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Cybernetics, eLearning and the Education System

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Abstract

This paper is based on the author’s inaugural lecture, delivered on 22 May 2003. The paper is dedicated to the memory of two recently deceased thinkers: Ivan Illich and Stafford Beer. The paper first gives an overview of the contribution they made to illuminating the nature of institutions and their organizational structure, in particular, the education system.

Learning technologies challenge accepted models of educational organization. Developments since the 1970s are examined, identifying how the three strands of learning content development, computer mediated communication and learning management have become integrated in Learning Management Systems (LMS) made possible by the World Wide Web.

It is argued that mainstream LMS offer restricted pedagogic opportunities if they are adapted to existing organizational forms, instead of being used relax organizational constraints. Beer’s work provides us with tools for the redesign of educational systems to make most benefit from new technologies, guided by Illich’s critique of formal education.

Keywords


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Biography

The author is Professor of e-Learning at Bolton Institute of Higher Education. He has worked as a teacher and manager in education and training for thirty years, in schools, post-16 education, and Higher Education. He has been involved in learning technology developments since the early 1980s, managing the design, creation and application of a number of eLearning systems including most recently the Colloquia Learning Management System. Previously he was the founding Director of Bangor University’s Centre for Learning Technology (CeLT) where he also established the JISC National Centre for Educational Technology Interoperability Standards (CETIS), now relocated to Bolton Institute. His research interests are in the application of cybernetics and systems theory to develop models of how technology, pedagogy and organizational structure influence and constrain each other in the process of educational change.
Introduction

This paper is dedicated to the memory of two leading thinkers of the second half of the twentieth century: Ivan Illich and Stafford Beer, both of whom died in 2002. Illich was concerned with the damaging effect of the structure of schooling on society and individuals, and Beer with the pathology of organizational structure in a rapidly changing environment. In the author's view, their work is of major relevance today, and their ideas can help guide us in the adoption of technology and the necessary and urgent accompanying redesign of the education system. In the last three decades, new information and communication technologies have provided opportunities for the design of new organizational forms and new pedagogic models and methods, and this has accelerated since the emergence of the Internet and the World Wide Web. New ways of presenting ideas and information are widely available, and can be searched for and accessed from any location. New forms of communication – email, discussion groups and instant messaging – allow learning discussions to take place free of time and space constraints. New tools are available that help people to manage their time, resources and business relationships in new and effective ways. Despite this, the education system is being slow to adopt these new opportunities, and continues to provide an education that is structurally similar to that of fifty or a hundred years ago. What is it that we wish to achieve through the education system? What are the unintended consequences? How can we improve the system? What is the best use of technologies? This paper discusses how the ideas of Illich and Beer can shed light on these questions, and provide tools to help with the transformation of the system to allow better pedagogy, and more appropriate organizational forms through the thoughtful application of technology.

Ivan Illich (1926-2002)

Born in Vienna in 1926, Illich grew up in south-central Europe. He studied natural science, philosophy, theology, and history. During the 1950s he worked as a parish priest among Puerto Ricans in New York City, but after several disputes with the Church he left the priesthood and founded the Centro Intercultural de Documentación (CIDOC), which became an internationally respected focus for intellectual discussion.

Illich's radical views first became widely known through a set of four small and provocative books published during the early 1970s: Tools for Conviviality (1973) [1], Energy and Equity (1974) [2], and Medical Nemesis (1976) [3], preceded by Deschooling Society (1971) [4]. In these he critiques what he calls "radical monopolies" and "counter productivity" in the technologies of education, energy consumption, and medical treatment. He challenges society to find ways of redesigning institutions to once again serve the needs of all people in respectful ways, through what he calls “institutional inversion”.

