Identifying educational core competencies for the Information Age

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Abstract: The Information Age cries out for education to be re-conceptualised, re-structured and re-vitalised from its Industrial Age model. Information has become a tacit, taken-for-granted entity, which education has ignored. If education is to capitalise on the opportunities offered by the Information Age, many bold steps have to be taken. A novel course titled *Information Search and Analysis Skills (ISAS)* was developed, based on a specially designed monthly publication *IT-Digest*, to train thousands of students in ICT. The course offers students a mechanism by which the very subtle transformation from data to information to knowledge can be clearly understood and practised. The paradigm shift from teacher-driven to learner-driven follows, as an obvious consequence of course objectives. The paper converts this experience into a full proposal for a core-competency course on information literacy and information skills. Such a course has very wide implications, as it could also be made independent of subject area, cultural and language issues.

Keywords: Information literacy, knowledge as a resource, social issues

1. INTRODUCTION

“Now, as never before, the prospects for a human future are exceptionally dismal.”
Konrad Lorenz (1989)

Lorenz sees great dangers and feels that the survival of any species is at risk, when sections of it compete for dominance. He sees one ray of hope and that is in education. And yet, it could not be the same education that has

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got humans into the present predicament in the first place. Many sages of education (led by Ivan Illich, 1973) warned that something was wrong ages ago, but somehow education seems to have a mind of its own.

The aim of this paper is to derive, formulate and propose an entirely new course, as a core course for all school curricula. This is felt necessary in view of the challenging Information Age paradigms that confront us. Present day school systems are deeply entrenched in traditional and established forms of education and training, and see no reason to change. However, what has been the result of these forms of education? Education was presumed to be the fundamental stepping stone towards progress and a better life. But are we any nearer towards humans achieving a better life?

And now education can make use of the advancing technologies beyond all expectations. What to do with what appeared to be a golden opportunity?

2. THE DAWN OF A NEW TECHNOLOGICAL ERA

The Industrial Age had assisted man in his manual or physical tasks only. The raw materials as input, the processing and the finished products were well-understood entities, often even by the general public. Such material production had little direct influence on fundamental education.

Computers and associated technologies now came to lead Man into the Information Age. Entirely new paradigms entered the scene. The fundamental clarity of purpose was no longer there. There was the headlong rush towards reaching out towards the unreachable. ICT seemed to expand that reach. Artificial Intelligence led to Intelligent Tutoring Systems and to Expert Systems in an effort to capture the essence of human understanding and expertise. Simulation seemed a more effective educational support than real live experience. The final triumph was to mimic life itself through the notion of Artificial Life. Human algorithms and heuristics seemed to be the order of the day, and even raised ethical issues.

It was then found that the new information thrust, brought about by these technologies, had much wider implications and ramifications than had been imagined. While Industrial Age technologies were designed to meet specific and well identified (closed) ends, such was not the case with ICT which deals essentially with open systems. These systems had built-in, and unexpected, potential for expansion and proliferation into society. The ultimate example of such an open information system is of course the Internet.

Let us consider a few well-known manifestations of ICT impacts on society, analysing the underlying concepts and issues in detail. In particular, we will monitor how these would have direct effects on educational needs.

2.1 The three computer ages

Any technology, using information, have serious consequences on humans and their inter-relationships. Let us consider some societal impacts of a simple telephone. Taken in the light of Marshal McLuhan's statements on the "global village" and the "media is the message", this indicated that it were not the actual messages (and their meanings) that were transferred over telephones that mattered. It was the societal fact of "intimate interconnectivity" that telephones had established. The same decomposition can be done for ICT. This results in three ages, see Table 1.

Table 1. The three ages

THE THREE AGES	INTERPRETATIONS
AUTOMATE	Computers are used to automate various processes (the Data Processing Era)
INFORMATE	Computers function as Information Systems , for example MIS (Management Information Systems)
TRANSFORMATE	As information capability percolated into society, it began to transform society (this results in the re-engineering of businesses to adapt to the information and knowledge environments).

The Industrial Age did not have such levels of influence, ranging from the machine to its applications and effect on society. The Industrial Age certainly affected the various aspects of life, for example, various forms of transportation, increased human connectivity. However, this was in a physical sense only. The Information Age however increases information connectivity, and information is man's powerful logical and decision-making tool, which ultimately leads to the enhancement of his knowledge.

