

Keynote Speech

Life Long Learning and Technological Innovation

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I have been asked to address the theme of life-long learning and technological innovation. This request, I must say, is quite daunting, since the development of life long learning patterns and the process and scale of technological innovation are two of the most dominant and enduring trends in the twentieth century. Moreover, these two processes are intimately related and, in the future, will become inextricably linked.

To some extent, life long learning is an imperative which flows from the very essence and scope of modern technological innovation. In this perspective, life long learning is a reaction to the scope of educational possibility which is inherent in technological innovation. At the same time, the varied processes and multiplicity of learning needs which flow from life long learning make on-going technological innovation an imperative.

Technological innovation and life long learning, therefore, exist in a symbiotic relationship, each impacting and being impacted by the other. Any effort to design systems of education and learning which encompass both technological innovation and life long learning must, of necessity, be based upon an awareness of this symbiosis. Beyond a recognition this symbiotic relationship, such a design for learning must also incorporate principles which are meta to life long learning and technological innovation. This superordinate frame of reference if necessary if learning systems are to be developed which are more than technology—dependent, on the one hand, or random excursions into the possible, on the other hand.

Thus, the purpose of this paper is to sketch the outlines of such a learning system; one which both accommodates and which builds upon the dual processes of life long learning and technological innovation, but is trapped, in its purpose, by neither.

These newly emerging educational modes, I call adaptive learning systems. Exemplars of these systems can be found in distance learning initiatives, in-house corporate training systems, computer conferencing networks, educational broadcasting services, global satellite networks, open universities, shared access data banks

and various adult learning projects. Moreover, adaptive learning systems are politically ubiquitous as exemplified in the fact that they can be found in the developed, newly developed and developing areas of the world.¹ They represent, therefore, a global development and, in this context, can be related, in significance, to the historic rise of basic schooling.

The Discontinuity of Life Long Learning

While learning has become a lifelong necessity, there remains a basic incongruence between that reality and the public and institutional policies within education. In today's world, the phrase "lifelong learning" is used as a rationale for changes which encompass a wide spectrum of reform proposals. The phrase is used with such off-handed ease, moreover, that it is my sense that we have lulled ourselves into believing that it is a living reality within our institutions. But is it?

The concept of lifelong learning was legitimated and injected into public consciousness through a 1972 UNESCO report entitled *Learning To Be*.² The very fact that such a report could be produced was revolutionary itself and provides a useful commentary on our times. Representatives from seven nations formed the commission: France, Chile, Syria, Peoples' Republic of the Congo, USSR, Iran, and the USA. If one reflects somewhat upon the political events which followed, this mix of nations is truly remarkable. Indeed, this report may have been the last major effort in which the two superpowers collaborated and agreed. It symbolized, if a modern term can be used, educational "glasnost."

In re-reading the report, it is evident that the commission had a very clear idea of what was meant by the concept of lifelong learning. This concept embodied six strategic principles:

- (1) That dimensions of living experience must be restored to education by redistributing teaching in space and time.
- (2) That education should be dispersed and acquired through a multiplicity of means—the important thing is not the path and individual has followed, but what he has learned or acquired.
- (3) That the concept of a general education must be broadened so that it definitely includes general socio-economic, technical and practical knowledge.
- (4) That educational action to prepare for work and active life should aim less at training people to practice a given trade or profession than at equipping them to adapt themselves to a variety of jobs, at developing their capacities continuously.
- (5) That lifelong education, in the full sense of the term, means that business and industrial firms will have extensive educational functions.

(6) That access to different types of education and professional employment should depend only on each individual's knowledge, capacities and aptitudes and should not be a consequence of ranking or below experience gained during the practice of work.

If taken seriously, the concept of lifelong learning is a revolutionary idea, perhaps the only significant educational idea of this century. Those who advocate it are arguing in favour of the implementation, on a systems basis, of a number of subsidiary ideas: accessibility, institutional openness, needs-based learning, competency-based education, co-operative education, mastery learning, paid educational leave, and credit for prior learning.

To talk earnestly about developing educational institutions as centres for lifelong learning, then, is to urge change of a most fundamental order. Given the hypothesis, suggested by Clark, that the primary imperative of any institution is to control rather than liberate those within, it may be a false hope to assume that any institution *per se* can be founded upon lifelong learning principles.³ But a learning system can, since it has a range and impact greater than the sum of its parts.

In this context, then, what we are experiencing today is a pressure against the internal and external boundaries of our formal learning system brought about, not by creative educational or policy thinking, but by the aspirations and actions of people themselves. If this pressure continues, as I believe it will, then one can argue that we shall witness either an accommodation within or a basic reconfiguration of our learning system. The shape, structure and degree of openness of our learning system not, as many argue, the financing of it, will be the policy issue of the future. This is so, since answering the former question inevitably begs an answer to the latter. To date, leaders in higher education have focussed upon the level of financing without realizing that this has energized an even more intriguing feedback loop: financing what?

The concept of lifelong learning, and the acceleration in the rhetoric in support of it, has affected both the expectations and behaviour of people. Increasingly, people expect that they will be learning throughout their lives. Indeed, for many, they expect that they will be "learning a living." In some societies, this expectation has been transformed into a sense of entitlement; that is, lifelong learning is seen, not only as preferable, but is also considered to be a right which should accompany national citizenship. Just as people receive salaries, they now want learning entitlements.

This shift from expectation to entitlement poses critical issues of financing, access and equity for Governments and employers. Moreover, the time gap in this shift from expectation to entitlement has narrowed rapidly. Co-terminous with what has been referred to as a rising revolution in expectations around the globe has been

an equally dramatic demand for learning entitlements. The right to learn now exists alongside the right to work and earn as goals of personal and national development.

Societies, particularly in the so-called developed world, are entering the age of the empowered learner. Unlike earlier eras in which dependency characterized the relationship of the learner to knowledge acquisition, the new learner has available real choices and options as to what he/she wants to learn, where, when and how. Even more important, the empowered learner is aware of his/her new found freedom. This growing availability of choice, and the awareness of such choice in learning, provides the fuel for a major dynamic which is pressing for the development of a much needed new design for education.

The Push of Change

While the emergence of the empowered learner is the axis around which a new design for education is and will be constructed, a collage of push and pull forces currently exist which reinforce this fundamental pressure for educational change. Not since the creation of public schools in the West, has society been faced with such a dramatic need or opportunity for educational change.

A number of factors today are pushing education and training systems toward change. Let us examine briefly some of the more salient of these, particularly as they impact upon lifelong learning.

Changed Learning Behaviour

The first factor, noted earlier, rests in the changing learning behaviour of people. Increasingly, people are learning in contexts outside of formal educational institutions. Concomitantly, their pattern of access to these formal institutions is becoming more recurrent, part-time, and problem-focussed.⁴ This style of participation has forced many institutions to change their concepts of time, place, relevance and context for learning. Learners are pressing against the historic boundaries of education in such a way that the long-term relevance of our existing formal structures of education are open to question.

While attracting learners was once the paramount goal of educational institutions, accommodating and coping with their varying needs and learning styles is the dominant issue today.⁵ As in the case of business, which has recently confronted a more sophisticated and demanding consumer, so too, education now faces the "informed learner." Given the dependency relationships which have traditionally underpinned most educational systems in the world, this is a development of historic and potentially revolutionary importance.

Institutional Gaps

The gap between the concept of lifelong learning, and its discontinuous expression in the institutional world of education, provides another push factor encouraging a new design for learning. This is not merely a reflection of a typical theory practise dichotomy, but is rooted in the fact that the concept of lifelong learning has moved from idea to ideology. As an ideology, espoused particularly among the adult education community, lifelong learning carries with it a growing body of adherents and exponents who press for change in accordance with these ideological principles.

The ideology of lifelong learning, moreover, has penetrated the thinking of people and groups outside of education in such a way that it also informs their calls for access, flexibility and change in education. In this context, the gap between the concept of lifelong learning and its revealed practise must be understood as a social and political issue in society, not merely a theory practise question. More and more lifelong learning, and its componential elements, is finding its way on the public policy agenda of nations. Once there, it serves as a benchmark against which educational systems are judged.

