

**Learning in the Information Age**

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**Abstract**

There is widespread belief that society is moving from the industrial age to the information age. This paper discusses what is meant by the term information age and how society will differ from the industrial era of the previous two centuries. In particular it considers the impact upon learning, both in terms of differences in the type of learning that will be required to survive and thrive in this new era, and of the new and improved methods it brings which might enhance the learning process.

## **What is the Information Age**

The 1990s heralded an era of dramatic and rapid improvement in information and communication technology accompanied by price falls which made the technology accessible to an ever-increasing audience. The proliferation of the Internet and World Wide Web gave this massive audience unprecedented access to vast quantities of information, as well as enabling communication and the formation of alliances unhindered by physical distance or national/political borders.

Numerous commentators have remarked that this new period will have an impact upon society as great as that seen by the industrial revolution of two centuries previously which saw the emphasis shift from agriculture to manufacturing. This new era has been variously termed the *information age*, *new economy*, *information society*, *knowledge economy* etc. The reality of the concept (at least) is witnessed by Google [<http://www.google.com>] searches returning 770,000, 880,000, 643,000 and 173,000 hits on these four phrases respectively. This paper uses the term information age to reflect the author's belief that the enormity of technological change will have more than just an economic impact.

Small [2002] believes methodologies which were successful in the industrial age are no longer applicable due to the inherent unpredictability of rapidly changing technology. "It is not just that there are new rules or that some of the rules have changed. The new rules which apply in the digital world of communications and e-commerce are sometimes the exact opposite of the proven and accepted dogmas which apply in the conventional world".

## **Characteristics of the Information Age**

Change in the industrial age tended to be planned and predictable. This is no longer the case. Intel founder G. E. Moore observed in 1965 that computing power was growing exponentially, doubling around every eighteen months (specifically Moore's observation concerned the number of transistors per square inch, but it has been shown to be valid for processor power and data density). Moore's observation continues to hold and has become known as Moore's law.

The industrial age has been dominated by large corporations. Their size meant they could benefit from economies of scale and provided high entry barriers to would be competitors. Big corporations are generally organized as militaristic style hierarchies with a chief executive officer delegating control through numerous layers of management to operational personnel at "the bottom". Operational staff were usually employed on rigid contracts with fixed job descriptions and much of their role could be described as algorithmic (eg a worker might be trained to pull lever B whenever light C comes on).

IBM was a classic example of the large industrial age corporation. Its fall from grace as the world's leading computer manufacturer has been attributed to its inability to respond fast enough to the changing market. Whittle [1997] writes "nimbleness offered change, ready or not, to the market before IBM could because of its rigidly hierarchical structure that devalued individual initiative."

The rapidity and unpredictability of change inherent in the information age will demand increased responsiveness and flexibility from the businesses and organizations of tomorrow. Top-down hierarchies will be replaced by more egalitarian ad-hoc teams and partnerships in which all members are valued and rewarded for their individual ability to contribute to the whole. The job description will be consigned to the wastepaper basket as roles change continually to take advantage of ever-evolving opportunities.

One of the perversities of the industrial age was that it would spend several years and thousands of pounds training individuals to do particular jobs. As soon as they had mastered their chosen

field they would be encouraged to aspire to promotion to management, at which point they would cease to carry out the role they had been so expensively prepared for.

The exalted status of management found in traditional hierarchies is likely to diminish as self-managed teams increasingly become the standard organizational model. Companies that have experimented with self-managed teams have found impressive results.

Williams [1995] reports that "3M has seen [self-directed work teams] make improvements in products, services and processes while increasing customer responsiveness and flexibility. At the same time, these teams have lowered operating costs, increased productivity and decreased cycle times." Armstrong [2001] reports that self-managed teams at Bell "gained a whopping 26% sales increase and a 6% customer service quality increase" over more traditionally managed teams. Allen and Economy [2000] report successes of self-managed teams in organizations as diverse as the San Diego Zoo, Boeing and the Star Tribune newspaper.

In an article for Wired magazine, Kelly [1999] predicted the number of enterprises in the U.S. would double by 2020 and that the number of workers per enterprise would halve to just three. It further predicted that many workers would be engaged in more than one enterprise, a phenomenon it terms "polyemployment". This suggests society is moving from the division between managers and managed to a situation where everyone manages, or owns, their own career.