This increase leads to the global village effect. It results in reduced distances between people, through instant communication across the globe. The Internet appears to be a source of unlimited information not only for being informed, but also for learning, publishing and so on. This opportunity offers the business community scope for very wide markets, and e-commerce has the potential to alter the face of business.

2.2 From material production into the productivity of the Information Age

The Agricultural and Industrial Ages were intimately linked to the production of physical or material goods. With the thrust towards achieving more efficiency and productivity, the paradigm of the factory system was established to achieve greater efficiency and productivity, leading to mass production. Associated was the concept of hierarchical management (the pyramid). With the focus on exploiting nature and the physical world, science and technology evolved, together with associated educational initiatives.

In the Information Age, with its emphasis on a service orientation, value systems had to be re-conceptualised. Though the central player was information, there was a problem. The word “information” had been absorbed into society and had become a tacit, taken-for-granted entity. This resulted in slogans such as “Information is Power”. No one wondered how exactly information became an economic factor.

Numerous theories had evolved through the ages, invariably considering an environment of the Industrial Age. For example, leading learning theorists often based their studies on analogies between animals and humans. Obviously the emphasis was on the physical environment. How applicable would these theories be if we are to shift into an information environment? How would educational strategies and theories change? With the introduction of Cognitive Science, especially with regard to learning, one would have expected studies in information to play a leading role. However, somewhat analogous to Computer Science and Information Science, Cognitive Science also ignored information as a core subject of societal interest.

The disciplinary era was synonymous with the Industrial Age and mainly focussed on science, technology and the understanding of nature and the environment. However, the Information Age has networked people so effectively that the soft sciences play a significant role. Knowledge is now generated not in closeted libraries and research laboratories, but in “man-built” human environments. So the very nature of knowledge, which education reaches out to, has drifted from its traditional mould. This has resulted in a drift from discipline-based (depth-based) education to trans-disciplinary (breadth-based) approaches.

2.3 From data to information to knowledge

If students are to fit into the Information Age, they should be familiar with the fundamental terms: data, information and knowledge. Yet education

chooses to ignore this aspect, almost consciously. But more important than just being familiar with the exact usage of these terms, is for students to know how they relate to the Information Age. And most importantly, how are data transformed into information and information into knowledge, and how are such transformations made possible and experienced (Isaac, 1997a).

While entities like knowledge management, data mining and virtual communities gain in prominence in the Information Society, students and the public have little awareness of what they signify. Just as in the Industrial Age, various educational mechanisms were applied to meet well-defined goals. However, there will be serious deviations. While industrial age educational goals were set on the basis of scientific content and stability, information age goals have to be set on the ability to meet competition and tackle variability. The information age will have to lay more stress on how information can be used to shape more innovative and creative work environments. Transformations between data, information and knowledge begin to gain significance (Liebowitz, 1999).

By enabling information and knowledge to be available at every street corner, the role of the teacher as a repository of knowledge is no longer valid. The teaching role turns into that of a facilitator in accessing information, and the teacher-driven world makes way for a learner-driven one. This calls for re-thinking on the very nature of educational systems.

2.4 From knowledge to skill emphasis

The Information Age may be thought of as a technology, thus going through 3 stages before being absorbed into society. This model indicates how the human needs, especially education and training, evolve through the stages. This also builds a case for information skills, see Table 2.

Table 2. Stages in education

TECHNOLOGIES:	Stage 1: CREATE	Stage 2: DEPLOY	Stage 3: USE
Technology requirements	Innovation and creativity	Deployment into society	Absorption and proliferation into society
Emphasis	Conceptualisation, development,	Deployment, awareness, marketing	Business promotion, towards building user communities.
Human need: knowledge to skills	Scientific knowledge	Marketing skills	Promotional skills business skills
“Education” versus “Training” needs	Education high training low	Transition stage	Education low skill high in large community of users
Human interaction	Individual	Transition	Inter-personnel

In the Industrial Age the connotation of “skills” was related to manual labour and low-level tasks. Hence, rarely did one compare skills with education, which remained on a pedestal. However, in the Information Age it is not manual skills that prevail, it is “information skills”. This concept will be very fundamental to the course to be proposed. If one were to consider the Management Pyramid, manual skills would be restricted to the lowest rung of the pyramid in the operational level only. However, information skills are the tools of management at all levels of the hierarchy. While excellence in manual skills would bring little additional returns, the same cannot be said for information skills. In fact, in principle, information skills can get one to the very pinnacle of management pyramid.