In the early 1970s, Deschooling Society was required reading on most education courses, when this author first encountered and was affected by its message; every page is full of powerful polemic. Illich was concerned with how schooling has become obsessed with curriculum content, and how the system forces students to accommodate this view:

"Many students, especially those who are poor, intuitively know what the schools do for them. They school them to confuse process and substance. Once these become blurred, a new logic is assumed: the more treatment there is, the better are the results; or, escalation leads to success. The pupil is thereby "schooled" to confuse
teaching with learning, grade advancement with education, a diploma with competence, and fluency with the ability to say something new." [5]

The struggle between the advocates of content knowledge and those promoting process skills continues to this day, and is particularly evident amongst learning technologists.

Illich argues further that we need to develop institutions and technologies that allow people to engage with each other creatively and autonomously, and for values to emerge from these interactions, since, in his words:

"...the institutionalization of values leads inevitably to physical pollution, social polarization, and psychological impotence: three dimensions in a process of global degradation and modernized misery... most of the research now going on about the future tends to advocate further increases in the institutionalization of values." [6]

In the present day, the UK government has embraced the institutionalisation of values as a central theme of their approach, as evidenced by many of the Prime Minister’s speeches, values not as emergent agreements between people and communities, but existing independently of people and needing to be inculcated through education, seen as the instrument for developing “good” citizens.

Illich was concerned that formal education was costing increasingly huge amounts, sums that the developing world could ill afford. However, many compelling arguments are made that education provides a potential route out of poverty; unfortunately, this is difficult to justify. Indeed, despite the enormous widening of participation in Higher Education worldwide, social mobility has decreased [7]. The real purpose of the education system, he argues, is to provide access to social roles and status:

“Learning and the assignment of social roles are melted into schooling by the combination of education and certification.” [8]

So in his view formal education is more concerned with providing mechanisms that sort participants for a range of future roles – hence the evident concern with systems for examination and certification, which many commentators see as being somewhat arbitrary – especially for the purposes that they are eventually used. We now see increasingly less skilled occupations demanding ever higher levels of certification in unrelated subjects. This is as true for higher education awards as it is for school matriculation:

“...university has become the final stage of the most all encompassing initiation rite the world has ever known.” [9]

Attendance at leading universities has long been the portal to leading positions in the civil service, and the subject studied is not seen as the primary concern. As Higher Education has expanded, its role in giving access to employment and status has grown. With current figures of those attending receiving Higher Education approaching 50%, soon all but the most menial of jobs will require a university degree – despite the fact that previously many of the same jobs were successfully undertaken by people without.
Perhaps the most lasting concept Illich provided was that of the hidden curriculum, the curriculum that is transmitted through the patterns, processes and relationships that make up the education system. The hidden messages of formal schooling tell us that knowledge can be broken into one hour chunks, and that subjects are independent of each other. They tell us about the importance of hierarchy and obedience, and about the passivity of instruction as represented by the apparatus of schooling – lessons, timetables and so on. Those who fall in line become successful and progress; rebels “fail” until they can be coerced into getting more educational “treatment”. Learners’ views are disregarded. It can be argued that the modern fashion to think of students as “customers” is simply another way of disenfranchising them.

In addition to his powerful criticisms, Illich makes proposals for a different approach to facilitate learning. Using surprisingly modern sounding language, he suggests the following be put in place:

- Reference Services to Educational Objects, which facilitate access to things or processes used for formal learning.
- Skill Exchanges which permit persons to list their skills, the conditions under which they are willing to serve as models for others who want to learn these skills, and the addresses at which they can be reached.
- Peer-Matching, a communications network which permits persons to describe the learning activity in which they wish to engage, in the hope of finding a partner for the inquiry.
- Reference Services to Educators-at-Large, who can be listed in a directory giving the addresses and self-descriptions of professionals. [10]

It may be that modern learning technologies finally make it possible for these recommendations to be realised, or as is suggested later in this paper, are actually taking place now on the Internet.

