INTELLECT: THE CINDERELLA ELEMENT IN EDUCATIONAL TECHNOLOGY

by CHARLES FARRUGIA

To many educators the term 'educational technology' creates visions of sophisticated and wonderous machines supported by necessarily expensive and highly complex organizations, the panacea of all educational ills. Many other educators regard educational technology as an inhuman, mechanical placebo that relegates teaching and learning to a series of impersonal and educationally suspect manipulation of switches and gadgets. Both views are extreme and wrong since they stress only the mechanical element of educational technology, and ignore the more pervading, if less conspicuous, intellectual element.

THE INTELLECTUAL AND MECHANICAL ELEMENTS IN TECHNOLOGY

Komoski defines technology as 'any man-made device, process or logical technique designed to systematically produce a reproducible effect' (1969, p.74).[8] He bases this definition on the Greek root where *technologia* (*techne* = art, craft: *logia* = systematic study).

> '... had to do with techniques of logically arranging things, activities or functions in a way that could be systematically observed, understood and transmitted; and hence reproduced in the absence of the person who had first done the arranging. Sometimes, such arranging or logical ordering had to do with a way of doing things – a process; but most often it took the tangible form of a mechanical device – a machine' (1969, p.74).[9]

Thus, the products of a mass-production concern can be regarded as the outcome of the two elements in technology: the *intellectual* element designs the artefacts, organizes the process and sets up the structure for the production to be carried out with predictable results, the *mechanical* element is evident in the machinery and the actual reproduction of the artefacts. Analogous situations in education can be found in most uses of the media. In educational broadcasting, for example, the studios, audio, visual and transmission equipment constitute the mechanical element of 'educational'

technology, while the broadcast script incorporating the selection, ordering and presenting of content, together with directions for the use of the equipment, constitute the intellectual element. *However, since the mechanical element is more manifest, 'technology' has become increasingly associated more with machines and less with intellect.*

The tendency to neglect the intellectual, and overrate the mechanical element of technology prevails in the educational world where administrators and teachers believe that when they buy and use audio-visual equipment they are benefitting from, and contributing to, technological advancement, if they lack the machines they are missing out on technological progress. Consequently, as the authors of *The New Media: Memo to Educational Planners* (Schramm *et al.*, 1967, Chapters 1 and 2)[10] stress, too much attention, time, finance and energy are devoted to proving that audio-visual devices teach as effectively as the teacher in the conventional classroom, instead of developing the content and devising methods which utilize these aids to their best educational advantages. Far too many human and material resources are employed to confirm the value of apparatus, when these resources can be better utilized to refine the intellectual element – through improved selection, organization and presentation of content followed by adequate evaluation and modifications – and in the process enhance the mechanical element. Furthermore, even when technological processes as well as machines are employed in education, these are frequently simply borrowed from non-educational situations and transplanted to serve educational functions. Thus systems analysis, performance contracting, contingency planning, computer science, as well as broadcasting, cinematography and typography techniques, among others, are often simply borrowed from the commercial and entertainment realms and applied to education with little or no adaptations to educational requirements. Similarly, conventional classroom presentations of questionable quality and unvalidated courses are frequently broadcast, filmed, multi-media packaged, programmed, and labelled 'educational technology'.

Effected and impressed by what Komoski calls the impact of the 'world-making technologies of industry, agriculture, and the health services' *on* education, many educators apply the mechanical, and occasionally the intellectual elements of technology *to* education, rather than incorporate these elements to develop a technology *within* education. The rest of this paper proposes how the impact of the mechanical and intellectual elements of technology *on*, and

their application *to* education can be exploited to evolve a technology *within* education.

THE IMPACT OF TECHNOLOGY ON EDUCATION

Toffler (1970, p. 29)[21] writing about the impact of technological innovations on society, explains that these do not merely force change on machines and techniques, but also suggest or compel solutions (or conflicts) to social, philosophical, even personal problems. A cursory look will show that this impact affects all facets of education including educational equipment, environment, attitudes and methods.

On educational equipment. The impact of technology on equipment is most evident in the quantity and quality of equipment in the schools. Design improvements, easier operation, relatively cheaper film, video and audio recording facilities, photocopying or printing equipment, as well as greater access to the more expensive language laboratory, television, and computer systems, have encouraged many educational systems to invest heavily in apparatus. Such developments enable teachers and pupils of amateur abilities to produce educational materials of high technical quality, a factor that has encouraged people to use apparatus when only a few years ago they would have been loath to do so.