2.5 How should education respond to these Information Age imperatives?

All major educational paradigms have been set by the Industrial Age, and most strategies remain based on them due to educational inertia. Yet from the above it can be seen that there have been dramatic upheavals and changes, from all points-of-view in educational needs, society and the business environment. The educational response has been to introduce numerous new initiatives and strategies: such as CBT, instruction design, distance education, flexible learning, linear/non-linear learning, learning styles, computer-based collaborative learning, learning-to-learn, technology facilitated learning, performance centred design, constructivism, Just-in-Time, Just-What-is-Needed, Just-Where-it-is-Needed, cognitive apprenticeship, learner modelling, adaptive authoring systems, and so on.

However, in practically all cases, it is the rate of change in educational needs, brought about by the Information Age, that is being catered to, not the root or core educational need of the Information Age itself. Also the attention seems to be on new and innovative methodologies and strategies and not on identifying the fundamental core “content” per se.

The purpose of this paper is to consider the complexities brought about by the Information Age and the potential opportunities that it offers. This then leads to the definition of “Information Literacy” as a core competency (see also Vockel and van Deusen, 1989 and Isaac, 1997b). We will outline an Information Literacy course, the ISAS course, which has been tried out on thousands of students in the domain of ICT education. However, the mechanisms and strategies used are applicable to school environments.

3. THE CORE COMPETENCY: INFORMATION LITERACY

With the critical issue being information and its understanding, Information Literacy is the core competency that we are searching for. It is the competency that enables one to understand the world of information and to acquire the necessary “information skills”. These skills can be taught from the very early standards in schools. The crucial issues will be in getting students to understand the concepts of data, information and knowledge; and the possibility of conscious conversions from one to the other in project contexts. They will have to be provided with an “Information Laboratory” in which to experiment and hone up their information skills.

Interestingly, as will be seen, the projects assigned in this ISAS course not only require the student to consciously exercise information skills, but also acquire skills associated with several other holistic and integrative tasks associated with general education. Students first work as individuals (in the data and information phases) and then as teams (in knowledge or integrative stage). A major learning from this approach is that students gain experience in tackling open-ended real-life problems, and find their own answers to hitherto rarely discussed, or unanswered, issues and questions. Examples:

- Why are there so many subjects in a school curriculum? In what ways do they support or complement each other? Are there any relationships between e.g. history, geography, English and mathematics?
- What are the different functions of a social organisation and how do they serve society (or a municipality or county council, club, etc.)?
- How would you perform a study on the functioning of a selected school body (the library, a sports body, a school club)?
- How would you provide a comparative study on media effectiveness for various media (radio, TV, Internet, conversation, books, newspapers)?

When confronted with questions of this open nature, most students would not know how to even start, there seem to be so many issues, and yet no specific issue! How can the problem be given a more meaningful “known” context, so that some constructive activity can be initiated? What information sources would be most relevant and where would they be found? What follows after all the information is collected? How does one proceed with individualised information, and how does one integrate findings from different sources? How can final conclusions be arrived at? How does one gain confidence and acquire proficiency, in such problem situations?

The aim of the course described in this paper is to train students through systematic information processes to acquire general competencies and experience in facing such open-ended questions. However, a crucial fall-out is that the information skills acquired are easily transferable to all other

academic activities and studies. Each project will be an exercise in data acquisition from relevant sources, conversion to information (in their own contexts), and then to knowledge (as an add-on to world knowledge). Further, these skills are life-long assets in a world of change. Thus the Information Literacy course becomes a “Core Course”, which enables students to acquire fundamental skills and methodologies which re-vitalise all forms of study and learning.