A New Economy

Most observers of the modern world consider that we are in the midst of a transformation in the basis of our economies.⁶ While various terms are used, essentially there appears to be a consensus that knowledge and information, rather than natural resources, will form the bedrock of the new economy. This belief is reinforced by the growing capacity of computing and telecommunication technologies to generate, store, manipulate and transmit knowledge and data. When belief in change coincides with a capacity to change, the force of change increases exponentially.

If knowledge and information are central to the new economy, then providing timely, flexible and open access to knowledge becomes a critical issue. Here again one can witness a growing gap between established institutions of education and the learning imperatives of the new economy.

This gap is related to four factors:

- (1) Information and knowledge are increasingly being generated in contexts other than higher educational systems.
- (2) Information and knowledge are being transmitted and exchanged through vehicles beyond the control of formal educational institutions.
- (3) Knowledge and information are being stored in a highly individualistic and decentralized manner.

(4) Knowledge and information are being accessed in flexible ways in which the typical concepts of time and place, within educational institutions, are of decreasing relevance.

The rise of the knowledge-based economy signals that the era of information scarcity is fast disappearing.⁷ In this new economy, information is a sharable, miniaturizable, manipulable, transportable, and diffusive quantity. Unlike previous economies, the new imperative is to access rather than control information. Here again, conventional educational models, with their control and gate keeping posture toward knowledge and information, have an increasingly discontinuous relationship with the society in which they exist.

Value Added Opportunity

If the new economy is based upon knowledge and information, then simple principles of economics dictate that knowledge and information are value added sources of business opportunity. Education, in this regard, shifts from being seen primarily as a social good to becoming defined as a source of economic value. A rapidly growing number of companies and corporations recognize this shift in the social locus of education. In fact, education is emerging as one of the largest, relatively untapped business opportunities in the modern world. Private corporations, of all kinds, consequently, are entering the educational market in direct competition, not only with each other, but also with established educational institutions.

The entrance of the private sector into the educational market, moreover, is not on the identical basis as educational institutions typically approach that same market.⁸ Private corporations and firms are utilizing advanced tele-computing systems as a vehicle through which to offer their clients, educational and training programmes which are customized to their needs, results-driven in their design, flexible in their of delivery mode, accommodating of time and place variables and credentialized in outcome. From the customer's perspective, he/she knows, in advance, what he/she is paying for and the outcomes which accrue from success.

Ironically, the principles which guide the entrance of the private sector into the education market are those which are embedded within the concept of lifelong learning; although embellished with a profit motive. It is indeed interesting, moreover, that increasing numbers of people are willing to pay substantially higher fees for just such a learning experience. If these trends continue, then we are witnessing the early stages in the development of a private sector-based, parallel system of learning. Formal, public systems of education, as a result, will find themselves in a truly competitive environment in which the preferences of adult learners, in particular, will

determine market share and sustainability.

Demand-Saving Nexus

In most developed nations, educational expenditures absorb a large and rising share of overall governmental budgets. As many Governments attempt to balance their fiscal affairs, or at least restrain the growth of deficits, they must inevitably look to these educational expenditures as a potential source of saving. This focus on educational expenditure as a source of saving, however, usually runs head long into the rising demand for educational services among the populace; a demand ironically fuelled by the insistence, by most governments, that education is central to a vibrant society and healthy economy.

Faced with the twin pressures of fiscal saving and growing demand, Governments are eagerly examining ways to maximize their educational expenditures by increasing efficiency, productivity and effectiveness. In this situation, a replication and extension of existing modes of education, with their heavy infrastructure costs, is not seen as a viable alternative.

Governments are and increasingly will explore alternatives in education which promise increased efficiency, productivity and effectiveness. The possibilities inherent in the application of new information technologies to the development of new delivery systems for education are, consequently, quite appealing to policy makers. These systems, on the surface at least, appear to overcome many of the rigidities of conventional modes of education. While their initial infrastructure costs may be high, their long-term incremental costs are lower than conventional modes of educational delivery. Add to these factors, the “futurist glow” which such systems exude, and it is understandable why politicians are attracted to them. This demand-savings nexus is yet another push factor in educational change.

Networking

On a political map, the boundaries between countries are as clear as ever. Put on an economic map, a map showing the real flow of financial and industrial activity, however, those boundaries have largely disappeared. What has eaten them away is the persistent ever speedier flow of information—information that governments previously monopolized. In the past, as well, there were gross inefficiencies in the flow of information around the world. New technologies are also eliminating these inefficiencies.

Through this flow of information, we have become global citizens. As global citizens, we have emerging global needs which lead to global products.⁹ As in the case of business, educators are coming to recognize that the universal flow of information

puts a premium on learning how to develop strategies and systems capable of meeting the learning requirements of a borderless world. The beginnings of a globalization of learning are before us, and from this, flows a new educational need—the need to interact on learning highways across borders.

Learning networks, rather than institutions, will provide the educational bridge to the future.¹⁰ All nations, in future, will have to design their educational systems in such a way that they, not only have internal coherence, but also have an open architecture—that is they can network with other educational and learning systems.

In Europe the Delta Project of the EEC is precisely such a system, linking as it does national learning systems to a regional trans-European learning system.¹¹ In Asia similar developments are underway. And within the Commonwealth, there has emerged a new transnational learning network—the Commonwealth of Learning.

Inherent in the very process of globalization of economic activity, then, is a push factor for educational change. This becomes starkly clear when one realizes that to constitute education as primarily a function of the nation state is fundamentally different than to define it as part of pan—national learning networks.

It is impossible in the space available to explore fully all of the factors which are combining to push education toward change. One could, for example, examine work and the changing ways in which it is being undertaken and mediated by new technology. So too, one could examine alterations in the relationships between the sexes.

With this caveat in mind, a basic pattern of change is becoming clear: not only are learners becoming empowered, but, so too, the fluidity in the context of learning is reinforcing this empowerment in such a way that conventional approaches to education are increasingly lagging behind cultural, social and economic dynamics. It is at these points in time that revolutionary and quantum leaps are not only desirable, but possible. We are at such a time.

The Pull of Change

While the need for change in education has been recognized well before this era in history, it is only when that need is linked to the possibility of actual change that change occurs. Possibility requires a vision of how to achieve change and the provision of the means to achieve it. In this sense, possibility is a pull factor in change; it is both a guide to the future and a map to reach it.

Technological innovation is the pull factor which, heretofore, has been missing in efforts to realize the objectives and ideals of lifelong learning. It holds the potential of converting the desirable into the possible and achievable.

What is it about the new information technology, that holds such promise for lifelong learning? The new information technology essentially allows for the generation, storage, manipulation and transmission of large quantities of information at rapid speeds. In this regard, it is a simple concept, but one which deals with complexity. Paradoxically, in dealing with complexity, new information technology increases the complexity of that with which we can deal. It is “simply complex.”

At least four features of the new IT reflect and reinforce the dynamics inherent in lifelong learning. First, IT reproduces and extends the capacity of the human mind and body. With IT, human beings can undertake tasks with a degree of precision and comprehensiveness not possible without it. Second, IT is whole medium: it simultaneously integrates text, voice and image in an interactive format. Third, IT expands the range of interactions potentially available to people. In this expansive interactional field, the person is not bound by place, time or the senses. Fourth, IT is potentially individualistic, fluid and decentralizing. It moves with the person, rather than forcing the person to move with it.

Lifelong learning means that people are empowered to learn what they want to, when they want to, where they want to, how they want to, and with whom. The new IT provides the means to allow this to occur. The expansive capacity of IT allows people to access what they want to learn, while the range of content available is a function of the power of IT not of the place of residence or status of the person.

IT is not bound by time—it is potentially available anytime. Through IT, a learner can access knowledge at any time. IT is not spatially bound. Increasingly it can be taken to the place where learning is to occur. The integration of voice, text and image available in IT allows for a range of learning styles, from print-based to highly tactile and visual modes, with or without the presence of other people. Lastly, IT allows for both individualized learning and larger more collaborative group based learning. Indeed, the range and complexity of group learning through IT is one of its major advantages.

One of the essential elements of lifelong learning is that it projects an image of a new society—a learning society in which the paramount skill is learning itself. Learning how to learn becomes a cardinal objective. The new IT's possess a hidden quality which, if properly utilized, can contribute greatly to this meta objective of lifelong learning.