Stafford Beer (1926-2002)

Stafford Beer is widely acknowledged as the founder of management cybernetics. Cybernetics emerged as an interdisciplinary science in the middle of the 20th century, originally defined by its inventor Norbert Wiener as “the science of control and communication in animal and machine” [11]. It brought together thinkers from many disciplines looking for new viewpoints – from mathematics, engineering, biology, anthropology, psychology and others. Beer redefined cybernetics as “the science of effective organization”, and applied the insights that came from this fertile development to the management of social organizations. In the 1960s he was one of Britain’s leading management scientists and consultants, becoming president of both the UK and the US Operational Research Societies, and advising major corporations and national governments on policy matters. His early books Cybernetics and Management [12] and Decision and Control [13] were best sellers in the management field. He was a member of the governing board of the BBC, and a founding member of the Open University’s Board, and played a large part in developing the partnership between these two organizations.

In 1971 he was invited to advise President Allende of Chile on the design of its social economy. As is documented elsewhere [14], this project came to an untimely end with the overthrow of the democratically elected government by Pinochet’s forces. This had a profound effect on Beer, and his subsequent work and writing focused on the diagnosis of global organizational – political, economic and cultural - systems. He spent much of his time as a visiting professor at some 20 universities worldwide,
including for many years the Manchester Business School, encouraging students to think holistically and to abandon the narrow instrumentalist views promoted by much of management education.

The work for which Beer is most famous is his Viable System Model. In this major work, Beer applies the ideas of another renowned British cybernetician, Ross Ashby [15], to the design of an abstract model of any system capable of independent existence – any living organism and many social systems. These, he argued, depend on having some sort of communication or nervous system that connects the parts into an adaptive whole, one that is capable of self-regulation and adaptation to the changing environment in which it exists. In many ways this work anticipates later concepts of learning organizations [16], but in the author’s view, provides deeper insights.

The VSM has been well elaborated and explored in many publications [17] [18] [19] [20], and there is not the space in this paper to do justice to the model. However, a brief description and summary of the key ideas follow.

Beer argues that organizations exist to manage complexity (or variety, to use the cybernetic term). They permit a group of people to organize themselves to solve problems of greater complexity than they could as individuals. However, the larger the organization, the greater the complexity they create themselves through their actions for their management. Ashby’s Law states that “only variety can destroy variety” – that the controller of any system needs to match its complexity. This can be achieved in one of three ways: the controller must amplify their own complexity in some way to match that of the controlled system; the system’s complexity must be attenuated somehow; or some combination of the two. Beer’s VSM applies this to an organization trying to control (or adapt to) its environment, and also to management trying to control the organization (figure 1).

Beer argues that if an organization still exists, it must be handling this problem. However the real test is if environmental change increases significantly and its viability is challenged. Because of technological innovation, the environment that organizations operate in is changing faster than ever before, and many traditional organizational structures are under great stress to adapt to the resulting pressures – the education system is no exception.

A key principle on which the VSM is based is the principle of recursion: that every viable system contains and is contained by other viable systems. This structural recursion or fractal structure makes organization modelling much simpler, once the viable subsystems of the organization under consideration have been identified. Figure 2 describes a possible unfolding of recursions for the education system.

The key to identifying recursive layers is the establishment of the primary activities of an organization. For a university these may be research, teaching and certification. From this position the finance or personnel departments of a university are not primary activities, and thus are not viable subsystems.

Each recursive level in the VSM has a similar structure: it has a management or regulatory aspect (the large square in figure 3) and an operational aspect (the large circle in figure 3). The management box itself comprises 3 subsystems, which Beer calls systems 3,4 and 5, but which can be thought of as operational management or...
control; intelligence; and policy. The control subsystem is concerned with the internal operations of the organization, whereas intelligence is concerned with external (environmental) questions – what the organization might do to given Operational control and intelligence need to be richly connected to ensure that one does not dominate the other: if operations take precedence, the organization may fail to adapt; but if intelligence dominates, the organization may be weak in delivering its commitments. If conflicts arise between these two systems, then system 5, or the policy system, needs to resolve them. From a complexity management perspective, it is important to note the role of policy: it is not necessary for the board to know or understand all issues, but to ensure that intelligence and operation function well and are properly balanced. Too often organizations have senior managements that attempt to micro manage operations, or “know” what adaptive actions should be taken. Examples of this from education include government deciding how teachers should teach, and how universities should manage their finances; or senior managers controlling how and what research should be undertaken in individual departments. The VSM suggest that these matters are best left to people at the appropriate level, but that support and coordination frameworks need to be put in place to avoid problems arising, and not by direct intervention or ever growing rule bases. Teachers should be left to negotiate their work with their learners within a supportive framework; universities should be allowed to manage their finances in the best interests of their stakeholders, within a global education framework; research matters should be the concern of researchers within a global institutional research framework, if we are to avoid only short term goals being met.