4. THE ISAS COURSE: INFORMATION SEARCH AND ANALYSIS

The ISAS course was designed for use in computer career programs of one of the world’s largest organisations (NIIT Ltd.) dealing with computer education (annually over 100,000 students). ISAS, at different levels, is used in all four six-month semesters in which students are trained on various software systems and applications (including the Internet and Web-based applications). The objective of the course is to equip students with all tools required as a computer professional in addition to technical competence. Professionals need to be aware of government policies, industrial norms, companies, personalities, imports/exports, commercial needs and so on, tempered with technical know-how and competence. ISAS attempts to train students for this professional world. Obviously, while placed in the specialised area of ICT, the course will have to be adapted and fine-tuned for other contexts. As ISAS was for students of ICT, it necessarily has an ICT bias. To give a realistic feel for the course, the ICT bias will not be entirely removed when applied to other areas. The justification for this is that even general students do have to pick up a certain amount of computer and information awareness, which is imbedded in the ISAS course.

4.1 Tools used by ISAS

ISAS several support materials for instructors and students. Here only the essential items to understand the course will be given. The course has a detailed Student Guide (theoretical background and problem sets) and Instructor Guide (further inputs on the data-information-knowledge process) for each semester. The sources of information inputs play a key role, and in this case, we bring out a special “abstracting and indexing” service called “IT-Digest”. This is a monthly publication that is brought out in hard copy format, and recently is also made available to students at some centres

through the Intranet. Brief descriptions of these will be given, as they are essential to understanding the intent and modality of the course.

4.2 The Student Guide and Instructor Guide

Contents: A comparative study of the three ages: Agriculture, Industrial and Information, is given against numerous parameters (production processes, tools used, societal implications, educational impacts and so on). Questions and exercise assist deeper understanding. In particular the Information Age introduces radical departures from normal thought and understanding. The notions of data, information and knowledge are derived from the primary communication aspects of signal, sign and symbols.

4.2.1 Defining data, information and knowledge

Table 3 gives a first level simplified model, used in order to explain fundamental concepts.

Table 3. Data, information and knowledge

ITEM	DESCRIPTION/FUNCTION	EXAMPLES /USAGE
DATA	A Representation of facts, entities, ideas, a set of "raw" fields	The teacher writes "1011" on the board. Use: Has no meaning to user. At most can be reproduced later (memory).
INFORMATION	Data + a set of descriptions define its meaning to the user. Required for user "interpretation". HOW or in what form is the representation, and WHAT is being represented, i.e. the context to the user.	Again "1011" Let us convert this into information for the user: - It is a decimal number. - It is the number of students in a college. Use: The user can interpret and use this information in his/her own context.
KNOWLEDGE	Information + a set of rules, regulations or conventions, governing its application in a user context. Intelligence is problem-solving ability using information and knowledge.	Again "1011", but represents a "knowledge base" to the user. A knowledge base is a networked collection of information or knowledge nodes, related to each other by rules, etc. Use: The number is given as the "average" number of student in city colleges. It is assumed that the user is aware of the number of colleges and the rules by which averages are calculated.

Undoubtedly, there is a great deal of abstraction involved with the above, yet this may be expressed in simpler ways at lower classes. Similarly, the abstraction can be raised to higher levels also. For example, students can be told that the above is an example using numbers. Can a similar example be given using only alphabets? Or, symbols only? This of course has to be extended to words, sentences, and above, as understanding grows.

4.2.2 What is information? Why the Information Age?

A closer study of the above reveals that the data and knowledge are representational levels (can be captured in a computer and are not dependent on purely the user context). These two levels may be said to be “passive” (or “static”) levels. However, information is the operational or active level, in which the user actually interprets the data or knowledge in his/her context for application in a specific context. Users can obviously have different contexts. So all three levels are externalised only through the information modality. Therefore it is information that plays the key role. The Information Level may be said to be active (or dynamic).

All three levels can also be split into two categories, implicit and explicit. The implicit or tacit part implies personalised or individualised aspects, which can not be codified or captured in a computer. The explicit part is not abstract, and is therefore easier to understand, explain and formalise, and will be the one used in most of our discussions.

Information comes at various context levels. Let us consider information, which has economic consequences, What exactly is the function or purpose of information? How is it used? Information is used in “a continuum of social choices” from “control” to “co-ordination”.

4.2.3 Information usage: A continuum of social choices between co-ordination and control

Though in principle co-ordination (group or team activities) would be the more productive due to the synergism possibility, usually control is used, as in say advertising. One lesson that students can learn is that society gains

more by the identification of co-ordination, rather than control activities. The developed world has thrived on control activities, however, in the context of development, the developing world must turn more towards co-ordination.

