DOCUMENT RESUME

ED 116 693 IR 002 938

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TITLE Progress and Pedagogy: The Teachers Dilemma in a Technological Revolution.
PUB DATE 19 Nov 75
NOTE 12p.; Paper presented at the National Association of Educational Broadcasters Annual Meeting (Washington, D.C., November 19, 1975)

EDRS PRICE MF-$0.76 HC-$1.58 Plus Postage
DESCRIPTORS Audio Equipment; *Educational Equipment; *Educational Innovation; *Educational Technology; Electronic Equipment; Instructional Media; Speeches; *State of the Art Reviews; Technological Advancement; *Video Equipment
IDENTIFIERS NAEB 75

ABSTRACT

Though most technological advances are triggered by the initiative of the military and business sectors, if educators can overcome their aversion to technology, some recent technological developments can easily be adapted for use in the educational sector. For example, an experimental color television camera developed recently is no larger than a 35mm camera; resolution in video equipment has been vastly improved and changed to a digital mode which can be used to generate extremely realistic computer animation; advances in fiber optics and lasers may lead to the development of high-density audiovisual recorders with no moving parts; and reducation of electrical components to the molecular size also provides some interesting possibilities for the near future. It remains to be seen if man's imagination and sensitivity will insure that these technologies are used in beneficial ways. (EMH)

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PROGRESS AND PEDAGOGY: THE TEACHERS DILEMMA IN A TECHNOLOGICAL REVOLUTION

Paper Prepared for Presentation at the
NATIONAL ASSOCIATION OF EDUCATIONAL BROADCASTERS
CONVENTION
Washington, D. C.
November 19, 1975

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Technology and Pedagogy: Preoccupation and Occupation

It is obvious to even the most casual observer that we as a nation-culture are infected with an ongoing technological revolution. This revolution has profoundly effected our way of life and the scope of the universe in which we find ourselves. In the area of our interests as teachers, we find ourselves by-products of this revolution. We are dependent on technology for our very existence--without it we would have no claim to a discipline. Bound as we are to technology, we find ourselves contributing little to it. Our field is one of use after creation; few of us make a significant contribution to the expanding store of sophisticated devices. After we make the recognition that most technological development in our field is triggered by requirements in business and military applications, we can begin to realize that we react--after the fact. We react rather than act because most of us find it difficult to gain and constantly update the information base which can give us the feel for developments which will effect our future. This ongoing investigation of potentials has been called futurism, futuristics, or simply daydreaming. No matter what it is called, it is fascinating as we catch glimpses of a world that may very well be, and one most of us find ourselves ill-prepared to act in or react to. As teachers in the role of reacters, we have a mounting level of frustration caused by our own distress at change. Eric Hoffer, in the Ordeal of Change, may have caught the essence of this when he wrote:

> It is my impression that no one really likes the new. We are afraid of it. It is not only as Dostoyevsky put it that "taking a new step, uttering a new work is what people fear most." Even in slight things the experience of the new is rarely without some stirring of foreboding.
>
> In the case of drastic change the uneasiness is of course deeper and more lasting. We can never really be prepared for that which is wholly new. We have to adjust ourselves, and every radical adjustment is a crisis in self-esteem: we undergo a test, we have to prove ourselves. It needs inordinate self-confidence to face drastic change without inner trembling.[1]

With this as an introduction, we can turn to a selection of developments that potentially must alter our approach to the preparation of students for roles in this fuzzy, dark-glass future. To obtain the information for this paper, I was faced with the problem of how to see ahead far enough to put it in a future mode without blueskying about developments that I can only conjecture. It seemed to me most reasonable to approach well informed sources, publications that deal with research and development, and any and all sources whose voracity I could verify. One difficulty encountered in such a pursuit is so called "proprietory" information which seeks to protect potentially profitable developments from unscrupulous exploitation. At the conclusion of the paper is an annotated bibliography that I offer for additional reading and ruminating.

We will begin our futurizing with a development already announced and with some degree of availability, the CCD television camera. The advent of the transistor let loose an avalanche of solid state electronic devices that boggle the imagination. Most, like the Charge Coupled Solid State Image Sensor require explanations of a magnitude beyond the scope of this paper for understanding. Suffice it to say that the

[1] Eric Hoffer, The Ordeal of Change, (New York: Harper & Row, 1967).

announcement in the past two months by the Bell Telephone Laboratory of a broadcast compatible black and white television camera about the size of a large single lens reflex 35 mm camera has caused ripples. The introduction of the Ikagami color camera and the rapid exploitation of its capabilities has quickly roused the interest of both producers and journalists. It is safe to assume that if a color camera of similar SLR size can be developed from the "boiler plate" CCD color camera displayed by RCA last spring at the NAB in Las Vegas, then a major production change will come about. The RCA engineers I have spoken to suggest that while they are guarded about the time table involved, they think a CCD broadcast quality color camera about the size of a large Nikon 35 mm camera is feasible in 5 to 7 years, if not before. The power requirements of these cameras is in the 250-300 milliwatt range and so could probably be powered by integral light-weight rechargeable batteries. The CCD sensors produced by Bell Labs, Fairchild, and RCA are postage stamp size and electronics for the cameras are contained in one or two CMOS integrated circuits. The CCD camera is so tough that a camera-transmitter package was test fired from a 155 mm howitzer as a possible battlefield reconnaissance unit. After withstanding the several thousand G's of the initial firing, the camera-transmitter shell was parachuted to earth transmitting pictures of the battlefield all the way down. The unit reportedly functioned well.

While the CCD is possibly the more exotic image sensor in the near future, the old standby vidicon has been updated by the RCA Astro-Electronics division. The so-called "return beam" vidicon system developed by RCA has a 4000 line resolution, roughly seven times that of our present US system.