Managing the internal operations of an organization also has several aspects. Following the principle of recursion, management need to regulate the operation of its viable sub-systems, collectively referred to by Beer as system 1. These need to have a clear resource bargain with operational management, establishing deliverables and resources needed. This channel needs to be available to allow for renegotiation as factors change. To avoid conflict arising between sub-systems, a strong co-ordinatory framework is needed (system 2). Examples of coordination are timetabling and scheduling, but may also include aspects of financial, personnel and other “service” management that allow sub-systems to work cohesively. Finally, the operational parts of sub-systems need occasional and irregular monitoring (system 3*) to ensure that problems have not arisen – more akin to health monitoring than auditing. These three channels – systems 2, 3 and 3* - need to handle all the complexity that operations represent, and each channel needs to be designed with appropriate amplification and attenuation. Finally, and crucially, sub-systems need rich channels that permit lateral communication between them – permitting self-organization.

Together, these provide an abstract model for any organization – a company, a school, a religion, an ant-hill. Structural recursion allows each sub-system to be modelled in exactly the same way, with connections between the various systems of different level recursions.

The model can be used to diagnose organizational problems, and to design new organizational structures and processes, and it has been widely applied to many varied organizations over the last forty years or so. As far as the education system is concerned, it allows reflection on the structure of traditional education at multiple levels, from the classroom to the national education system (figure 4); and it provides an approach to thinking about the potential role of new learning and
information technologies. It focuses attention on the where complexity needs to be managed without determining how it should take place: according to Beer, how this is done is an ethical question.

The Traditional Education System

The education system in the UK has a long history, and most of its instruments and processes were designed for a different age, an age when knowledge grew slowly, when the needs of industry were simple and predictable, and when societal structures were better defined. The complexity of knowledge was dealt with through categorisation into well defined academic subjects. This allowed institutions to organize themselves into subject based departments, define courses, curricula and syllabuses, and lesson or lecture programmes. This has made knowledge manageable, but much is lost in the process. Interdisciplinary study becomes difficult, new subjects find it difficult to find a home, and generally, education becomes rigid. It is not the requirement of knowledge to have this structure, but rather the need of traditional educational establishments.

This structure constrains the educational options available to learners, who have to be fitted into its structure. They typically need to choose from lists of available courses, and have to be assessed for their suitability to study these. This usually results in so-called “ability” groupings, and typically, teaching proceeds as if all students in a cohort were identical, separated only by final examination results. But people do not easily fit these categories. They have different personal histories, aptitudes, interests, desires and preferred ways of learning. Fortunately, the efforts of teachers and the willingness of learners to forgo their uniquely individual requirements allow the system to continue.

The education system has evolved a complete and comprehensive structure that supports the model outlined above, comprising sectors (primary, secondary, further, higher), and support systems (certification bodies, inspection, publishers, libraries, validation procedures); the system works... so far. But the stresses in the system are beginning to show, provoked in part by the life long learning and widening participation agendas. People now want to participate in defining their learning agendas, and want to engage more actively in the learning process, at precisely the time when education resources are stretched to the limit. A system designed for the transmission of pre-defined content makes it difficult to organize individualised learning, small group learning, problem based learning or any other pedagogical approaches that are more learner-centred. The result is that at a time when process skills are increasingly demanded over the factual knowledge, skills involving team working, problem solving, evaluation, interpretation, application, interaction and so on, it is becoming increasingly difficult to provide these.