4.2.4 Why are information and information goods/commodities so difficult to understand?

The Industrial Age paradigm made the understanding of material goods quite simple, particularly due to their tangible physical nature and the easy logic of barter as an economic tool. In fact, Man's notion of value was established in this context. However, when we arrive in the Information age, in which information and information goods are abstract intangible entities, problems arise. The notion of barter of information does not make sense, information given away is not lost to the sender (seller). The easy-to-understand concept of the gold standard is no longer valid. A new value system has to evolve, supported by abstract concepts such as Intellectual Property Rights (IPR). Such thoughts are totally shielded from present day school-going children. Yet they must be exposed to the fundamental concepts of how value gets ingrained into information, right from school days if they are to thrive. It is only through personal and group involvement with information studies that these abstract notions can evolve, and be better understood. As an information environment impacts on the individual, the group and society, education must bring about its awareness and implications at school level itself.

4.3 *IT-Digest: The information source for ISAS*

"IT-Digest" (ITD) is a monthly publication, specifically designed as an Information Laboratory to support ISAS. It is basically an abstracting and indexing service, which uses about 70 selected publications as information inputs. The diversity of publications makes it possible for students to have inputs from a variety of information sources and also to get familiar with their nature and intent. At present, the sources consist of 12 Indian newspapers, about 20 Indian IT magazines and journals, and some international publications. There is a diverse spread among newspapers, magazines and journals, as they will include not only commercial aspects, but also several levels of technical information. From these sources, articles are abstracted, indexed and also cross-indexed by information specialists. The emphasis for ISAS is now on ICT and related aspects.

The supportive role of ITD, as an information laboratory is essential to understand in the context of the core course to be proposed. A major aspect is that IT-Digest (ITD) is specifically designed for the course. For this, the

essential human element exploited must be acknowledged. ITD is not just one vast source of information. It's course-supportive features, include:

- Only relevant articles are extracted and classified.
- The articles are carefully indexed in a uniform way, irrespective of their original source. There are 15 categories, each further split into 3 sub-categories, ranging from computers (hardware, software, etc.) to communications to societal impacts of information. This results in an information access matrix which enables the student to integrate information into logical groupings.
- There are special sections, some specifically designed to tame the information overload. Articles are filtered and condensed into themes and sub-themes. The very human aspect of perception is captured through a few selected articles. A bibliography section covers a wide range of objectives: simplified explanations for the beginner and hundreds of classified references for the specialist.
- The *Annual IT-Digest* (each December issue), gives the user an annual index which links all articles of the year together – under the various categories and sub-categories.

4.4 STRUCTURE OF THE ISAS COURSE

The structure of ISAS has been carefully derived in order to get students to consciously understand and practice the processes behind the conversion

Table 3. An example of a group project

Group Project Assigned: Derive India's global ICT potential through study of 5 Indian ICT companies			
Phase	Mode	Main actions	Details
Phase 0: Project allotment (Group uses own criteria for company selection – diverse contributory areas or partitioned focussed area)	Group uses ITD and selects say TCS, WIPRO, CMC, NIIT and IBM (India). Covering software, hardware, applications, manpower, etc.	Case of individual student: say company allotted TCS. Identify nature of company, products, services, management strategies, performance ratings.	Plan to collect and organise facts on TCS: How to compile actual data, to be collected through ITD and other sources - focus on software.
Phase 1: Presentation and Report 1	Individual (in this case, focus on TCS data)	All facts and figures on TCS data	The student begins to organise and interrelate data (Software Co. TCS)
Phase 2: Presentation and Report 2	Individual (personal interpretation of data)	Begins to "interpret" data (information)	Builds case for TCS. Uses more expressive title. (Flagship)
Phase 3: Group presentation, and executive summary	Group ("putting things together")	Combining all 5 conclusions into consolidated "findings"	Networking of information into a knowledge base (global player)

of data to information and then to knowledge. The normal grouping of students is 5 and the duration of a course is six months. A theme, topic or project is given to the group. This theme has been logically split into 5 sub-themes. Table 3 shows a probable project in the ICT area, and we see how it is decomposed, in order to enable systematic training in the exploitation of identified Information Skills in the general processes of problem solving.