On traditional school environment. A different kind of impact is provided by the technology that makes it easier for students to pursue self-instruction. The development of resource centres, information retrieved systems, radio and television broadcasting, programmed texts, and self-instructional packages* can free some students from the classroom environment, and allow them to pursue their own interests at their own pace in their own time. Technology can break down classroom restraints to an extent that the early audio-visualists would never have thought possible. The new technology, points out Kurland (1968),[10] has brought closer the possibility of realizing the long desired objective of many educators of having the best teachers do for every pupil what previously they could do only for a selected few.

Technology makes it possible for educational systems to discard their traditional fixed time-tables. The eight-thirty-to-four school day, Monday to Friday school week, and September to July school

*The educational value of this equipment depends on the quality of their 'intellectual' element (i.e. their content and organization) as well as technical quality.

year, need no longer be rigidly maintained. Similarly, the individualized and mass educational media make it possible to abandon the tradition that the period of formal schooling should begin at five years and end around the age of twenty. for the now possible, indeed necessary, process of 'lifelong' education.

On traditional attitudes to education. The effects of mechanical and intellectual technology on society at large are having a direct influence on the students. The young student exposed to mass transportation, instant communications, multi-colour newspapers, comics and magazines, chainstore consumerism, advertising, and the mass communication media, goes into the classroom with a vaster store of knowledge and simulated experiences than his parents did. Other sources of information and experience have demoted the school from being the major official source of knowledge and opinion maker (Coldevin, 1971).[2] They have heightened the division between the in-school and out-of-school life experiences, and the problem of the relevance of much that goes on in school. Far from being awed by technology, today's student accepts and regards it as an integral part of his life, to an extent that in many ways technology is re-shaping concepts and attitudes once held unquestionable.

On instructional methods. Less noticeable, but perhaps of greater magnitude than the more spectacular effects described above, has been the impact of technology on the methods of teaching and learning. Programmed instruction comes immediately to mind: it has compelled educational systems to look more closely at curriculum development and methodology, at educational aims and instructional objectives, at lesson structures, and at assignments and evaluation.

The greater use of audio-visual aids can effect methodology even when the lesson-delivery is of the conventional format. Hoban (1968)[8] argues that the instructional efficiency of educational materials derives not so much from the media themselves as from the effective use of psychological principles of teaching and learning incorporated in media utilization. The literature supports this claim. MacKenzie *et al.* (1970, p. 75),[11] for example, state that it is a matter of common observation in higher education that the use of educational materials tends to add clarity and precision to the way the lesson content is presented. They suggest that the mere discipline of seeking out, or preparing for oneself materials that are suitable for one's course adds to its educational effectiveness. Vriend observes that due to the use of educational materials,

'lesson design has inevitably become more precise, more realistic, more highly specified, and as a consequence, probably more effective' (n.d., n.p.).[23] Furthermore, Schramm *et al.* (1967, p. 79)[10] and Schardts *et al.* (1970, p. 39-40)[18] evaluating the effect of the new media in education note that the resultant improvement in lesson design produced by the use of educational materials becomes noticeable not only among educators producing mediated lessons, but also among those who use them in the classroom. The author's own experience in training teachers to prepare lessons both for the conventional classroom and for broadcast presentation, supports this view.

The impact of technology *on* education reaches into every facet; it is not too difficult for educators, therefore, to simply use mechanical devices and believe they are engaged in technological processes.

The application of technology to education

The use of audio-visual and other teaching-learning aids, and the application of communication theories in education are often regarded as synonymous with educational technology. In fact, they exemplify the way in which the intellectual and mechanical elements of technology are often applied *to* the educational process, rather than developed *within* a technology of education.

The emergence of film and radio devoted almost entirely to entertainment, and to a limited extent as mass education media, quickly fired the imagination of many educators who fancied the limitations of the classroom spirited away by the new media. For example, a cartoon printed in all seriousness in 1923 by *The Chicago Tribune* and titled 'The Changing World' illustrated Edison's prediction that motion pictures will replace books in the school. The presumed result, as the illustrations and captions indicate, will be that instead of the students having to go forcibly to school, mothers will get them to behave with such admonitions as: 'Now young man, if you aren't good, I'll not let you go to school today'; instead of shuffling their way reluctantly through the school gates, students will be waiting eagerly for the doors to open; instead of rushing out joyfully once school is over, students will leave reluctantly with such remarks as 'Gee, it ended too soon', and 'I wish we could have had another of that nature pitcher' (cf. Adams, 1965, p. 20).[1]

The Yale Motion Picture Research Project (May, 1958),[15] and the Pennsylvania State University (cf. Saettler, 1968, pp. 333-335)[17]

experiments with film and filmstrips as media of instruction, reinforced and gave official sanction to the above notion, even though these studies, among many others, did not provide conclusive evidence that audio-visual instruction is more, or less, effective than conventional methods. Still, the popularity and mystique of audio-visual aids increased with the spread of photography and the greater access to filmstrips, films, and gramaphone records.

