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the nature and implications of educational technology for teachers

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THE TERM "educational technology" seems at first glance simply to imply the use of technology (that is, the products of modern technology, such as overhead projectors, slides, audio tapes and television and film) in education. From this perspective, it seems to be a matter of, first, familiarizing yourself with the nature and working of the piece of equipment, and then using it imaginatively in your teaching. Certain "techniques" will need to be developed to replace or add to certain techniques or methods which you already possess. But, in exchange, a certain degree of flexibility and variety of teching methods and materials opens up.

However, you cannot give much thought to these effects and changes, nor indeed work with them for long, without realizing that several other important consequences flow from technology in education. They all arise from a quite modern and growing realization of the complex nature and implications of technology itself. So perhaps we should first consider what we mean by technology?

The crispest definition of technology I know comes from J. K. Galbraith, and immediately makes it clear that technology is a process of thought and not a mass production line of hardware. To him, technology is . . .

> "the systematic application of scientific or other organized knowledge to practical tasks. Its most important consequence is in forcing the division and subdivision of any such such task into its smallest component parts."[1]

Three implications of this view of technology for education immediately spring to mind: (i) that knowledge gained about education should be applied in turn to improving teaching; (ii) that this application of knowledge should be undertaken in a systematic way; (iii) and that, as a consequence, the process will be for purposes of understanding and changing it, best viewed in "its smallest component parts."

Let me emphasize these points by another quotation. Robert Heinich writes:

> "Technology is both process and product. Its power lies in the former, but its successes are measured by the latter. In this sense, history plays a trick on us."[2]

Here again, you will perceive a distinction being drawn between technology as product (which is how it is usually thought of) and technology as process. It is the implications of technology as process in education that are the most profound.

One final reinforcement of this idea before we trace its implications. Henri Dieuzeide, Director of the Division of Educational Methods, Materials and Techniques at Unesco, comments:

> "technology is not just a question of hardware, but one of man thinking about the nature, function and rational use of tools. Educational technology is not about how the machine is to be incorporated, but how technological principles are to be transferred."[3]

What I wish to concentrate upon in this article is the radical difference between technology **in** education and the technology of education, a difference which conditions all thinking about education. From the definitions already given of technology it will be clear to you that there is a difference between technology in education and the technology of education. In the former case the emphasis is upon the technological product (the hardware) and the latter it is upon the technological process — that is upon a new and more systematic way of thinking about what you are doing it with. The product approach, which is sometimes also called the "audio-visual aids" approach, is based on the con-

cept of "enhancement". By using the new technologies as products, existing courses can be enhanced by the addition of visual or auditory stimulus, or both; but the technology is essentially an aid to the teacher in his or her traditional role. Technology is seen as an attachment to what is already being done.

Now, though this is a fairly familiar and apparently simple approach, it is worth spelling out the assumptions on which it rests and the implications which follow from it.[4] First, the assumptions. The 'Audio-visual aids' use of technology assumes that the goals of education are known and are relatively stable. It is assumed that the new technology does not call these into question. Secondly, it assumes that the means used to achieve these goals **do** change, but that the effects of using new means or media are predictable. Thirdly, it is assumed that new media are, to some extent, educationally neutral: that is, they do not by their very nature (regardless of what is conveyed on them) disturb the structure of the existing process of education. Finally, it is assumed that what aids the teacher automatically aids the learner — visual or auditory enhancement devized by the teacher to enhance what he wants to teach, is assumed to enchance what the learner wants to learn and how he learns it.

The implications of this approach are basically these: a strong orientation towards stability with the appearance of change (arising from the refusal to question goals while altering means, or to look at the idea that, in education, altering means automatically alters goals); an orientation towards hardware, the equipment itself; and in training teachers, an emphasis upon the manipulative skills required to work the equipment rather than upon what they are going to do with it. Finally, all too often, this approach has been motivated by the desire to deal with greater numbers of students and ends up (as in the case of first year classes lectured to on television) allowing the teacher to do more efficiently what he should not be doing at all.