As IT is used to reproduce, extend and improve upon the process of substituting machines for human agency, it simultaneously accomplishes something different. The devices that automate, by translating information into action, also register data about those automated activities. Thus, they generate, in the process, new streams of information. Scanner devices in supermarkets, for example, automate the checkout

process and simultaneously generate data that can be used for inventory control, warehousing and market analysis. CAL programmes, not only provide content and learning experiences, but also generate new data on the learners encounter with that content and those experiences.

Thus, IT is not mute. It not only imposes information via programmed instructions, but also produces information. It both accomplishes tasks and translates them into information. IT is reflexive: it reflects back on its activities and the system of activities to which it is related. It symbolically renders events, objects and processes visible, shareable and knowable in a new way. IT, to use Shoshana Zuboff's term, "informatates" as well as "automates".¹²

The informing capacity of the new IT is of immense potential value in helping people to learn how to learn. The essential skill required in learning how to learn is the same quality contained in the new IT—reflexivity. To learn how to learn is to be able to step back and observe ones own learning processes as they unfold in different contexts. For this skill one needs information about that process, one's performance and style within it, and the way it links to other contexts. IT, while essentially a learner—centered technology, should also be seen as a teacher—guiding one in learning how to learn.

Adaptive Learning Systems

As the previous section hopefully illustrates, lifelong learning and technological innovation are indeed symbiotically linked. When one adds to this symbiosis an empowered learner, facing forces both pushing for educational change and pulling education in new directions of the possible, the need for a new design for education becomes pressing and real. And that is precisely what is occurring in the world.

During the past decade, various countries and regional associations, throughout the world, have faced a similar interlocking set of issues related to cost, scale, access, relevance, flexibility and quality in their educational and training systems. With increasing rapidity, particularly within the developing world, nations have opted for network as opposed to an institutional solutions to these vexing issues. In their approaches, and to varying degrees, information technology has been used to bind the parts of the learning network together. The common thrust in these developments has been to find ways to take education to people in their communities, rather than requiring them to access it at a common point and to do so in a way which fits learning around peoples' life and work patterns rather than the reverse. The cumulative impact of these new approaches to the provision of learning has led to a new concept of the design of learning itself; one which I call an adaptive

learning system. The innovation in these new adaptive learning systems centers not on the content transmitted, but in the processes used to transmit the content and the purposes to which the systems are directed.

And adaptive learning system is a learner—centered knowledge and information system designed to improve access to learning as a way of anticipating, responding to and creating change on an individual and societal level. Adaptive learning systems are designed to pursue their objectives, with increasing effectiveness, under both constant and changing conditions. Just as an adaptive learning system provides a context for individual learning and social adaptation, the system itself must be capable of learning and adapting. Adaptation involves the ability to respond to an internal or external change in such a way or to maintain or improve performance and effectiveness. Learning involves improving performance and effectiveness under unchanging conditions.

Adaptive learning systems are designed and managed in such a manner that learning and adaptation are purposeful activities. These systems, given their open and networked relationship to the environment, must build in mechanisms and processes which allow them to continuously learn how to learn and adapt. They are engaged, on an on-going basis, in what is referred to as double-loop learning.¹³ Adaptive learning systems, thus, not only serve society and its learners, they *flow* with them.

Adaptive learning systems are characterized by the presence of four features. They are: learner-centered; open systems; change-focussed; and technologically-mediated. The uniqueness of adaptive learning systems does not rest in the presence of any single feature, since these single elements can be found in various educational institutions (eg. many early childhood programmes are learner-centered), but in the cumulative impact of the integration of these features in one system. The remainder of this paper examines adaptive learning systems in terms of their distinctive features, the application of new technologies within them, and the issues and potential which they pose for lifelong learning.

Learner-Centered

Not only are adaptive learning systems learner-centered, but they also reflect a newly emerging view of the learner. Indeed, the combination of learner-centeredness with a new view of learning gives these systems their truly unique character.

A number of recurring themes shape the new view of learning upon which adaptive learning systems are designed. These include:

- (1) A concept of the active learner;

- (2) The importance of meta-cognition;
- (3) A learner-centered curriculum;
- (4) The need for multiple representations of knowledge;
- (5) The goal of mental self management.

The Active Learner

A growing body of research concludes that the dominant transmission view of knowledge, which so pervades conventional education, is fundamentally misguided. According to this transmission view, the major focus of educational activity is to provide well-structured presentations of material to be learned primarily through lecture, demonstration or recitation.

The concept of the active learner, on the other hand, understands learning to be *constructed* in terms of prior knowledge by an active learner functioning in a social context.¹⁴ Knowledge, accordingly, is best acquired in functional contexts which exhibit similarities to future situations embodying knowledge transfer. Learners, it follows, need strategies to enable such knowledge transfer. The instructional result is the development, in learners, of a more flexible understanding which will better prepare them to meet the novel situations an uncertain world presents.

Since, in the new view of learning, knowledge is constructed by the individual, it follows that the learner is active. New knowledge, moreover, is acquired in relation to previous knowledge building upon intuitive, informal experiences. This “experiential knowledge”, must be accounted for and built upon within education. It is one of the distinctive roles of an adaptive learning system to provide this bridge between experiential and formal learning.

The knowledge base acquired through adaptive learning systems, by the active learner is not inert, memorized for recall on tests, but alive, conditioned for application to appropriate contexts. This enlivened view of knowledge has led to a focus, in adaptive learning systems, upon such instructional strategies as “guided microworlds”, experiential learning programmes and learning by doing. Through such methods, students acquire knowledge-in-use, experiencing and employing new ideas in situations which are similar to their desired contexts of transfer.

Meta Cognition

The new view of learning has also led to a reconceptualization of what it means to understand a topic. Understanding is seen as an active process guided by prior knowledge and expectations. Learners pursue understanding, through the application to experience and new knowledge, of frames or schemas which function as prototypical problem solving and order-creating strategies.¹⁵ These prototypical

schemas, when applied to more sophisticated levels of reasoning, form the basis of much current research into artificial intelligence and expert systems.¹⁶ But they also exist within all so-called “novice learners”. The key point is that it is through these schemas, and the range available to learners, that understanding develops.

The new view of the learner, as a result, places great emphasis upon the use of meta cognition in learning.¹⁷ This term encompasses both reflective cognition, one’s awareness of particular characteristics of one’s mental states or processes (eg. that list is too long for me to remember) and regulative cognition, one’s use of executive or monitoring strategies for guiding mental activities in problem-solving (eg. time allocation in studying).

Flowing out of these views of understanding, is a major pedagogical goal of adaptive learning systems: fostering autonomous learners through instruction in or experiences designed to develop learning to learn strategies.

Learner-Centered Curricula

For the past several decades, education has been content-centered. Recent learning research, however, poses a learner-centered view of curriculum based upon what has been termed a cognitive shift. While properly structured content is important to learning, that structure, should be informed by the knowledge states of the learner and built from that point. This view requires a shift, within curriculum development, from a focus on inert to applicable knowledge.

The learner-centered view of curricula has given rise, within adaptive learning systems, to the development and use of functional learning environments where basic skills are taught, not as ends in themselves, but as component tasks requisite to success in real activities. Real applications of knowledge to be acquired are at the core of instruction.

Learner-centered curricula also faces issues related to the individualization of learning. Research has shown substantial individual differences in experience with and the capacity to learn from different modalities, such as text, pictures, diagrams, graphs and equations.¹⁸ In this context, there is emerging a distinction between text-based and graphically-based models of learning. This distinction has critical implications, within adaptive learning systems, for the design of visual learning environments.

Multiple Representations of Knowledge

Beyond the focus on individual differences, the new view of learning underpinning adaptive learning systems reflects the utility of multiple representations of knowledge for supporting learning, reasoning and problem-solving

activities.¹⁹ Each representation system—natural language, symbolic equations, logical formalisms, pictures, functional diagrams, moving pictures etc., are seen as having strengths and weaknesses in what each provides as facilitation to problem-posing and problem-solving processes. There is, as a result, no single mode of representing knowledge which is applicable to all learners in all contexts. Hence, a goal of adaptive learning systems is to facilitate fluency in the various modes of representing knowledge.

Mental Self Management

The new view of the learner, underpinning adaptive learning systems, also gives rise to a new view of intelligence. In opposition to mind mapping, computational, faculty-centered, and cultural models of intelligence, adaptive learning systems reflect more the views of Robert Sternberg who defines intelligence as a form of mental self-management²⁰—the management of one's life in a constructive and purposeful way.