Many educators hastily envisaged the use of these media as a means of enlivening instruction by introducing previously unavailable elements into teaching and learning Scenes and sounds remote from the school could be brought into the classroom: the wilds of Africa, the treasures of the Louvre, the King's voice, Beethoven's 5th, even scenes and sounds from the Bible, or the remote, only imaginable first landing on the moon, could be as close as the nearest film or record library. These might be brought into the classroom at the teacher's or student's convenience, the argument went, a facility which undoubtedly could become a valuable asset in facilitating learning. However, exaggerated claims soon began to be made about audio-visual aids, claims that could not be sustained unless the aids were used in conjunction with validated instructional methods.

The main argument that audio-visual aids enliven teaching and increase interest, comprehension and retention is based on the hypothesis that the more abstract the content the more difficult it becomes for the learner to comprehend it. Conversely, the more lucid and nearer to 'first-hand experience' the teaching material becomes, the greater are the learner's chances of comprehension. Dale's Cone of Experience (1961, pp. 42-56)[1] and its later adaptations are based on this hypothesis. To this is added the argument that audio-visual aids are able to overcome the teacher-pupil communication barriers of day-dreaming verbalism, referent confusion, limited perception, and physical discomfort, as well as counteracting the out-of-school interferences caused by the entertainment media (Wittich & Schuller, 1962, p. 15).[24]

Although one cannot disagree with these arguments one can only accept them to a limited extent. No amount of first-hand or simulated experiences can ensure that learning will take place if teacher, or students, or both, lack the interest, the motivation, and the right attitudes towards the subject matter. Further, the passive student facing a boring teacher will remain just as passive facing boring or irrelevant films, filmstrips, television programmes or programmed texts. In spite of the inherent presentational attributes

of audio-visual materials and their potential contribution to education, their full value will not be realised as long as they are used simply as additions *to*, and not incorporated *within* the educational process. Gagné, quoting Thorndike's 'Telling is not teaching', warns that even when audio-visual materials facilitate communication:

> '... one cannot simply equate communication with the process of instruction. Communication in its broadest sense of an event involving apprehension of a situation may be said to be an inevitable part of instruction, but by no means the whole (1969, p. 95).[5]

Furthermore, communication implies a two-way process in which the sender becomes aware whether the receiver has received, understood and accepted the message. This point is often overlooked by audio-visual enthusiasts.

The failure to fully appreciate the student's role, his interest and personal motivation in the process of learning, remains the major shortcoming of those educators who place too much confidence in the mechanical element of educational technology, and too little concern for its intelligent element. In overstressing the presentational attributes of audio-visual aids, they tend to take the student forgranted as a passive and willing receiver. Consequently, they remain primarily concerned with improving the hardware rather than enhancing the role of the mechanical element in educational technology to help the student reach his educational objective. In contrast, the educational technologist is concerned with the role of audio-visual aids in so far as these affect the learner's behaviour. Goldiamond (1968),[7] for example, sees the role of educational materials – including books – as stimuli that the teacher uses to reward students for work well done, as discriminative stimuli that provide information and instruction, as deprivation variables or motivators for further research, as constant stimuli where they become part of an ongoing instructional programme, and as behaviour creating or producing stimuli (i.e. making a model, shooting a film, producing a classroom magazine) in the process of learning. In this content the use of educational materials takes a proper perspective among the many variables that lead to learning *through a technology within education.*

A TECHNOLOGY WITHIN EDUCATION

The intellectual element in educational technology has its roots in 'programmed instruction' which came to the forefront with the

work of B.F. Skinner and the so-called Behaviourists and stimulus-response psychologists.