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I further anticipate that there will be a major change in the operations of video equipment with the signal being transmitted digitally rather than in the present analog mode. The digital mode offers improvements in signal to noise ratio and enables enhancement and processing of the picture that is not now possible. Some technical people have suggested that this will also enable advances in the computer control of video and switching that are not easily obtained by analog devices. This shift to digital encoding provides the additional possibilities of by-passing the camera and talent altogether with the generation of animated productions by the use of computer technology and the appropriate algorithms. Work at M.I.T., Yale, The University of Utah and by the private sector has paved the way for frighteningly real animative techniques. The latest I have seen are in color, have roundness and dimension, articulate their limbs quite smoothly and are generated mathematically rather than by some sort of analog device. The algorithms mentioned above are the mathematical expressions that act as digital descriptions of an object and which may be manipulated to represent motion, line, and color. The oral portion of this chimera could be proviced by an M.I.T. developed computer which, it is claimed, can pronounce any word in the English language typed into it on a key board or read into it by an optical character reader. While M.I.T. concedes that the present sound generation equipment produces a voice which is somewhat flat and featureless it is considered feasible to build a modification which can produce a more human-like delivery, complete with emotion.

The use of micro-miniature lasers and fiber optic transmission cables will lead to further reductions in the size of electronic devices coupled with an improvement in signal to noise ratios. Advantages

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listed for fiber optics information transfer systems include:

total electrical isolation
no grounding problems
no open circuit problems
light weight
high temperature resistance
wide band frequency transmission

While some of us may not see immediately the impact of what fiber optics may mean, Bernard D. DeLoach, Jr., writing in Bell Labs Record and J. R. Pierce in a contribution to the American Scientist identify fiber optics as a major revolution in telecommunications. The advent of the laser has provided food for thought in areas from photography to three dimensional television to long distance communications and future warfare. One of the interesting types of devices suggested by laser technology is in the area of high density video/audio storage and retrieval. One example of this is the reported development by the Hitachi Laboratories of Japan of a high density video disc which stores audio and video information as holographs at a density of 54000 per square millimeter. A disc 30 centimeters in diameter turning at only 6 r.p.m. can store 30 minures of color video with its accompanying audio. Developments by Bell Labs, General Electric, Texas Instruments, Fairchild and others suggest that we may see video/audio recorder/playback units which have no moving mechanical parts. The storage, retrieval, and addressing of programming will be accomplished by solid state devices.

The use of charge coupled audio devices may very well enable us to have a self-powered condensor microphone with excellent frequency response about the size of a cigarette filter tip, not the whole cigarette, just the filter tip. Couple such a microphone with a micro-sized laser (Aviation Week and Space Technology report a communications-type with a 2 nanowatt input) feeding its audio signal through fiber optics cabling

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into a CMOS amplifier and the biggest audio problem would be controls of a size you could get your hands on. You might want to launch off on the possibility of bio-feedback audio controls but I'm not quite ready for that myself.

Miniaturization on the horizon is rendered even more formidable and almost unbelievable with a report from New York University and IBM's Watson Research Center that they believe it is theoretically possible to tailor make an organic molecule which will act as a rectifier. Molecular level electronic circuits would allow designers to produce fantastically complex devices in subminiature size with extremely low power drain. The range of what this portends I leave to your imagination. The contemplation of tooth-size television devices and organic molecules powered by biological reactions or even by the electrical fields of the body itself are concepts to conjure with.

Now that we have achieved the molecular level of minutia with our gadgetry and invited you to look at the annotated bibliography at the end of the paper for the remainder--let us look for the balance of the paper at the human element of the problem.

Some few years ago in a paper on technology and pedagogy delivered before an interest group of the Western Speech Communication Association meeting at Fresno, California, I recounted the research I had run across on human powered electronic devices. RCA under contract to the United States Air Force is reported to have found that some 22 volts of energy at some 300 milliamperes of power exists between the pericardium, the lining of the heart sac, and the pertineum which lines the abdominal cavity. Since this is within the power requirements of several of the new solid state electronic devices, I noted that we might someday employ our audiomen or television cameramen on the basis of who had the greatest potential. You can imagine the humor generated by the task of determining where to place the power outlet, etc.

The real problem of human potential in a technological revolution is not measured by milliwatts and voltages but rather by creativity and concern. A person is purported to have approached Edward R. Murrow after the success of the first transatlantic communications satellite with the gush--"Oh, Mr. Murrow, isn't it wonderful? Now we can talk to Europe directly by satellite"--to which Murrow is said to have replied--"Madam, the question is not whether we can talk to them by satellite; the question is, do we have anything to say?" The challenge is the message he carries for the faithful. The challenge to the faithful as I see it is to identify and somehow codify the underlying principles which are the basics of the production of meaningful audio and video presentations. If this sounds simplistic, let me suggest that we need to build a body of theory and philosophy from which to base our future movement and direction. We react after the fact to technological change because we fundamentally do not have a codification of principles which will hold true in the face of change. Our texts, and therefore much of our thinking, has been traditionally geared to grounding our students in the operation of generally accepted pieces of gear that are in the present industry inventory. The challenge of change is the education of students to identify basic concepts and to apply them to changing technology. It may be argued that such a position is untenable because of the uncertainty of future developments, the cry is, "What if we're wrong?" So what if? Much of what we use in production and writing is borrowed from theater, a repository of concepts and forms identified in Greek times. The challenge of change then is the identification and promulgation of fundamentals which

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can be applied to the ebb and flow of technology. If we are truly to achieve the level of being a discipline, it would seem necessary to build a base from which to discipline. It is not enough to know how, it is Imperative ~~imperitive~~ in our age to know why.

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