Many would support the views expressed in the last paragraph, but the education system and its institutions, designed for earlier times, prevent change from happening without enormous effort. Initiatives to promote choice, such as modularisation, have not achieved the expected results, having become subverted by the needs of subject departments as cost centres to maintain student numbers. Instead of providing a co-ordinatory framework for the higher education sector,
league tables encourage defensiveness and isolation. Instead of institutions providing a context where departments can collaborate, competition for resources is encouraged. Instead of encouraging cooperation between students, teaching and assessment methods encourage individualised passivity. The results are low autonomy and deskilling at every level. The VSM suggests that if attention was paid to providing rich communication and coordination channels, and to maximising autonomy at all levels, then education could be higher variety, provide more choice for learners, and enable better adaptability. Better frameworks to facilitate coordination are needed, not more powerful instruments for control, if we want education to become more flexible and adaptive at all levels. Technology can be used to allow students to collaborate while pursuing individual approaches to learning subject content, instead of all following the same course in the same way. Technology can be used to help teachers to work together to develop and share resource bases and teaching strategies; and technology can be used to help institutions to collaborate to better serve their students, instead of competing for student numbers. Government should seek to encourage this through the better design of the global system, encouraging coordination and cooperation between sectors and across institutions, and should spend less effort on constant and invasive inspection. Deming, the founder of Total Quality Management argues that quality should be assured through system design, not by increasing inspection [21].

The perceived crisis in education has been of concern for many years and every government has had its answers. Increasingly they have looked to eLearning and information technologies to provide solutions, especially since the explosive growth of the Internet and the World Wide Web. There is no doubt that these technologies have great potential for learning and the organization of education; but it is their design and application that determines their impact, and it is evident that people have widely differing views about their proper use. To understand these it is necessary to reflect on the short history of learning technologies.

Elearning – a short history

Computer based learning technologies have been around since the 1950s, but really began to make an impact after the advent of the micro-computer in the 1980s. This predated the widespread availability of the Internet, and so the assumption was that the computer was a standalone machine, and thus being used by a single user. Consequently early learning technology focused primarily on content-based software with some interactivity, and there was significant development in multimedia, hypertext, microworlds and simulations. The ultimate aim of this “computer content” approach was to achieve intelligent tutoring, where the computer would have total mastery of the subject and was able to assess and respond to learner needs. However, the promises of visionaries in the 1980s have not yet come to pass, although some still cling to them [22] and some doubt whether this vision can ever become reality [23].

In parallel to this, the 1980s also saw the growth in interest in online communications for education, and dial-up bulletin boards and conferencing systems began to appear, including for example systems like Prestel for Education in the UK, offered by British Telecom. The Open University in the UK was an early adopter of conferencing for education as described in Mason and Kaye’s seminal book, Mindweave [24]. In the same book Linda Harasim, (now CEO of Canada’s Telelearning Networks of Excellence) envisions the radical possibilities of collaborative technology: “If we approach this new domain from old mindsets (such
as theoretical frameworks underpinning traditional face-to-face or distance mode education), we may be applying metaphors that are not only limiting as a perspective but perhaps even misleading. We need to recognise the distinct nature of on-line education ... if we are to realize the potential of this new domain for augmenting educational options and opportunities.” [25].

In the 1980s there were also the beginnings of interest in the use of technology as an aid to support teachers managing the learning progress of their classes, recording and assisting with the assignment of learning activities [26]. This emerged from the management problems inherent in classrooms that adopted an individualised approach to supporting learner-centred learning. From a cybernetic viewpoint, this was an example of teachers trying to amplify their capability to respond to the complexity of their students’ learning needs through the use of resource bases; computers had the potential to make the recording of activities allocated and tracking of student progress much easier.