On the principle that changed behaviour may imply learning. and that teaching is a process of behaviour modification, the educational technologist proceeds through experimentation and varifiable outcomes to develop a technique whereby teaching and learning will proceed in a pre-determined pattern and with predictable results. Thus Goldiamond,[7] for example, regards good educational technology as derived from good teaching theories (science), which in turn are derived from good teaching principles. Thus, *practice* is the application of knowledge, artistry and intuition leading to good or bad results; *science* is the systemization and the making of generalizations drawn from the practices; while *technology* is the application of science to solve practical problems (1968, n.p.).[1] As a scientist, the educational technologist first identifies his problem, then forms a hypothesis to explain it, and finally performs the experiments that allow him to accept that hypothesis or reject it in favour of an alternative. Starting by practice, the educational technologist proceeds to develop a process whereby the environment of the learner is deliberately manipulated and adapted until the response required by the predetermined educational objectives is achieved. In this process of learning, the stress is on *doing* rather than knowing. This factor, points out Gagné (1968, p.6)[5] is the most important outcome of the programmed instruction movement since what is being taught becomes an intellectual skill not merely recallable verbal information. In this concept the learning of history and geography, for example, does not consist in the memorizing and regurgitating of facts, events and dates, but in understanding and interpreting them as factors that influence the way people live. Likewise, mathematics does not consist in the manipulations of figures and formulate, but in the recognition of relationships and the building of concepts.

The stress on 'process' not 'content', and the importance of empirically verifiable results provide the basis for establishing instructional objectives (Mager, 1962; 1967),[12] developing learning systems (Glaser, 1965),[8] stressing instructional design (Merrill, 1971).[14] It leads to curriculum research which looks for relevant content (Taba, 1962)[20] rather than simply updating the information in old established subjects. This development of an intellectual technology of instruction has injected into the educational process the concept, and the proof, that teaching and learning need not be a haphazard activity where the outcome can, at best, be only

guessed at. On the contrary the process of instruction can be structured and conducted in a manner that yields predictable results. The exception occurs – or should occur – when instruction is devised to lead to open-ended results.

The concept of developing a technology within education recognizes and accepts, but at the same time seeks to incorporate, the impact and contribution that mechanical and intellectual technologies can have on education. It is appropriate for adherents to this view of educational technology to seek out ways of incorporating within the instructional process the developments in learning theory, the production and utilization of educational materials, new curriculum content, and planning and management practices. Consequently the interest of the educational technologist in teaching/learning aids, for example, does not lie in proving how powerful or effective they are in teaching, but in devising means and processes where they can be utilized most efficiently. Similar considerations are applied to curriculum development, pedagogical change and educational planning.

The educational technologist's interest in curriculum development derives from his concern about the student's desire to undertake meaningful learning experiences. He sees the need for the student to learn 'how to learn', devise his own learning environment, understand what he is doing and why he is doing it, rather than repeat without understanding what has been drilled into him. The educational technologist's interest in new pedagogy, particularly in instructional design, derives from the stress programmed learning theory places on what Ullmer describes as:

> '... the contention that *instruction is a process that can be approached in a systematic or technological manner*, in which the numerous parameters relevant to the efficiency of instruction can be identified, analyzed and manipulated toward the end of prescribing optimum conditions for learning based on and validated by scientific inquiry and measurement (1968, p. 11).'[22]

The educational technologist's concern with planning derives from his conviction that 'the numerous parameters to the efficiency of instruction' can become most effective when educational needs are identified and problems specified, so that all the human and material resources available to the system are planned, organized and managed within the constraints of the society that will benefit from them.

The inter-relationship between the parameters is brought together

by the (British) Council for Educational Technology through its definition of educational technology as 'the development, application and evaluation of systems, techniques and aids to improve the process of human learning'; or Mitchell's definition as:

> '... a field of study and practice within education concerned with the intentional and systematic organization of ideas, activities, and environments (through the application of cybernetics, systems theory, and other relevant knowledge and skills) to accomplish a specified and potentially reproducible educational outcome (1971, pp. 7-8).'[16]

The foregoing attempts to elucidate that overconcern with the use of audio-visual devices (or the muscle power) of educational technology, over-emphasises just one of its major variables. Furthermore, this over-emphasis tends to polarize the extreme convictions of many educators and non-educators who at one end of the continuum regard the adoption of machines as the only hope of education's survival in an increasingly technological world, and those at the other end who see in machines a further personal threat to themselves as teachers and as another contribution to the dehumanizing of society. The over-emphasis on the use of machines in education overshadows and relegates to a secondary position the intellectual power of educational technology. Instead, the intellectual element should plan, structure, and regulate the use of machines – whether they are blackboards or computers – to lead to an effective, efficient and rewarding process of teaching and learning.