The technology-as-process approach obviously has quite different assumptions and implications. Basically, it still originates in the idea that education can and should be improved by drawing upon the resources of technology; but it emphasizes the idea of technology rather than its products. The educational process is viewed as a system of interaction between teacher and learner, a system which can be studied and improved, especially if it is divided into its component parts, and the functioning of each of these parts is optimized. In order to optimize the functions, of course, some understanding is required of what they are now doing, and what it is intended they should do. Consequently, educational technology in this sense involves:

> the assessment of what the course is now doing;
>
> decisions as to what it should be doing;
>
> creation and application of means to make it do what it should be doing, in each part and as a whole;
>
> assessment of whether the new system is doing what it should be doing;
>
> further opportunities for change built into the system so that it can become "self-rectifying".

Two more formal definitions will emphasize this use of technological process:

> (i) "... specifying the objectives of the educational process, either in total or in part, deriving from these objectives the curriculum content which can contribute to achieving them, selecting the most appropriate and effective means for learning, creating the most appropriate materials, testing their effectiveness in the real learning situation and applying the results of that testing to the (further) modification of the learning system ..."[5]
>
> (ii) "... a systematic way of designing, carrying out and evaluating the total process of learning and teaching, in terms of specific objectives, based on research in human learning and communications, and employing a combination of human and non-human resources ..."[6]

There are four common themes of this kind of thinking about education. First, it is (like the audio-visual aids approach) orientated toward change; but in this case change in the pursuit of stated objectives. Second, it emphasizes the systematic study of education with an aim to improve **learning.**

Thirdly, it is prepared, indeed eager, to consider what the US Congressional Committee calls "non-human resources" — that is, the media of communication and learning need not be restricted to various forms of face-to-face contact, such as the lesson, lecture tutorial, seminar or live laboratory demonstration.

Fourthly, and perhaps most radically, it emphasizes the design of learning systems rather the use of them in the teaching situation. It will be appropriate to end this article by defining a little more clearly the implications of "design" in the technology of education. Once again, we need to go back to the nature of technology itself.

As you will realise, a fundamental aspect of technology is that it shifts the emphasis from the use of a tool to its design for a specific use. Primitive man finds a piece of stone that looks a likely weapon, and by chipping away at it fashions a first version. He tries this out and then modifies it — and so on. Proceeding by trial and error while using the tool, he evolves a design. Technological man decides upon the desired uses of the weapon, researches the nature of the materials available, designs the tool in accordance with these, and then produces it, knowing that it will work. Primitive education proceeds like primitive man. A broad "use" — i.e. the aims and nature of curricula and syllabuses — is set, and within this individual teachers work as well as they can, taking most work of the teaching decisions at classroom level. The quality of teaching and learning thus rests heavily upon the quality of the teachers. Educational technology is concerned, however, to design courses which are, as far as possible, independent of the personal charisma of each teacher. By using research concerning learning processes, by conducting developmental testing, by clearly specifying needs and creating means to meet these needs, educational technology mediates instruction to the learner in the design of the learning sequence.

The most important decisions about teaching are, on this view, those made in the planning stages; when the course is being planned or designed. The less important decisions are made in the implementation of the design, that is, in the class or lecture. Ultimately, as in computer assisted instruction or televised courses, the learning might be mediated without direct human involvement at all, at the time. And the final aim of this approach has been summed up by Robert Heinich:

> "Assurances of quality teaching were sought by criteria affecting the quality of the person responsible for instruction rather than instruction itself. Technology makes instruction visible, and independent evaluation can be made of instructional effectiveness. Assurances of quality are built into the teaching rather than sought in the teacher."[7]

NOTES AND REFERENCES

1. Galbraith, J. K.: **The New Industrial State.**
2. Heinich, R.: **Technology of Instruction: impetus or impasse?**
3. Dieuzeide, Henri: **Educational Technology and the Development of Education.**
4. This section of my article owes a great deal to discussions with Mr. Norman Mackenzie of the Centre for Educational Technology at the University of Sussex, and to an unpublished paper by Geoffrey Squires.
5. National Council for Educational Technology, London.
6. United States Congressional Commission on Instructional Technology.
7. Heinich, **op. cit.**

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