4.4.1 Linking course structure with the data / information / knowledge process

This is a crucial aspect of the ISAS methodology, as it illustrates the conversion from data to information and then knowledge. See table 4.

Table 4. Project phases and associated information skills

Project Phase	Phase analogy	Information skills called into play	
		Main Skills	Sub-skills
Phase 1	DATA	Focusing Information gathering Remembering Organising	Defining problems, setting goals Observing, formulating questions Encoding, recalling Comparing, classifying, ordering, representing
Phase 2	INFORMATION	Analysing Generating	Identifying attributes and components Identifying relationships and patterns Identifying main ideas Identifying errors Inferring, predicting, elaborating
Phase 3	KNOWLEDGE	Integrating Evaluating	Summarising, restructuring Establishing criteria, verifying

4.4.2 On the identification of information skills

In table 4 the information skills derived by Vockel and van Deusen (1989) have been used. For the ISAS course developed, the aim was to select a model that could be used most effectively for both teacher and student understanding. The main categories and the sub-categories enable suitable adaptations to the range of situations encountered in the course. Also, the information-skill resolution allowed permits the full power of this model to be explained in simple terms. However, information skills have been classified or modelled in various ways, by various researchers. One model organises the information skills in a pyramid of five levels, identified with the mode of use of the information received. The lowest level is the passive

level (receive, process, store, retrieve, circulate), then the reactive level, the pro-active level, the initiative and finally the causative (create demand). The model of Table 5 gives the progression from data to information, knowledge, education and finally wisdom.

Table 5. Model from data to wisdom

Entity	Information or thinking skill
DATA	Researching, Accessing, comprehending
INFORMATION	Critical and creative thinking
KNOWLEDGE	Linking, conceptualising, synthesising
EDUCATION	Application, judging, philosophising
WISDOM	Goal attainment

In general, specific meanings and functions assigned may vary slightly between researchers. However, the general import and intent remain substantially constant. It should make an interesting study to attempt to match these levels with the levels of Bloom's Taxonomy of Education - which has established itself as a standard. The lowest level in that model is knowledge, then comprehension, application, followed by analysis, synthesis and evaluation.

4.5 ISAS in summary

As students take up their successive semesters of 6 months each, the project levels are raised. They start with a data-orientation and gradually shift to a knowledge orientation. With experience, students devise their own stratagems for the data to knowledge conversion process. Such a process from data to wisdom is illustrated in table 6 below for a military context, using only a "So What" mechanism for eliciting information at each stage.

Table 6. From data to wisdom

<i>Input Statement</i>	<i>It rained heavily last night.</i>
Question to elicit more information	Responses to pro-active, but simple, queries
So What?	The ground will be wet
So What?	It will turn into mud quickly
So What?	If many troops and vehicles pass over the same ground, movement will be progressively slower and more difficult, as the ground get muddier and more difficult.
So What?	Where possible stick to metalled roads or expect movement to be slower than normal.

ISAS is a special course for ICT students intending to turn into ICT professionals. Hence, the Information Laboratory used *IT-Digest* and other support materials that were ICT-related. Students are not restricted to using only *IT-Digest*, but are encouraged to widen their input information sources. However, the process ensures that the student, after four successive semesters, has gained considerable knowledge that is expected to be possessed by an ICT professional. Such knowledge would include not only the technical content of the program, but also professional knowledge gained through ISAS. Such knowledge enhances the confidence of the potential employer, and the purpose of the course is served.

It was noticed that ISAS was also able to meet interesting side issues. Due to healthy competition between individuals and groups to excel, motivation was aroused automatically. The individual responsibilities in the first two phases and then the final group responsibility encapsulated some of the fundamental learning initiatives. Constructivism in student and group learning was built-in. The third phase enforced the formation of co-operative learning groups. The open-ended learning and involvement with an Information Laboratory often gave rise to serendipitous findings, a feature lacking in traditional learning, and yet, an essential component of learning in the Information Age.

5. DEFINING INFORMATION LITERACY

Information Literacy was first defined by Zurkowski in 1974 as the ability to use techniques and skills “for utilising the wide range of information tools as well as primary sources in moulding information-solutions to ... problems” (Kuhlthau, 1987). This definition still remains current and valid. However, the definition should take into account the totally changed information environment from the 1970s.