Mental self management, moreover, is congruent with the concept of the empowered learner in a life long learning context. It defines intelligence as the progressive development of the capacity to adapt to, select and shape environments. The ability to think and act in various contexts is, therefore, of paramount importance in developing one's mental self management capacity. Adaptive learning systems, since they can potentially take learning to a variety of contexts and involve various learners in those contexts, are ideally suited for the development of mental self management capacities.

Adaptive learning systems, unlike conventional approaches to education, rest on a view of learning which necessitates that the learner be taken seriously. In so doing, these systems face squarely challenges in design and implementation which go to the heart of issues related to how people come to know and understand. Given that many of these systems do not allow for regular corrections, through prolonged face to face encounter, these challenges and issues are inevitably debated publicly and self consciously.

Most adaptive learning systems are exposed systems, that is, they are open to public and peer evaluation; there is no classroom door to hide behind. For this reason, these systems have no choice in their willingness to articulate a vision of the learner and learning; nor to some extent of the society in which they exist. Their very existence will continue to provoke debate within education. Indeed, this is one of the latent functions of adaptive learning systems and should inform anyone's decision to become involved in their further development.

Open Systems

Adaptive learning systems, as the name implies, are systems of learning as opposed to institutions. As such, they demand a mode of thinking, a perspective on their role and function, which is quite distinct from that engendered in educational institutions.

In technical terms, a system, as argued by Rosensleuth & Wiener, is a set of two or more elements which satisfies the following three conditions:²¹

- (1) the behaviour of each element has an effect on the behaviour of the whole
- (2) The behaviour of the elements and their effects on the whole are interdependent
- (3) however subgroups or elements are formed, each has an effect on the behaviour of the whole and none has an independent effect.

A system thus is a whole that cannot be divided into independent parts. The essential properties of a system, taken as a whole, derive from the interaction of its parts, not their actions taken separately. When a system is taken apart, it loses its essential properties. Because of this, a system is a whole which cannot be understood by analysis.

Synthesis, or putting things together, is the key to systems thinking; just as analysis or taking them apart was the key to machine-age thinking. Analysis focuses on structure; it reveals how things work. Synthesis focuses on function; it reveals why things operate as they do. Thus analysis yields knowledge; synthesis yields understanding. There are considerable differences between analytical and synthetic approaches to planning and management. One such difference is based upon the following systems principle: the performance of a system depends more on how its parts interact than on how they act independently of each other.

Adaptive learning systems, particularly when cast within the larger concept of open-learning systems, are ideally suited to planning and management within a systems perspective. These enterprises can be seen as parts of a larger learning system: the varied processes through which people acquire knowledge, values and skills on a formal, non-formal and informal basis. The meaning and function of adaptive learning systems, as a result, derives from the pattern and processes of the larger learning system and its interrelationship to it and its other parts. It follows that these systems are best construed, in the words of Arthur Koestler, as "a whole part of a whole".

Within such a systems perspective, a primary goal is to contribute to the larger learning system and to consciously build interrelationships and connections to it. The more interconnected adaptive learning systems are, the more effective they are. Their identity and legitimacy, within a systems perspective, derives not from isolation and uniqueness, but from relationship and a linkage to the community of learners. A clear

implication of this is the need to balance an analytical focus with its own nature and role—the part, if you like, with a broader focus on the learning system of which it is a part. This focus, rather than normative, in essence begins with it a simple descriptive question: What and how are people learning and what affects that process? An answer to this question should provide the appropriate context in which to locate an adaptive learning system and provide a sense of cultural meaning to the enterprise.

Adaptive learning systems must maintain fluid boundaries and be open to the society at large. Without such openness they, rather than being facilitative vehicles, can potentially emerge as yet another institutional barrier to learning. How can this be done? At this point, I would argue that it can be partly achieved through collaborative models of programme development and networking.

True collaboration in programme development goes beyond adversarial functions and moves towards real power-sharing with external groups and agencies. Moreover, it is premised upon the assumption, as argued by Botkin, that knowledge is socially constructed and, therefore, its transmission must be evolved in a social context. At Athabasca University, our recently developed special access project provides, in my view, an example of collaborative programme development, with all the give and take and mutual learning which that entails (Athabasca University Access Project 1986).

Networking means that an institution accepts the fact that, in certain cases, it is not the whole but a whole, part of a whole. The process expertise of distance-learning systems, for example, can provide a necessary and vital link in many areas where the components exist in isolation. This approach, in marketing terms, is called “nichemanship” and conforms to the ways in which, as described by Levitt, many people are finding solutions to personal, social and business problems.

Adaptive learning systems challenge substantially conventional approaches to the management of educational enterprises. They require what might be called an ecological perspective on management in which relational and functional dynamics are the most critical. Adaptive learning systems must be designed and managed in such a way that their parts fit each other so as to work together harmoniously, as well as efficiently and effectively. Such a view means that managers, within adaptive learning systems, must constantly guard against creeping myopia in their perspective. The early warning signal of the onset of this organizational disease is evident when one begins to believe in and act on the following principle:

If each part of an adaptive learning system, considered separately, is made to operate as efficiently as possible, the system as a whole will operate as effectively as possible.

Change Focus

Adaptive learning systems are designed and funded, in most cases, as instruments of social change and development. They carry with them egalitarian and efficiency mandates to alter the existing pattern of access to learning and opportunity. Frequently, these mandates have a clear expectation that “results” will be achieved at “lower costs”.

Unlike conventional models of education, adaptive learning systems function in an environment in which clear policy expectations exist and equally clear results are expected. Participatory, success and cost benchmarks inform the evaluation which they are subject to. This is both the bane and blessing of their existence.

This mandate for “affordable access” typically encompasses the following subsidiary participation goals:

- Increased Participation
- Broadened Base of Participation
- Targetted Participation
- Successful Participation

Increased Participation

Adaptive learning systems are perceived in many nations as a vehicle to increase the volume of participation in learning in society. This represents a quantitative objective which speaks to the absolute numbers of people who have access to or participate in learning. These systems have been remarkably successful in achieving such quantitative goals and have accomplished them using a variety of means. If quantity alone were the sole criterion of success, then adaptive learning systems have been resoundingly successful.

Broadened Participation

Broadened participation means opening up access opportunities for people who are geographically remote from centers of learning or culturally and economically distant from the mainstream of society and opportunity. Adaptive learning systems have been reasonably successful in overcoming spatial barriers to learning. This has been accomplished, particularly in recent years, through the utilization of regional centers and tele-computing technology.

The record of adaptive learning systems in broadening the social basis of participation is less stellar. By and large, the same groups who participate in formal schooling, participate in adaptive learning systems. Two factors help to explain this. First, to date, most adaptive learning systems assume the very skills which people, with

low participation rates, do not possess. Since most systems are print-based, for example, high literacy skills are usually required to learn. New CAL and other technologically mediated forms of learning, however, offer great promise in this domain.

Secondly, most research on adaptive learning systems, suggests that nonacademic factors play a significant role in determining participation. Attitudes towards one's competence, family circumstances, work styles, previous educational experiences, financial situation, time management skills, experiences of discrimination and prejudice—these, and a host of other non-academic factors, intrude between a person and his/her desire to access a learning opportunity, even when that opportunity is readily available.

In meeting the challenge of broadening the social basis of participation, then, adaptive learning systems must forge closer linkages with the social and economic context of current and prospective learners. Until recently, these systems have not formulated, in any conscious way, an image of human development unfolding within the context of the environment. This pattern exists, despite the fact that substantial cross-cultural research exists to document how socio-cultural environments shape human development. This research shows, among other things, that patterns of thought develop differently in different cultural contexts. The very role of cultural experience in shaping cognitive patterns, however, has been repeatedly confused with human capacity.

Michael Cole and his colleagues have recently proposed the concept of a situational code as a way of clarifying this confusion.²² To Cole, cognitive processes and cognitive content, contrary to the view of most developmentalists, are intimately intertwined rather than discrete. Most measured differences between people, or the cultural groupings to which they belong, reside more in the situations to which particular cognitive processes reappplied than in the existence of a process in one cultural group and its absence in another. What is actually being measured in most adult and distance education research, then, is a situational code; a code that determines the cognitive process used in a given circumstance, making process, content, capacity and experience inseparable.