The information age has the potential to empower individuals, economically and otherwise. In addition to raising the status of the humble employee, we now have access to greater information than ever before allowing us to make more informed decisions as consumers and citizens. We have greater choice in how we spend our hard-earned money, and have a greater range of businesses and service providers from around the globe competing for our custom.

It is often said that knowledge is power. Traditionally knowledge has been jealously guarded by those in authority, either in government or boardrooms. In the information age knowledge, and thus power, will be diffused.

Traditionally the mass media has been few-to-many in nature. A relatively small number of publishers and broadcasters have been able to transmit their message for passive absorption by the masses. The Internet and World Wide Web offer a many-to-many communication medium. Every individual with 'net access can speak to the world through the numerous discussion forums such as USENET or the many proprietary bulletin boards, or by publishing on the Web.

### **Challenges of the Information Age**

The shift in the role of the citizen from that of industrial age "factory fodder" to empowered individual brings unprecedented potential and opportunity, but it also bestows greater responsibility. It is said that a little knowledge is a dangerous thing, but now we all have access to considerably more than a little. This suggests the need for appropriate learning opportunities to be accessible to all.

For many the case of having access to insufficient information has been replaced by the new problem of having access to an overwhelming amount of information, so much so that it can be almost impossible to find what we need from the morass of irrelevance clogging the metaphorical superhighway. This has been termed "information overload". The ease with which anyone from college professor to disturbed adolescent may publish "information" demands a high degree of discernment on the part of the seeker.

This paper has thus far considered the impact of the information age on humanity as a whole. In technologically sophisticated countries it is now reasonable to assume that the vast majority of the population will have some form of access to information and communication technology.

However, it is sobering to reflect that some 90% of the world's population does not have Internet access, based upon figures by Global Reach [<http://www.glreach.com/>], September 2002. These tend to be the people of the world's least developed countries. For them, far from being a liberating and empowering force, technology threatens to exacerbate their disadvantage by further excluding them from the information-centred world.

### **What is Learning?**

Learning may be defined as the process of gaining knowledge, skills or experience. Meaningful learning is that which equips the learner to apply his/her newly acquired abilities in authentic and novel situations.

We all learn throughout our lives as a result of our experiences and our reflections upon them. However, this paper is concerned only with learning as a process that has been consciously chosen by the learner and/or educator.

Learning is an active process. Learning cannot occur without the involvement of the learner. The best educators are those that most successfully create the conditions under which learning may take place.

People learn for a variety of reasons. The most basic of which is survival, this is why we learn what's good to eat and what isn't and who we can trust. A further reason is societal pressure. In most developed countries the law requires that children receive full time education for a decade or so. Family and peer pressure can also be a powerful motivator. The realisation that increased knowledge and skills lead to a higher status and better-paid job also drives us to learn. And many choose to learn purely out of interest and/or enjoyment.

There are a number of (competing) theories of how learning take place. Additionally, a number of different learning styles have been suggested. Whilst psychology has yet to provide a definitive explanation of the learning process, it seems clear that learning can be of different types, and that different people learn best in different ways.

### **Learning and Education**

The vast quantity of information freely available to anyone seeking it, raises the question of what role education may play in the information age. The following suggests some possible answers:

- Often, learners are unaware of what it is that they need to learn. Education can guide the learner through the mass of available knowledge towards that which is most appropriate to their particular needs.
- Whilst children are born naturally curious about their world they might not have the natural desire to acquire the basic literacy, numeracy and other skills essential to modern citizenship. Education can "sell" the advantages of mastering these basics as well as providing a taster of the broad range of fields of human endeavour with a view to enabling the individual to identify those he/she wishes to pursue further.
- Education can provide feedback on the learner's progress. It can identify strengths and weaknesses, provide more detailed explanation in the case of difficulty, and provide remedial pathways where appropriate.
- Reputable educational institutions can provide learners with certification as proof they have attained a certain level of competence in a given discipline.