A more recent (1985) definition of the term, is provided by the American Library Association, Presidential Committee on Information Literacy, which states:

“To be information literate, a person must be able to recognise when information is needed and have the ability to locate, evaluate and use effectively the needed information. Producing such a citizenry will require that schools and colleges appreciate and integrate the concept of information literacy into their learning programs and that they play a leadership role in equipping individuals and institutions to take advantage of the opportunities inherent within the information society.”

However, the information environment has taken a totally new context since the proliferation of ICT, and the definition of information literacy should be suitably adapted. Particularly the advent of the Internet and its radically new paradigms had not been fully envisaged. Apart from the information onslaught, the student's major educational hurdle is change, particularly the rate of change. The smug complacency of Industrial Age educational paradigms will have to be shed. But then, what are the educational implications, as far as the student is concerned?

5.1 The educational paradigm shift: From teacher-driven to learner-driven

The aftermath of the Internet, virtual environments and the Information Age has resulted in a major shift of emphasis from the teacher to the learner. Educational systems, known for their inertia, have to respond to this call. As mentioned earlier, the response of educators has been to devise a series of new methodologies and strategies. However, none of these confront the educational challenge head on. The ISAS course fully supports the learner-driven paradigm, in which instructors essentially play the roles of facilitators.

5.2 Towards an information environment

With the merger of ICT, there was a major thrust towards the enhancement and aggregation of an information environment. Falling computer costs resulted in a wide proliferation into society. Even developing countries in which computers were still comparatively expensive found proliferation taking place. This was due to government initiatives usually taken on the grounds that the introduction of ICT would expedite developmental processes. Besides, the Internet was a powerful lure, as a cure-all for all information ills.

It may be recalled that the evolution of information usage first started as a conversation. Then scientific discovery and the printing press brought about an Age of Enlightenment in the form of the Gutenberg revolution. This was a period of hope for the growth of science and education. Then one started to realise that something was wrong, when the Internet seemed to arrive as a saviour. However, it must be realised that the US courts branded the Internet as a "giant conversation between people", which, if censored, would be tantamount to banning free speech. So society had gone full cycle from conversation to a return to conversation! It does not take much thought to realise that a conversation cannot give rise to an educational base.

5.3 Putting things together again

Just as in the case of the first conversation expanding into an intellectual explosion, so also it is expected that this second conversation will ultimately explode into an intellectual asset. However, at the moment, not only from a legal point of view, but also from an academic, the Internet is in a primitive stage and is an enigma with respect to extracting hard-core education. However, attempts are in progress to put things together again in the form of virtual universities, educational portals, and so on.

6. SCHOOLS OF THE FUTURE

With the current rapid-change environment and the full potential of the Internet yet to be achieved, planning for schools of the future presents numerous problems. The only solution seems to lie in identifying educational core entities, which could have lasting utility, despite the rapid change. Also there is no doubt that the proposed plan should be Internet-ready. While Internet may not at present have direct and crucial educational relevance, there is no doubt that it will be an important player.

It is in this context that it is felt that school courses can be modelled on the ISAS experience, as the emphasis is on information literacy and the acquisition of information skills. These initiatives are fundamental to the Information Age, and hence would have lasting value. They are particularly relevant to the change from one-time to life-long education.

We must not forget that in talking of the schools of the future, we can not ignore the schools in the developing world, which are highly significant in sheer numbers. What is being planned for them, considering that most of them do not have a computer or information environment at present? In the context of developing countries, there is a significant difference. A proposal that has been submitted calls for the introduction of information literacy in schools that do not as yet have computers. This is to get them to be information savvy, so that they prepare the ground for computer acceptance. However, it must be noted that through the process of co-ordination, developing countries could benefit greatly. Imagine for instance the implementation of a program to simultaneously teach six million primary teachers all over India (and that too in various languages!).

6.1 School core courses: Modelled on the ISAS experience

In many ways the school course could resemble the ISAS course in structure and intent, with appropriate minor modifications and extensions. As in the case of ISAS, it would be desirable to have a Student Guide and an Instructor/Co-ordinator Guide. These can vary their contents, depending on the level of the classes that they are intended for. However, the three phases of the individual/group project must be retained. The idea would be to get the students to gradually acquire an understanding of the conscious data to information to knowledge transformation process. This will be briefly illustrated with one of the sample problems stated earlier.