The concept of situational code poses several implications for adaptive learning systems, particularly in light of the future. *First* differences in the apparent capacities of individuals within the same culture may be, as the more recognized differences between people from different cultures, manifestations of different cultural codes. Most developmental assessments, then, are really, at root, *a priori* cultural evaluations which are then applied through a ranking process to individuals.

Secondly the concept of situational code suggests the need to uncover those

intellectual and other developmental capacities which are nested in various settings, and the degree of congruence between various people and these settings. Substantial research has recently unearthed in this regard, the situational codes of the school and charted the degree of congruence between these codes and “types” of student. A fruitful direction for research would be to examine the learning codes of the various non-formal settings in which adults participate, most importantly work and the family. Facilitating development for the diverse individuals who inhabit these settings may require a modification of settings as much as they do changing people.

Thirdly the concept of situational code and its relation to development makes the social structures in our society the basic problematic for education. In times of social stasis, an ideal type in any event, this problematic is less pressing. Today, however, various settings in our culture are being dramatically altered. New situational codes are being born out of the daily impact caused by such dynamic processes as technological change, new communication modes and demographic transiteris. In fact, one could argue that essentially new types of people are being created in these settings.

Lastly the concept of situational code presents us with the need seriously to question the tendency to stereotype people and their capacities by the behaviour they exhibit in particular situations. It requires, in particular, that we realize the tentative nature of our knowledge of any one person at any point in time or in any particular setting. A more holistic and inquisitive approach to the person is urgently demanded; one which is open to discovering new capacities, particularly those blinded to our consciousness by the settings in which we observe people.

If development is rooted in situations and their codes what, then, does this suggest for adaptive learning systems? Obviously educational institutions, and people within them, must be more outwardly sensitive to the emergent structures within which people, in any given culture, find themselves as they are growing and developing. This demands a degree of cultural sensitivity not often characteristic of formal educational institutions which, by and large, still define their own particular settings as master contexts for human development. The growing decentralization in the accessibility of the populace to knowledge and information, and the various settings within which this knowledge can be accessed, makes clear that the dominance of formal institutions in this area may be fast disappearing.

Rather than formal educational institutions teaching the current or next generation, they may have to learn from it. The schools and universities, as other educational institutions, have traditionally been storehouses of knowledge to be transmitted across the generations. In future, if these institutions are to retain their educative roles, they must become places to which people come to share the knowledge they have acquired in other settings. In this context, educational institutions become

less storehouses and transmitters and more synthesizers and interpreters of that which is known.

Adaptive learning systems, if they are to fulfill the role of cultural interpreter, will also of necessity, have to rethink many aspects of their current structure and process: the focus on knowledge transmission, age segregation, professional exclusion and isolation from the culture. More importantly, the staff within these systems must acquire an openness of mind toward the fundamental processes of societal learning with all its diversity and unpredictability.²³

Successful Participation

Until recently, most adaptive learning systems have focussed their efforts on increasing access to learning. This focus is understandable, since the concept of access has been traditionally linked to the idea of equality of opportunity. Policy makers, for instance, have tended to believe that the goal of educational equity is attained when the conditions exist in which no person is denied access to higher education because of race, income, social status or place of residence.

This concentration on access has resulted in a front-end and input-focus in programme and systems design. Removing barriers to access, be they of time, space or life circumstance, for example, has been the abiding concern of distance education. Flexible registration procedures, the use of communications technologies, regional centres, tutorial support systems, and educational counselling services have all been used to remove access barriers and, judging by growing participation rates, they have achieved a good deal of success.

Equalizing access, however, does not necessarily equalize the chances of success for learners. The barriers which block a person's access are not those which prevent success following admission. Access barriers relate primarily to such factors as time, space, lifestyle, income and a person's perception of competence. Success barriers also relate to these factors but, as argued by Jencks and Astin, also encompass such variables as preferred learning style, cultural assumptions within curricula, the labelling process, and power relationships.²⁴ An adaptive learning system which is geared, not only to increasing access, but also to altering the social pattern of its outcomes, must confront squarely the barriers to success. Equality of opportunity, in other words, must be linked to equality of results. Most importantly, this linkage must be forged in ways which recognizes what Amy Guttmann postulates as the twin principles underpinning a just approach to education: non-discrimination and non-repression.²⁵

The idea of equality of results often brings forth counter-arguments regarding a presumed decline in equality or excellence. In other words, is it true that an outcomes

orientation, and the changes required to achieve it, leads inevitably to a decline in quality and, hence, works against the egalitarian ideal itself?

An outcomes orientation, contrary to the criticism it suffers, does not alter the substance of what is learned. Rather, it concentrates on the processes of learning—on how that substance is acquired. Much of the debate about a presumed decline in quality, in the face of an equality of results scheme, wrongly assumes that quality is a function of how one learns as opposed to what is learned. If, for example, the learning time for *X* is elongated to accommodate a cultural difference, and if the student, as a result, learns *X*, then has there been a decline in quality or a rise in efficacy?

Moreover, a concept of quality in education, which is not tied to the developmental capacities of a person and to the socio-cultural context in which these are expressed, is ultimately a mask shielding the fact that bias is the operative principle. The function of such concepts of quality is not education—that is, the development of the talents of those who participate—but exclusion, selection and tracking.

Any real social impact of adaptive learning systems must occur at the level of outcomes.²⁶ It is at this level, that the potential redistributive function of education occurs. In order for adaptive learning systems to redistribute real opportunity in society they must increase both their efficiency in guaranteeing access and their efficacy in producing success. To accomplish these twin goals means that adaptive learning systems must undertake a thorough examination of their processes and models to determine whether or not they provide for maximum access to success. Such an examination, I would suggest, would be challenging, if not intimidating to most institutions. But if the rhetoric is to match reality, it needs to be done.

Given that problems of access and success are linked to social, cultural and economic factors, no adaptive learning system alone will be sufficient to broaden access or increase success. The difficulty embedded in this suggestion is that some educators have become so wedded to particular concepts of adaptive learning systems, and the belief system which it engenders, that they have become the “new traditionalists” in an innovative field. They resist the idea that any given system alone may be inappropriate to the attainment of social goals. Instead, as other educators, they insist on forcing all needs and goals within an adaptive learning framework. The model, in other words, not only confuses, but dominates reality.

If they are to fulfill their wider mission, adaptive learning systems need to be recast conceptually and linked to the broader and more normative concept of an open-learning system. An open-learning system is characterized by five features:

- the absence of a discriminatory entrance requirement
- a results-driven concept of equality
- a success-based concept of programme and service design

- a multiple strategy and matching model approach to programme delivery
- a developmental concept of quality.

When assessed against these criteria, it is apparent that an adaptive learning system is not necessarily an open-learning system. This distinction, and the failure of many adaptive learning systems to assess its implications for change, explains why such systems have not achieved a broadening of the social base of access or significantly increased levels of success for diverse students. This is not to criticize the achievements of adaptive learning systems, but to suggest that, if their exponents intend to take broadened access and success seriously, then these systems must take the next step towards the development of open-learning systems.

Targeted Participation

By targeted participation is meant a focussed approach to increasing the participation of selected groups in learning, or achieving a broader range of participation in specific learning goals. Adaptive learning systems have been used, on a selected group basis, to increase the participation of women and minorities in learning. These programmes, when successful, have typically provided specialized recruitment, on-going counselling, modified curricula, front-end learning skills, and focussed financial supports. They tend, as well, to be more staff intensive and involve collaborative models of programme development. Even when successful, though, such programmes often face arguments concerning the differential treatment of specific groups in the context of an ideology of universal service.

Adaptive learning systems have also been used to involve various people in selected learning goals. Literacy and employee training provide two examples. Broadcast media have been quite successful in constructively attacking such problems as literacy. The individualistic nature of this learning environment has been able to overcome somewhat the stigma of illiteracy and group evaluation.

An increasing number of companies are developing in-house adaptive learning systems to achieve their training goals. These systems are gaining in prominence, since they deal simultaneously with a number of issues in the corporate training environment:

- (1) Timeliness—training provided when needed;
- (2) Customization—training designed for the specific needs of a specific firm;
- (3) Adaptability—training that can be modified as circumstances change;
- (4) Cost—training which is taken to the learner in a cost-effective manner;
- (5) Scale—training that can cope with large and dispersed numbers of people;
- (6) Flexibility—training that allows for a variety of learning modes and styles.

