class can be conducted in the instructor's absence! In addition, professional videos are typically attractively prepared and are able to enhance student interest in the content being presented.

The limitation to available materials or the need to generate personally-prepared or on-site productions is perhaps the biggest drawback to the use of videos. The available materials may be somewhat costly, are frequently not available at the requested times, and often do not portray a clear linkage to the material the instructor wishes to have presented. The classroom screen size is small, typically limited to the size of a television monitor. Having video equipment in every room can be costly, but moving equipment around between classrooms presents its own problems of scheduling and invites the potential for equipment damage in transit. Finally, there is a complete detachment between the instructor and the material being presented. A well-prepared instructor can close that gap both during and after the video showing through the use of comments and questions, but the gap remains.

Programmed Instruction

There are at least two types of programmed instruction. The old technology is the "correspondence course" self-learning textbook with blanks in the text and answers in the outside margins of the book. The student was encouraged to cover the answers and try to fill in the blank as he/she read along. The new technology involves either instructional or interactive computer learning. Many computer software packages make use of instructional packages, typically known as tutorial programs, that are used to familiarize a novice user with the new software. Except for being on the computer screen, these instructional packages are not very different from books. Interactive packages allow for student involvement in the form of responses or input values, with the program then following a preprogrammed algorithm based on the

accuracy of the response or the values of the inputs. Buying and selling exercises in profit-maximizing simulations constitute a common economics version of interactive programmed instruction. It is this latter type of instruction that I have in mind as I discuss programmed instruction. The advantages, unfortunately, are few relative to the disadvantages:

a. Advantages

1. No limitation to day-and-time presentation
2. Student works at own speed
3. Students can work together
4. Can serve well as homeworks.

b. Disadvantages

1. Students can work together
2. The program becomes a game
3. Student is tied to the keyboard/mouse
4. Sporadic, often tedious pace
5. Little opportunity for dynamic learning
6. High level of instructor-student detachment
7. Total instructor-material detachment

The biggest advantage of computer programmed instruction is the flexibility afforded the student. Not only is a student able to work at his/her own pace, but classroom absence is not as serious as when a normal lecture is missed. These advantages thus work well in assigning programmed instruction as homework. Unfortunately, one of the benefits of programmed instruction is also a detriment -- working in groups can be beneficial to learning for many students, but can also allow a weaker student to be carried along in a class with very little learning taking place. Another context where little learning takes place is when the program becomes a game instead of a learning tool. Beating the highest posted score becomes the objective instead of understanding the concepts behind the assignment. Further problems include the student being tied to the computer for the exercise, and the pace of the program which suits some of the students some

of the time, but never is ideal for all of the students all of the time. Because there is a high level of instructor-student detachment and complete instructor-material detachment, there is very little opportunity for dynamic learning, unless a student is ambitious enough to write down questions for later discussion. All in all, as noted earlier, computer programmed instruction seems to serve better as homework than as a substitute for other classroom activities.

Computer Laboratories and Classrooms

Thanks to investments in education by Apple, IBM and other corporate endowments, many colleges and universities today have well-equipped computer classroom facilities. These computer labs (as they have come to be known) serve as a resource for word processing for student term papers, for data manipulation and analysis for class assignments and projects, and for in-depth student research. They also have been used by many an enterprising instructor as an alternative classroom setting. Although a group of stand-alone computers can serve adequately as a computer classroom laboratory, the best-equipped computer labs have computer terminals that are "networked" at various levels. At the most fundamental level, computer networking allows for students at each computer terminal to access programs, information or data from a central source -- sort of a "hub-and-spokes" system. Higher level networking allows a student at one site to communicate on line and exchange information with another student at a different computer in the same room or in a different location. For instructional purposes, the hub-and-spokes system serves quite well, especially if the instructor is able to (1) send an identical message or screen of information to each computer terminal and (2) monitor each site unobtrusively and inconspicuously. The following list of advantages and disadvantages applies to this last type of hub-and-spokes system:

a. Advantages

1. "Hands-on" learning of tools
2. Individual attention in a group setting
3. Instructor can monitor individual progress

4. Students can explore and try new ideas
5. Students can learn from one another
6. Computers can simulate an economic environment

b. Disadvantages

1. Material must be computer-compatible
2. Start-up costs
3. Class speed is often at slowest learner's pace
4. Dichotomy between teaching and learning
5. Various levels of instructor-student and -material detachment

The items listed above are fairly self-explanatory. With computer laboratory instruction, detachment is only as serious as the instructor or the individual student allows it to be. Individual attention and monitoring are readily available. However, many students prefer to learn from one another or to try new tools/processes on their own. The "hands-on" learning of tools -- from spreadsheets to statistical packages to graphics capabilities -- is perhaps the greatest advantage of computer classroom instruction. Because the computer lab can simulate a variety of economic environments, a few enterprising instructors have even conducted classroom economics experiments to enhance learning of market concepts. The disadvantages, though few in number, are compelling. First, the class material must be computer-compatible. Thus far computer laboratory instruction in economics has been primarily limited to statistical and econometrics courses. Start-up costs are also large. In addition to the obvious computer hardware and software costs, there are large start-up costs for individual instructors to feel comfortable in such a foreign environment. When introducing new material, the class must often proceed at the slowest learner's pace. Finally, with computer lab instruction there is, for some students, a dramatic dichotomy between teaching and learning, while other students see a dynamic integration of the two.