### **Learning Theories**

B.F. Skinner (1904-1990) is associated with the approach to learning known as *behaviourism*. Skinner conducted experiments in which pigeons and rats were taught to obtain food pellets by performing certain actions, eg pecking a lever a certain number of times. Skinner asserted that

learning occurs through operant conditioning. This is based upon the idea that organisms operate on their environment. If an action has positive consequences for the organism it is more likely to repeat that action, if the consequences are undesirable then the action is less likely to be repeated. [PageWise, 2002]

Skinner's approach has been used "to teach mentally retarded and autistic children, ... in industry to reduce job accidents, and ... in numerous applications in health-related fields." [PageWise, 2002]. However some kinds of learning are not easily explained by conditioning, eg "those cases where skills are used in a highly flexible way, as in the use of language; ... where people do things that lead only to intangible rewards; ... where people appear to learn passively by observing others' actions". [Tennant, 1997]

Skinner's 1971 work "Beyond Freedom and Dignity" drew criticism because it appeared to deny the essential human attributes of free will and dignity and declared "man's actions were nothing more than a set of behaviours that were shaped by his environment, over which he had no control." [PageWise, 2002]

According to Tennant [1997] the influence of behaviorism on adult education is "most apparent in the literature on behavioural objectives". Behavioural objectives are formulated using language that refers to observable behaviour only, eg "describes", "identifies", "explains", "predicts"...

Criticisms of such predefined objectives include:

- they are inappropriate for certain types of learning, eg music, drama etc.;
- they fragment learning into many narrow categories and in so doing fail to address the "big picture";
- they are concerned only with the outcomes and not the process of learning;
- they cannot describe the acquisition of general ideas which are applicable in a variety of contexts;
- they cannot account for subjective outcomes, eg the development of self-concept;
- they ignore peripheral learning, ie that which lies beyond the formal syllabus but frequently occurs in any course of study;
- they do not account for changing learner needs as learning takes place.

The theory of *cognitivism* was developed in response to observed deficiencies in behaviorism, eg Bandura and Walters [1963] found individuals could produce behaviour without it being reinforced, merely from observing it in others, and this behaviour could appear some time after the initial observation. Cognitivism seeks to understand the internal processing which takes place between stimulus and response.

A key feature of cognitive theory is that of the schema, our internal knowledge structure. The schema concept was described by Piaget in relation to infant and childhood learning, but is also applicable to adults. When we encounter a novel idea we may, if it fits our existing schema, *assimilate* it into our current understanding. Where it conflicts with what we believe we must change our schema to *accommodate* the new knowledge. [Hayes, 2002]

A particular challenge to behaviourism came from Chomsky's theory of language acquisition. Chomsky argued that human beings are endowed with an internal understanding of the fundamental rules of language that allow us to develop language skills far in excess of those which would result purely from environmental conditioning. Gross and McIlveen [1997] give the following evidence supporting Chomsky's view:

- language acquisition appears to occur in a culturally universal and invariant sequence of stages;
- native speakers use language creatively, i.e. they are able to produce sentences of a form they have not previously encountered;
- children spontaneously use grammar rules they have never heard or been taught;

- the meaning of a sentence is more than the meaning of its individual words and varies according to context;
- babies as young as two days have been shown (by Eimas) to be able to discriminate between 'ba' and 'pa' sounds;
- studies of twins (by Malmstrom and Silva) have shown the existence of private languages intelligible only to the twins, such languages share certain features with ordinary languages.

Knowles (1913-97) differentiated between the needs of adult learners and juveniles and used the term *andragogy* to describe the specific methods which should be employed in the education of adults. Smith [1996] summarizes Knowles' andragogy thus:

- The adult learner moves towards independence and is self-directing. The teacher encourages and nurtures this movement.
- The learner's experience is a rich resource for learning. Hence teaching methods include discussion, problem-solving etc.
- People learn what they need to know, so that learning programmes are organized around life application.
- Learning experiences should be based around experiences, since people are performance centred in their learning.

Andragogy requires that adult learners be involved in the identification of their learning needs and the planning of how those needs are satisfied. Learning should be an active rather than a passive process. Adult learning is most effective when concerned with solving problems that have relevance to the learner's everyday experience.

*Constructivism* asserts that people construct their own individual mental models of the world in order to make sense of their experiences. Learning is the process of adding to or refining this mental model. The key to effective learning is thus to involve the learner as actively as possible in the learning process.

On Purpose Associates [Constructivism] describes how constructivism impacts on learning:

- There is no standardized curriculum. Curricula are customized to the students' prior knowledge, and hands-on problem solving is emphasized.
- Educators focus on making connections between facts and fostering new understanding in students. Instructors tailor their teaching strategies to student responses and encourage students to analyse, interpret, and predict information. Teachers also rely heavily on open-ended questions and promote extensive dialogue among students.
- Assessment is part of the learning process and students play a larger role in judging their own progress. There are no grades or standardized testing.

Significant proponents of the constructivist approach include Bruner and Jonassen.