The arrival of the Internet, and the World Wide Web suddenly made it possible for all three of these aspects - content delivery, communications, and learner management - to be integrated into a single system, and Learning Management Systems (LMS) or Virtual Learning Environments (VLEs) began to emerge, offering online access to computer based materials, providing communication tools, and allowing teachers to provide assessments, track students, build course materials and manage the whole process.

It is, however, an over-simplification to think of Internet based VLEs as just assemblages of older technologies, since the Internet has transformed each of the parts in particular ways. It has permitted an explosion in content availability, and easy access to it that is way beyond what was available on CDROM, for instance. Information in the Internet can be more up to date, it can offer access to multiple viewpoints as well as offering interactivity; but it also raises questions of reliability, it raises problems of searching and browsing, and thus demands better evaluative and research skills on the part of the user – teacher and learner. Secondly, as far as communications are concerned, the widespread availability of tools such as email, conferencing, instant messaging, chat, groupware and group gaming or role playing has resulted in an enormous global community of people interacting online. Thirdly, technologies that enable the extensibility of the Web, including Perl, JavaScript, Java, Active Server Pages and most importantly access to database technology, have permitted value to be added to these content and communication tools, and resulted in the rapid growth of VLEs in the late 1990s. There are now a great many systems that fall within this category; the Edutools website has a review of 51 course management systems, and is by no means comprehensive [27]. Although many are functionally similar, especially the market leaders, others promote different pedagogic models and are more radical in their structure [28], which focuses on knowledge building rather than content transmission).

For those concerned about the constraints of the formal education system, VLEs at first seemed to offer new possibilities for learning. They promised to lift the constraints of time and geography, allowing learners to have access from any location at times suited to them, but while still allowing them to part of a learning community in constant contact and not isolated distance learners. They offered the possibility of realising a range of pedagogical models embracing active, open, collaborative and learner centred learning; and indeed, conceptually VLEs have the potential to deliver on these promises. Unfortunately, the widespread adoption of
VLEs by colleges and universities has seen the emergence of market leaders that while certainly providing for new models of access, do not promote pedagogical diversity, instead opting for an online version of the traditional delivery model. They do not provide learners with tools to organize themselves, they do not easily permit group learning, they do not easily support group or problem based learning, and they do not easily integrate with the wider Internet, instead creating a “learning ghetto“. On the Internet, people are meeting each other in chat rooms, running Weblogs, engaging in various eGroups, answering each others’ questions on “Ask” websites, and sharing resources using peer-to-peer systems: none of these features is typically available in leading VLEs.

**Illich, Beer and e-Learning**

Why is this? Why, when a technology that can finally realise the self-determined and self-organized educational models that Illich argued for has become widespread, is it instead applied to reinforce the old models he criticised to forcefully? Antonio Dias de Figueredo, in his presidential address to the European Commission’s PROMETEUS initiative, puts it powerfully:

“Most current developments in the use of modern technologies in education and training are... little more than relatively naïve transpositions to new environments of the much criticized educational paradigms of the past.

Driven by an invisible force that calls us to the past, we seem to keep putting emphasis mainly on the delivery of information, that is, of content, almost completely disregarding interaction and activity – the context, the completely renewed social and cultural contexts that the new technologies are pleading to offer us.” [29].

For universities especially this inability to exploit the powerful new discursive capabilities of the Internet is of concern. As Diana Laurillard points out [30], higher learning is concerned with worldviews, with the acquisition of the concepts and distinctions of a discipline, its discourse; and this is best learnt through practice, though engaging in the discourse. This requires a form of cognitive apprenticeship [31], where a rich conversational engagement between learners and teacher can take place; it cannot be achieved just through the learning of facts. The Internet provides new tools to support this, but the leading VLEs are not exploiting them. Thus there is a mismatch between what people are doing on the Internet, and what leading learning environments are providing. The Internet empowers people by giving the possibility of control over content and organization; many VLEs shift the locus of control further away from learners and teachers to institutional management.