Adaptive learning systems, whether functioning in a public, voluntary or private

sector context, reflect and induce change in societies in which they exist. Their change impact is at two levels. First, they provide a means to accommodate the processes of life long learning within existing learning systems. That is, they offer a flexible option parallel to conventional learning and one more attuned to an empowered learner. To date, this has been the predominant role of adaptive learning systems.

There is, however, a second, and more fundamental change impact of adaptive learning systems on the horizon. This impact involves not only first order change, that is change *within* the existing learning system, but also second order change, change *of* the learning system.²⁷ This potential for second order change flows in part, from the natural affinity of and increasing linkage of new information technologies to adaptive learning systems. It is to this possibility that we now turn.

Technological Mediation

It is difficult to imagine a discussion of education in the waning decades of the twentieth century which does not stumble over, or face squarely, questions posed by the rapid development of new information technologies. Adaptive learning systems share, with these new technologies, a quest to find new ways to mediate the relationship between a person and experience. Of all areas of education, adaptive learning systems are most intimately intertwined with technological development and, for that reason, face issues which are at the forefront of these developments.

The new "Republic of Technology", as Daniel Boorstin the Librarian of Congress has named it, is a world of obsolescence.²⁸ It is not normal for a publisher of a book, as part of his/her sales pitch, to talk of the book's relationship to newer writing which will make it obsolete. The book stands alone, a symbol of tradition and perseverance. Newer technologies, particularly computers, however, are marketed on a relational basis. They exist at a point between the past and a changing future. They represent and embody change, not permanence, offering the consumer only a glimpse of the future.

The new obsolescence generated by technology is particularly problematic for adaptive learning systems, for these technologies are being used, not as additional stand alone devices, such as books, but as integral aspects of the delivery system itself. Decisions about the role and application of new technologies in adaptive learning systems are decisions about the enterprise itself. This produces an interesting double bind for these systems: not to use new technologies makes the adaptive learning systems obsolete; to use new technologies, however, ensures that the adaptive learning system is obsolete. How these systems cope with this iron law of obsolescence will affect profoundly the ways in which new technology is used.

The Republic of Technology is also a world of convergence wherein there is a

tendency for everything to become more like everything else. Each step in the development of modern technology tends to reduce the difference between older categories of experience. Consider, for example, the once basic distinction between transportation and communication: between moving the person and moving the message. While communication was once an inferior substitute for transportation (you had to read about it because you couldn't get there), it is now often the preferred alternative.

The T.V., by traditional categories, a mode of communication, brings together people who still remain in their living rooms. With the increasing congestion of city traffic, with what is now called "the" parking problem, and holding patterns in airports, our T.V. becomes a preferred way of "getting there". Now, when it comes to public events you are often more there when you are here than when you are there.

The new convergence wrought by modern technology applies as well to technology itself. While previously, in communications technologies, we witnessed the separate development of systems to carry voice, image and data messages, today there is a growing convergence in which voice, image and data are transmitted simultaneously and in a way in which there can be a high degree of interaction between the senders and receivers.

This development has also bred a new category of participant the intervener: a person who is neither a sender or intended receiver of the message, but who, by virtue of an ability to link with the network, can intervene and become a sender, receiver or observer. The use of computer conferencing in adaptive learning systems is a case in point. In many of these systems, overall enrollment is dramatically affected by just such interveners.

In adaptive learning systems today new information technologies are employed at three levels: as a tool in the learning process; as an aid to the learning process and as the medium of the learning process.²⁹

IT as Tool

Using computers and other forms of IT as an object of the learning process represents their development as tools. Until recently, this was the dominant use of IT in education. In essence, this has involved the study of a computer, as an information processing machine and the training of people in how to use it.³⁰

While initially an obsession with the variation in hardware, this approach has now shifted to the soft-side. Students are introduced to programming languages, operating systems and, increasingly, are taught the skills for the adaptation of these tools to their unique needs. The assumption in these efforts has been that, since computers were becoming universal, everyone should know about them and how to use them.

This logic led to substantial investments in such efforts. As computers become increasingly user-friendly, however, the need to learn how to use them will dissipate somewhat as the need to understand the internal workings of a telephone has in order to make a call. The only area of continuing need may be as in driver education, for safety and security reasons.

IT as Aid

Using IT as components of the learning process represent the use of technology as an aid. By and large, most development of IT in adaptive learning systems is at this level today.

IT as an aid to learning generally has been used on three levels:

- (1) data and wordprocessing;³¹
- (2) content modules;³²
- (3) intelligence extenders.

Data processing uses have been developed to allow students to manipulate information or process it during their learning.³¹ Computer-assisted and telematic modules, within courses, have been developed as aids to learning and to build skills related to decision-making and analytical situations.³²

More recent developments have involved the use of computers as intelligence extenders.³³ These “cognitive technologies”, or “workbenches”, make qualitatively easier the specific mental activities involved in complex tasks, such as collecting data, crafting ideas, writing, and designing and running experiments. What these applications have in common is to make more accessible, with less mental effort, the achievement of what are considered to be complex acts of mind. Unlike so called machines that think, these intelligence extenders enable students to better express and build upon their own creativity and intelligence.

IT as Medium

Using computers and integrated interactive systems as the actual ambient of learning represents their deployment as the medium of learning. Three levels of application can currently be seen in adaptive learning systems. The first, involves the translation of textual course material into a computer format with remedial and branching enhancements. This form of computer based learning offers individualized study, instant evaluative feedback, depth learning and remediation. The key is that these are provided in an integrated format, with access being tailored to a person's stage in learning.

A second level of application is in what is known as context based learning. Through the use of micro worlds, students are provided with dynamic computer

models of systems or parts of systems which can be studied without the support of an instructor.³⁴ Such modes of learning have been described as discovery worlds. Unlike earlier simulations, though, these discovery worlds allow students to change the properties of the system or to construct their own. This represents, through the use of IT, the concept of the active learner constructing knowledge.

Apart from micro worlds, most technologies in education are print based. The so-called text reading eye has been the primary sensory channel in the learning process. This has resulted in a radical impoverishment, given the senses available from which learning takes place in the world.

This state affairs will change in the near future. Dramatic developments in the consumer electronics, telecommunicating and electronic publishing industries are rapidly making available low cost, high quality and high volume editing and storage technologies for high speed access to high quality still and full motion imagery. These developments will make possible the development of dynamic, interactive, multimedia learning environments that can access vast archives of text, image and sound for educational purposes. Given these developments, and the need for multi-media literacy which flows from them, it is safe to say that out whole concept of what is possible in the range and mode of learning will have to be re-thought.

As the use of new technologies in adaptive learning systems move from tool, through aid to medium of learning, the tendencies of these technologies to structure experience for the learner emerges as an important question. All technologies, print included, do this. We know something about how print structures experience and the pros and cons of that. What we do not know enough of yet is how electronic communication systems and their supporting conceptual apparatus do this. We know one thing from the history of print: it can and has been used for control or empowerment. Given that technological development appears to create its own momentum, adaptive learning systems must inevitably debate, within that context, the organizing principle for its use: to control or empower people.

Until recently, the possibility of serving learners simultaneously, on both an individual and social basis, was a faint hope. The challenge, in this regard, has been to find a way of meeting the learning needs of people, both as individuals and parts of a larger whole. In other words, to serve them as individuals and members of various social groupings simultaneously. It is what Arthur Koestler has called the Janus principle: "treating people as whole parts of a whole."

Newer technologies, and most particularly their tendencies toward integration of voice, image, text and data, offer adaptive learning systems a unique enabling device. These newer technologies now deal with differentiated parts of the wholes they are part of. They are able to get specific about parts that earlier technologies had to leave

undifferentiated. In addition, they operate at such fast speeds that they can treat parts simultaneously. Speed and specificity are the hallmarks of these new technologies and they provide the foundation for the next stage in the development of adaptive learning: what can be called the “mass customizing of adaptive learning.”

Consider, as an example, the potential of integrating speed, specificity, mass and customization, the current developments in teletraining. Building on base teleconferencing technology, tele-training systems now currently exist which enhance two-way audio with two-way video, two-way tele-writing, and individualized computer communication. Voice, image and data are combined in one interactive system.

This technology enables one to teach across a wide geographic area and to do so on a group and individual basis, or a combined group-individual format simultaneously. AT&T in the USA currently has 330 tele-training centers for in-house training of over 45,000 students per year. This training can be offered on a mass basis, an individualized or customized basis, or a mixture of both and on a need-to-know or fast track basis in terms of the time gap between identified need and training response.