Kearsley [Constructivist Theory (J. Bruner)] identifies three key principles arising from Bruner's work:

- Instruction must be concerned with the experiences and contexts that make the student willing and able to learn (readiness).
- Instruction must be structured so that it can be easily grasped by the student (this may be achieved by "spiral organization", in which the same concepts are revisited multiple times with greater detail and complexity being added with each treatment).
- Instruction should be designed to facilitate extrapolation and/or fill in the gaps (the learner should be encouraged to go beyond the information given)

The importance of dialogue is stressed by Jonassen, quoted by Mergel [1998], who states "Constructivists ... believe that much of reality is shared through a process of social negotiation..."

### **Learning in the Industrial Age**

Industrial age education generally took place throughout childhood, adolescence and early adulthood, ending (apart from occasional training courses) once working life began.

In the traditional model students sat in rows of chairs facing a teacher standing before a blackboard. The teacher would speak and the students made notes, occasionally asking questions. Students would complete exercises to test their comprehension and practice their ability to apply the subject matter. The teacher would monitor progress and offer guidance before demonstrating the correct solution and method.

Students might be given assignments to complete outside class which drew upon what they should have learned. At the end of the session students sat a timed examination and were expected to recall appropriate parts of the material in response to the exam questions. Students would often "cram" for exams - memorising large amounts of relevant facts and figures immediately prior to the exam, only to forget most of them just as quickly as soon as the paper had been completed.

The traditional educational model could be described as a behaviourist approach to learning, although its methods were in use long before the development of behaviourist theory. This style of education was well suited to industrial age society where individuals had rigidly defined roles in which carrying out certain actions under certain circumstances would generally yield the desired results.

### **Learning in the Information Age**

The information age has replaced the relative predictability of the industrial age with an increased degree of uncertainty that will require greater levels of flexibility and adaptability in order to survive and thrive.

Workers will be more involved in the planning and decision-making processes. Individuals will need to develop the discernment required to make sense of the mass of facts, figures claims and counter-claims that surround them.

Education will need to change from being a process of conditioning to one of empowerment. Learning will need to change from being a homogeneous commodity to a customized experience tailored to the needs and characteristics of the individual. Learning will no longer end in the teens or early-twenties. Instead it will continue throughout life as individuals need to continually update knowledge and skills to keep pace with ever-changing technical and social conditions.

In order to meet the learning requirements of the information age learning opportunity providers should adopt a more constructivist approach to learning, creating conditions in which learners may learn by actively engaging with realistic scenarios and exchanging views and experiences with peers and mentors. The following section describes how technology may provide powerful solutions for the delivery of high-quality learning suited to the needs of the age.

### **The Potential of Learning Technology**

In addition to shaping the desirable outcomes of the learning process the information age offers potential enhancements to the ways in which learning may take place.



Technology provides near instantaneous access to vast quantities of information and learning materials at near zero cost to anyone with Internet access. Educationalists may provide a pathway through the mass of available content by means of selective, quality-assured directories and search engines, effectively forming subject-specific "digital libraries".

Technology may relieve the "loneliness of the long distance learner" by providing asynchronous communication channels bridging both temporal and geographic distance. A major function of learning environments is the ability they offer learners to communicate with both peers and tutors irrespective of physical locality or time zone. There is enormous learning potential in the exchange and discussion of ideas.

Technology offers the potential of delivering a personalized learning experience to individual learners. People have different strengths and weaknesses and learn in different ways. In a classroom setting the same experience is delivered to every student. In technology mediated learning a unique learning experience may be presented to every learner based upon individual characteristics and performance in previous lessons.

Technology can provide models and simulations that actively involve the learner to a greater degree than was ever possible in classroom-based learning. The learner is able to receive feedback on his/her interactions with the system and is thus able to learn by doing within the safety of the virtual world.

For further detail on the potential of learning technology see Finnis [2003].

## **Conclusion**

Society is moving into a new era. An era of rapid change and inherent unpredictability driven by ongoing advancements in information and communication technology. This new era will impact upon every aspect of society.

Citizens of the information age will need different kinds of skills to those that served them in the industrial age. They will need to be managers of their own destiny. They will need to find relevant information from the morass of freely available data. They will need to interpret and evaluate what they find. They will need to adapt to ever-changing conditions. And they will need to learn throughout their lives.

Traditional behaviourist approaches to education will no longer be sufficient in the industrial age. Education will need to adopt constructivist principles to empower learners through an individualised and active learning experience. However, constantly improving technology can provide exciting new ways of delivering that learning.

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