The reasons for this failure are systemic. The structure of formal education has become ossified, after centuries of operation, and is unable to change to make use of these powerful new tools. The mechanisms that were used to make widespread access to education possible have become inevitable. For example, the division of knowledge into subjects and subjects into curricula made it possible for an institution to structure itself and plan how it manage the provision of learning. But by embedding it so tightly in educational culture it has prevented interdisciplinary learning, and curricular sequencing has constrained learners to a narrow range of options for traversing a domain. Learners are put at the mercy of a subject and curriculum based system, and have to be graded and sorted in order to fit them to
the system. Another example is the timetable, which provides a powerful mechanism to coordinate learners and teachers; but usually it constrains learning to take place in arbitrary length chunks, and demands that students switch from subject to subject at the behest of the clock.

Both of these are examples of an approach to managing the huge complexity of knowledge on the one hand, and learners on the other. They are nothing to do with effective learning or teaching. However, since this way of organizing education has become so predominant, for many the discussion of pedagogy has become confused with the exploration of what is possible within these constraints. Politicians argue for a return to formal teaching – chalk and talk – as if this represents good pedagogy, instead of a way of managing a classroom of different individuals with a single teacher to transmit a curriculum. To make the prison of the formal model even more secure, an elaborate examination system exists that reifies the curriculum, along with a publishing machine that pushes materials to reinforce the curriculum and that require large sales to be economic. So what began with the best intentions, to provide access to education for the masses, and has become a self-justifying machine that bores and alienates many bright young minds, while compelling them to longer and longer “treatment”. This is not the fault of any individual or group: it is a property of the design of the education system, and the technologies that were available when it was first built.

The inertia of the elaborate edifice of the education system resists change, and it requires more than technology or new pedagogies to make change happen; it requires organizational redesign. For this we need to revisit the fundamental purposes of education, what we seek to achieve, and how best to do it. Illich’s critique is of more relevance than ever, and we need to heed his words. How might we invert our institutions so that they truly support the educational development of our population, achieving their wishes and ambitions while respecting their individual histories and interests? Do we want people who can engage in debate about current issues of concern, who are curious, creative and confident, who can identify what they want to learn and manage their own learning? Or are we happy for them just to know lots of facts, and have certificates that verify this? If it is the former, is the traditional school or university the best option we have to achieve this in the modern age?

Technology is providing tools that provide radical new opportunities for education, but simply adding technology to the existing mix is not enough. We need to use technology to develop better pedagogies, and most importantly, to redesign educational organization at all levels, from the course to the national system, to allow potential benefits to be realised. How can we negotiate individual learning programmes with lifelong learners? How and with whom might they engage in the discourse of their chosen learning paths? How can we coordinate groups of learners to enable collaborative learning while preserving individuality? What is the proper role of assessment? What is the best way of organizing institutions, and what role should they play? What can the government do to encourage progressive change? Beer gives us instruments to design systems that can fully exploit the potential of new technologies to both organize ourselves without the loss of freedoms that the formal education system imposes. This is not a trivial task, but nor is it impossible.

We need to design a system that encourages the best use of the skills and knowledge of teachers and learners, and encourages collaboration between learners, between teachers, between institutions, and between education, work and culture;
and we need to abandon the current competitive paradigm that drives wedges between people. This requires radical change at all levels, but if we can grasp the opportunity that technology affords us, then we may be able to see an end to the boredom that many learners experience, to certification being valued over learning, and to the repression of creativity and curiosity. Illich has provided us with insights into the often unintended consequences of formal schooling, and Stafford Beer’s insights into the nature of organizations give us powerful tools for reinventing educational institutions. Together these can help stimulate a research agenda that explores the co-development of pedagogy, technology and organizational structure. Suddenly there are new possibilities; are we brave enough to seize them?

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![Figure 1: The Simple Viable System Model](image)
Figure 2: Recursions of the Education System

changing opportunities and threats.
Figure 3: The full Viable System Model with two recursions
Figure 4: The VSM applied to the classroom and the institution