6.1.1 Case study

Let us assume a student group of five. The Group Assignment Project is: "Why are there so many subjects in a school curriculum?" The course duration for ISAS is six months. However, depending on the level, an appropriate number of months should be allotted. Individual Sub-Projects: This could be done in two ways: 1) The teacher assigns the subjects, say English, Mathematics, History, Geography and Physical Education, or 2) The five students could be asked to come up with five subjects that they would like to take up.

Table 7. A case study

Phase 1	Each student of the group begins a data search in class and school library, public library, magazines and books, the Internet, discussions with peers and teachers. It is the students' responsibility to systematically record all the data collected. All information skills, related to this level, should be consciously exercised. The data should be condensed, correlated and structured. The student should submit a written report and, if possible, present a short talk on his/her findings. An appropriate "data" level title should be used (example: Why should English be part of the curriculum?). This would be the data level of activity.
Phase 2	The student seeks more data if possible, and then begins to order and interpret the data collected. What does it all mean in my context? The student should plan how he/she will most effectively sell the study made to others. (The information title: "English: The Educational Foundation or The Stepping-Stone to Education".)
Phase 3	The five students have to present their cases to each other in open debate and then negotiate on the principle factors to be included in the Executive Summary Report (restricted to, say one or two pages only). This is the knowledge conversion stage in which the information items are networked in a logical manner, to publish the final group finding. (Possible knowledge title: "The Five Pillars of Education".)

Initially, the instructor assigns the project in either of the two forms above, after ensuring that information fundamentals have been studied from the Student Guide. Assume that the teacher has allotted the sub-projects. The group must initially evolve an appropriate strategy to carry out the project, with a view towards arriving at a logical conclusion to the project. Students should be familiar with information skills and their use. In Table 7 we explore the different phases of this case.

6.2 The one hurdle to this process

The success of the ISAS course was ensured due to the Information Laboratory environment provided to the student by the *IT-Digest*. The *IT-Digest* was most effective due to the human effort that went into it in the context of ICT only. How could this be substituted in the school scenario? The school learning can be in focussed areas at certain levels or may be totally open-ended. When it is focussed it should be possible to give a similar human support, but for the open-ended case there would be a problem. However, this problem is not insurmountable, after all, we are moving into an information environment.

At each level of the course, an appropriate level of an Information Laboratory would have to be created in order to enable a more focussed and educationally-guided search. In other words there should be a project list together with references to selected magazines, journals and books in the library and with supportive web-sites. The Internet effectiveness could increase at higher levels by having course supportive “information portals”.

In fact, even in the *IT-Digest*/ISAS combination, we are planning to expose students to more and more of Internet, as the competence builds. Obviously, if students can transfer their data-information-knowledge transformation skills into Internet, it would potentially be ideal.

7. CONCLUSIONS

In view of the dramatic shift from Industrial Age to the needs of the Information Age, and the rate of change, it is argued that a sustainable educational core competency has to be identified for schools of the future. From a study of the effects of the Information Age, information literacy has been derived as the core competency. Information literacy is vitalised by the acquisition of core information skills, which will serve as growing life-long assets in an expanding world of information. Information skills go a long way towards putting things together again, as they search for holistic solutions.

The course structure proposed is applicable both to developed and developing countries, as information literacy is a universal concept. Further it is not language or culture dependent. It is also a tool towards levelling the field between the “haves” and “have nots”, because above all information literacy is human, and not technology, dependent. Understanding information literacy should drive ICT and not visa-versa.

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BIOGRAPHY

J.R.Isaac completed his engineering studies in Bangalore, India and at the Carnegie Institute of Technology (now Carnegie Mellon Institute in Pittsburgh, PA, USA). He worked for two years at the IBM Research and Product Development Labs in Poughkeepsie, NY. From 1958 until 1990 he taught electronics and computer science courses, the last 29 years at the Indian Institute of technology (IIT) in Bombay, India. On retirement from IIT-B in 1990, he joined NIIT (National Institute of Information Technology) Ltd., New Delhi, as a senior advisor and he is also director of the Institute for Research in Information Sciences (IRIS), a division of NIIT.