The Chalkboard

The chalkboard can neither dispel the many disadvantages noted above associated with the various alternative teaching media nor command the preeminent position of being without its own detractors. It, like the other methods, has its own particular set of advantages and disadvantages:

- a. Advantages
 1. Widespread usage and acceptance
 2. Simplicity and flexibility
 3. Low cost
 4. Many panels
 5. Student and instructor operate at same speed
 6. Students at the board "thinking on their feet"
 7. The thought process comes through
 8. Limited instructor-student detachment
 9. No instructor-material detachment

- b. Disadvantages
 1. Chalk dust
 2. Spine-shivering chalk screeches
 3. Non-portability
 4. Small classroom size
 5. Limitation to "day and time" presentation
 6. Limitation to 2-D, limited color presentations
 7. Sloppy handwriting or drawing
 8. Instructors who "talk to the board"

The fundamental advantage of the chalkboard is its availability and widespread usage in the college classroom. It is the singlemost time-tested, tried and true method of college instruction. It is a simple, straightforward teaching tool, yet the flexibility it affords the university professor in designing or especially in modifying a lecture in mid-stream is unparalleled. Its start-up and ongoing costs, including the opportunity costs of preparation

time are relatively low. The many available panels allow for a synthesis of material from a number of different sources and a weaving together of disparate ideas and concepts. Because the instructor is often writing as he/she is speaking, the instructor and the students tend to operate at same speed. The chalkboard has the distinct advantage, from grade school on, of having students at the board "thinking on their feet." The instructor often finds him/herself in the same position, and in both cases, the thought process comes through. An instructor can better gauge a student's true understanding (allowing for some degree of nervousness), and students can see first-hand how their instructor responds to a confusing or unfamiliar situation. Finally, there is only as much instructor-student detachment as either allows or as the physical space demands (such as a classroom that is too large), and instructor-material detachment is completely absent. The instructor and the chalkboard become one -- they interact!

No teaching method is without its disadvantages. The ever-present chalk dust and those spine-shivering chalk screeches are at the top of everybody's list. Travel pads and easels which are designed to overcome the immobility of the chalkboard are a poor substitute. Also, the chalkboard is ideally suited only to smaller size classrooms, and a student who is absent from a chalkboard lecture can never completely make up the missing presentation. Except for the very skillful artist, chalkboard presentations are limited to two dimensions, and are very limited in the amount of color or contrast on the board, even given the availability of colored chalk. Although dry erase white boards help to cut down on the chalk dust and screeching problems and allow for multi-color presentations, the other disadvantages remain. Finally, poor instructor habits can contribute to a poor chalkboard lecture. The most annoying of these habits are sloppy handwriting or drawing and instructors who constantly face away from the students and seemingly "talk to the board"

Suggestions for Better Chalkboard Presentations

Because of the many advantages associated with chalkboard instruction, I maintain that chalkboard instruction needs to be

improved, not eliminated. To that end I offer the following suggestions:

1. Be prepared. Plan ahead: be certain that graphs "come out right," and do new or complicated drawings in your office before class.
2. Utilize an outline, leave it on the board, and refer to it often.
3. Be neat. Draw slowly and precisely. Explain to students that curves are tangent at this point, or that point A is northeast of point B, etc.
4. Prepare handouts (or overheads) for overly complicated materials.
5. Make liberal use of colored chalk, or better yet, encourage your administrators to purchase dry erase boards and felt tip markers. Encourage student use of colored pencils or different colors of ink.
6. Use chalk "grippers/covers" to conserve chalk and minimize chalk dust.

rear-projection technology, thereby eliminating the shadow and glare problems of existing projection media. A rear-projection screen fronted by an erasable clear plexiglass board and bordered on the sides by white dry-erase boards strikes me as the best combination of existing technologies. I believe the problems of instructor-material detachment and the inherent split concentration required of students are so severe as to warrant complete elimination of the problem. Until teaching progresses to the point where all students are self-motivated to learn and are able to learn on their own, the instructor remains a key force in both the quality and the quantity of learning that takes place.

Conclusions

I have heard it said that the best teaching technology is the one with which the instructor is the most comfortable. Although there is some truth to this maxim, I maintain that instructors can learn new methods and need to try some of the available and impending teaching innovations. The many problems with all projection media and the inherent limitations on settings where computer classroom instruction is appropriate cause me to caution instructors against leaping forward with any of the alternative media discussed above. The most promising avenue that I see is the computer-enhanced chalkboard lecture, where the computer uses some variant of