Tele-training and other such interactive, and convergent technologies, allow for the intervention, at various points in the learning cycle, through education linkages. Each person, theoretically, is at a different stage in the learning cycle and functioning as an individual or member of a larger group or both. This is the context which generates both the need and possibility for mass customizing in education. Add to this the variations in time (when to know) and learning need (need to know) demanded in a training context and mass customizing becomes even more important.

Given that new technologies enable the mass customization of education, all education programs, institutions and systems exist somewhere on the mass customized continuum. Moreover, various components of their system also exist on this continuum.

A mass customized approach to education, particularly within a distance education context, empowers people both as individuals and members of social and cultural groupings. It avoids the trap of confusing sameness with equality: a logical fault in the assumptions which underpin most educational efforts to reduce inequity. The mass dimension speaks to the non-discrimination principle, while the customized dimension allows one to address non-repression. The mass customization approach, finally, allows the design of programs which addresses the life context of the learner and to do so in a way which is sensitive to the differentiated experience of people in the learning cycle. And it is through the appropriate application of new, more integrated and interactive technologies, which enables this mass customization to be a reality in education.

A strategic device that can assist adaptive learning systems in a planned approach to life long learning is the mass-customization matrix. This matrix links the targeted learning context, either a mass or customized focus (with various points on the continuum possible) with the strategic focus of the organization, expressed in terms of products, services, markets or delivery systems. Products, services, markets and delivery systems, as the chart shows, can either be standardized or customized, with various combinations among them. Thus, as the chart displays, a standardized product can be developed with customized services and delivery systems and provided to segmented markets. This type of matrix analysis, similar in ways to portfolio planning techniques, provides a way for an organization to re-think its strategy within the context of mass-customization.

The Emerging Human Gap

At the outset of this paper, I noted that addressing the issue of the relationship between life long learning and technological innovation was a truly daunting task. Given the number of themes touched upon in this paper, I think the reader will concur with this assertion. The themes of life long learning and technological innovation are compelling, since they evoke images and visions of educational potential, and speak clearly to those learning needs which are so vital to social development and national economic health. It is understandable, in this context, why proponents of information technology and life long learning are so zealous in their advocacy and why as well those outside of education find these ideas and technologies so appealing. However, a cautionary note is warranted.

Unquestionably, new information technologies hold tremendous possibilities for the future development of adaptive learning systems. This potential is further enhanced because of the natural affinity of new information technologies to these systems and their barrier-removing goals. As these information technologies become more pervasive, in adaptive learning systems, the problem of human factors will increasingly confront these systems. By human factors is meant the gap between human and machine capabilities.³⁵ To avoid this gap growing wider, a major social innovation is needed; one which will effectively integrate information technology into the work place. Effective integration should not be confused with the diffusion of such technology in organizations. The latter refers to quantity, how much is used; the former to strategy, why it is used.

To date, vast sums of money have been spent on information technologies in adaptive learning systems without a clear understanding of how people can optimally integrate with these technologies. Information systems expert Paul Strassman notes,

for example, that over the last decade USA corporations have increased their data processing budgets an average of 12% per year. At the same time, productivity increases averaged only 2% per year. At Athabasca University our productivity increase over a three-year period has been 25%, but our budgetary expenditures on information technology has more than doubled. This gap is now more than a matter of intellectual curiosity.

Increasingly, managers and others are beginning to be disturbed by the discrepancy between gains in productivity and rates of fiscal outlay on information technology. Although we may not know how to definitively measure productivity in the service economy, the evidence is growing that whatever we are measuring is not necessarily appreciatively benefiting from the massive influx of information technology. The costs of dependency on new information technology, in other words, should not be confused with productivity improvements which flow as a result of its application.

Information technologies can now give us more information, more quickly than we can possibly absorb it. There is no possibility for most of us to access all the available information or of utilizing it effectively. Information technology, ironically, can also ruin our lives unless we think of new ways to get it under control. In the past, according to Daniel Dennett, people could lead lives of "unavoidable ignorance". We now have unlimited opportunities to know and this information obligates us to act.³⁶ At the same time, particularly in a management context, we draw on the available information, unable to make decisions. The end result is what Stan Lee calls Dunn's Conundrum: that is, "negative information": "information that reduces rather than increases one's knowledge".

Managers frequently complain, today, that information technology has not lived up to its potential. But this is not true. These technologies have lived up to their potential; indeed they regularly exceed expectations. The real problem is that human beings and forms of social organization have not caught up. At Athabasca University, we have developed a totally computerized and integrated student information system. Yet, this system hinges on the abilities of secretarial and clerk positions to enter and read data properly. One mistake in either function, not only neutralizes the technology, but creates massive systems and client service problems. So too, academic policy decisions in our university are made with no reference whatsoever to the information systems developments which are necessitated in their implementation. This parallel decision process, of course, leads to dramatic costs in labour and dollars. I am not arguing that academic policy should be dictated by technological systems, but a new relationship between each is required, if only on a cost basis.

It is necessary to reestablish, at this juncture in time, an age old principle: that in

organizations there is no substitute for human intelligence. It is also necessary to examine critically, what information technology can do to support that element, as well as how it might interfere. There is in fact, wisdom what is known as the “Law of the Hammer”. This law states that when you give a child a hammer, everything becomes a nail. There are many functions, particularly those involved in analyzing and assimilating information, that do not necessarily benefit from new technology. The technology may provide an aesthetic adornment of the future, but it does not substantively alter or improve it. Indeed, new information technology can actually impair these functions or render them more complex than they are or need to be.

Unless we in education are to be ruled by technological innovation, being locked in forever in a reactive mode, then that process and its application to life long learning must be *managed*.

In attempting to manage technological innovation and its application to adaptive learning systems, one will soon find a paucity of successful models or approaches.³⁷ This is due primarily to the tendency, until recently, to regard new technological innovations with a sense of awe and corresponding feeling that they could only improve upon current practice. It is only now, after many organizations have rendered substantial investments of people, time and money in new technology, that there is a growing recognition that new technology, in an uncontrolled environment, can pose monumental problems for educational institutions.

Personal experience, to date, suggests four rules which every educator should employ in decisions about new technology. Call these Morrison’s iron laws:

- Focus on Strategy
- Beware of Complexity
- Control the Underground
- Avoid Mysticism

Focus on Strategy

Most organizations, educational institutions included, are guided by a strategy, whether clearly espoused or embedded in its activities. This strategy is usually composed of two parts: a vision of the future and an understanding of the unique attributes which will get one there. New IT should only be introduced if it does one of two things: (1) Is sufficiently compelling to have you change your vision or (2) adds significantly to your unique attributes and will get you to your goal more quickly. If your organization exists in a competitive environment, then IT should be used to maximize your competitive advantage.³⁸ If it does not, IT should not be used. If you have no vision, and are unaware of your unique strategic attributes, and have no plan for maximizing your competitive advantage, then IT will merely add to your basic

confusion. Technological innovation, in other words, should be guided by organizational strategy. If you cannot answer the questions of why you want to use IT, you are better off not using it.

Beware of Complexity

Many organizations are beginning to see that IT, from a cost perspective, is like language: it has a surface and deep structure. The surface structure, what many managers see, are what are called hardware costs—the price of machinery. The deep structure, of IT, surprising to many managers, generates other costs related to licencing, maintenance and software. These deep structural costs, surprising as well to managers, often are significantly higher, overtime, than the surface costs. Once managers recognize the surface and deep structural costs of IT, they often feel more in control, even if shocked by the awareness itself. But this sense of control is an illusion, for there exists an even more fundamental driver of costs in IT, the core driver at both structural levels. This core is complexity. The more complex the IT system, the more costly it is and will become.³⁹ Highly integrated systems mean that a change in one part necessitates a change in one or all others and generates cost. Radical simplification should be every manager's fundamental rule in IT.

Control the Underground

All too frequently, IT systems are purchased, installed, initial systems developed and approved, and then forgotten about or left to “experts” to run. The assumption is that you know what you bought and paid for and the rest is implementation.

Nestled within implementation, however, is a cost driver of monumental significance. It is called on-going system development or better yet systems “enhancement”. These enhancements are not only undertaken by computer services or MIS staff, but increasingly come as a result of what I call “random fiddling” by users, many of whom are at low levels in the organization. The occasional bit of fiddling is of no import. But the cumulative impact of fiddling and enhancements can be of such a scope- as to change the actual system purchased when compared to the system-in-use. These underground systems development (in the sense that they are rarely approved) can add substantial costs to IT systems and, overtime, make systems obsolete. Beware of this underground.

Avoid Mysticism

Computers are the icons of the modern age. They generate a form of worship and Messianic activity among believers that has not been seen since the Christian crusades. Discussions about hardware and software options often are permeated with a mystic

quality. Unless one is a firm believer, a dangerous state of mind in the computer world, the best posture for rational decision-making is a secular and atheistic one. Focus on function and benefit, rather than form and style. All things considered, it really is true: a box is a box.

The ultimate logic of lifelong learning is that it leads to a mass market of unique individuals. From an educational perspective, if one is serious about lifelong learning, this poses the challenge of finding ways to meet the tailored learning needs of individuals and doing so on a mass basis. New information technologies, if applied appropriately within adaptive learning systems and in a way which is congruent with the principles which underpin such systems, can allow us to do just that. Together, information technology and adaptive learning systems allow for a unique form of educational holography: a unity of person, process, content and context within a stream of change.

Conclusion

The concept of life long learning, at heart, speaks to questions of human potential and to the factors which impede or facilitate its expression. Seen in this light, life long learning is a deeply humanist philosophy of education. Life long learning challenges all of us to provide the conditions in which all human beings can pursue their learning destinies and, in that process, contribute to the betterment of the human community.

Life long learning is guided by three interrelated goals. The first is to remove those barriers which stand in the way of a person acquiring the capacities which allow for the expression of particular potentials. This is life long learning as the *enabling* of learning; that is, to allow it to occur in the first place. These are primarily access issues.

The second goal is to establish facilitative conditions under which learning skills can not only be acquired, but broadened, and applied. This is the *development* of learning. These are primarily *process* and *design* issues.

The third goal is to provide circumstances and contexts in which people are in a position to develop their potentials as they choose. This is life long learning as the *empowering* of learning. These are primarily issues of *value*, *power* and *control*.

Life long learning, then, is not merely focussed upon the present, but intimately concerned with the future, both of individuals and societies. Within the perspective of life long learning, the person is perceived not just as what he/she is, but as what he/she might become, under what conditions he/she is likely to become, and what, if he/she chooses, he/she will become.

If one wishes to assess the potential contribution of technological innovation to life

long learning, then, of necessity, a number of fundamental questions must be explored. Unless one is to assume that technological innovation is, by definition, a positive contributor to life long learning, then one must ask pointedly whether it contributes to the enabling, development and empowering of learning. To ask that any activity in society be able to address such challenging expectations may appear to some to be unfair. Not to ask that technological innovation address itself to these goals, however, is to forfeit a unique opportunity to develop human potential and contribute to the social betterment of humankind. For this reason alone, a commitment to life long learning is a very serious business indeed.

NOTES

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- (2) E. Faure, *Learning To Be* (Geneva, UNESCO, 1972).
- (3) B. Clark, *The Higher Education System* (Berkeley, University of California Press, 1983) pp. 107—110.
- (4) P. Cross, *Adults As Learners* (San Francisco, Jossey Bass, 1983).
- (5) See D. Bok, *Higher Learning* (Cambridge: Harvard University Press, 1987) pp. 114—158.
- (6) See, for example, M. Dertuzzos, R. Thurow, R. Solow, *Made In America* (Cambridge, MIT Press, 1989), M. Poire and C. Sabel, *The Second Industrial Divide* (NY: Basic Books, 1984), and N. Hakino, *Decline and Prosperity: Corporate Innovation In Japan* (NY: Harper Row, 1987).
- (7) See H. Cleveland, *The Knowledge Executive* (NY: Dutton, 1985).
- (8) *The Corporate Classroom*, op. cit., pp. 1—20.
- (9) See K. Ohmae, "Managing In A Borderless World", *Harvard Business Review*.
- (10) See R. Wigard, "Integrated Services Digital Networks: Concepts, Policies and Emerging Issues" *Journal of Communication*, Winter, 1988, pp. 29—49.
- (11) European Economic Community, *Delta Project* 1985.
- (12) Shoshana Zuboff, *In The Age Of The Smart Machine* (NY: Basic Books, 1988) pp. 1—19.
- (13) C. Argyris, *Reasoning Learning and Action*, (San Francisco, Jossey Bass, 1982).
- (14) See R.S. Sternberg, *The Triarchic Mind*, (NY: Harper, 1988); "Cognitive Science and Education", *Cognitive Science*, June 1988, pp. 21—44.
- (15) M. Gardner, *Frames of Mind*, (NY: Basic Books, 1987).
- (16) J.R. Anderson, *Cognitive Psychology and its Implications*, (San Francisco: Freeman, 1985).
- (17) J. Segal, S. Chipman and R. Glaser ed. *Thinking and Learning Skills: Relating Instruction "To Basic Research" vol. 1.* (NY: Hillsdale 1988).
- (18) See R.E. Snow, "Individual Differences and The Design of Educational Programs",

- American Psychologist*, vol. 41, pp. 1029—1039.
- (19) D.G. Bobrow, "Dimensions of Representation", in D. Bobrow and A. Callins ed. *Representation and Understanding Studies In Cognitive Science*, (NY: Academic Press, 1976), pp. 1—34.
- (20) R. Sternberg, *The Triarchic Mind*, (NY: Harper, 1988).
- (21) A. Rosensleuth and N. Wiener, *Philosophy of Science*, vol. 17, pp. 318—326.
- (22) M. Cole, *Education In Cultural Perspective* (NY: Basic Books, 1983).
- (23) See D. Michael, *On Learning To Plan: On Planning To Learn*, (San Francisco: Jossey Bass, 1979).
- (24) A. Astin, *Achieving Educational Excellence*, (San Francisco: Jossey Bass, 1984) and C. Jencks, *Inequality*, (NY: Doubleday, 1975).
- (25) A. Guttman, *Democratic Education*, (Princeton, Princeton University Press, 1987).
- (26) G. Psascharopoulos and M. Woodhall, *Education For Development*, (NY: Oxford University Press, 1986).
- (27) See P. Watzlawick, *Change*, (NY: Norton, 1981).
- (28) D. Boorstin, *Hidden History* (NY: Oxford University Press, 1985), pp. 170—195.
- (29) See Tony Adams, "Computers in Learning — A Coat of Many Colours", *Computers and Education*, vol. 12, No. 1, 1988. pp. 1—7.
- (30) A. Luehmann, "Should The Computer Teach The Student of Vice Versa", R. Taylor ed. *The Computer In The School*, (NY, Teachers College Press, 1989).
- (31) R. Degl'Imocenti and M. Ferrais, "Database as a Tool for Promoting Research Activities in the Classroom — An Example In Teaching Humanities", *Computers and Education*, vol 12. No. 1, 1988. pp. 157—163.
- (32) M. Schwartz "Computer Software For Critical Thinking", *Computers and Education*, Vol 12. No. 1, 1988, pp. 163—168.
- (33) S. Brand, *The Media Lab*, (NY: Harper, 1987).
- (34) Allan Martin, "An Adaptable Micro World for the History Classroom", *Computers and Education*, Vol 12, No. 1, 1988, pp. 169—172.
- (35) E. Weiner and A. Brown, "Human Factors: The Gap Between Humans and Machines", *The Futurist*, Vol XXIII, No. , June 1989, pp. 9—11.
- (36) D. Dennett, *Mind Design* (NY: Plenum, 1985).
- (37) See W. King, "How Effective Is Your Information Systems Planning?" *Long Range Planning*, Vol 21, No. 5, 1988, pp. 103—112, and W. Ramsley, "Towards a Framework for Analysis of Country Active In the Field of Information Technologies and Education", *Journal of Education Policy*, Vol 4, No. 2, 1989, pp. 135—148.
- (38) M. Porter, *Competitive Advantage*, (NY: Free Press, 1987).
- (39) See M.R. Smith, "Technologizing Office Work", *Society*, Vol. 26, No. 1, June 1989, pp. 65—72.

Moderator: Thank you very much, ladies and gentlemen. According to the information in front of you please take and enjoy your lunch.