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Connectivities of Content, Context, and Communication

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1. Disciplines: Grammar, Dialectic, Rhetoric
2. Aspects of Language: Structure, Logic, Effects
3. Technologies: Speech, Printing, Television
4. Orientations: Content, Context, Communication
5. Knowledge: Enduring, Collaborative, Personal
6. Domains: Culture, Knowledge Organisation, Learning
7. Modes: Access, Interpretation, Learning Processes
8. Conclusions

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1. Disciplines: Grammar, Dialectic, Rhetoric

The late Marshall McLuhan is best remembered for slogans about the medium is the message and the global village. These resulted from his study of implications of new media which began with a dissertation tracing the history of the *trivium* (grammar, dialectic and rhetoric) in Western thought. He became fascinated with the ways in which different media or modes of communication, such as writing, printing, radio or television brought changes in emphasis on either the structure of language (grammar), the logic of language (dialectic) or the effects of language (rhetoric).

2. Aspects of Language: Structure, Logic, Effects

McLuhan was very concerned with how the introduction of printing gave particular emphasis to an analytic approach which he associated with the logic of language (dialectic). He claimed that this led to a cubby-holing of knowledge resulting in narrow specialization. He was fascinated by the potentials of new media such as television in bringing back a more synthetic and wholistic approach to knowledge which bridged gaps rather than creating them. Hence McLuhan focussed on the interconnectedness of knowledge.[1]

To throw light on these historical shifts McLuhan typically resorted to lists of dichotomies or oppositions such as hot-cool, analytic-synthetic, left brain-right brain and so on. A shortcoming of this approach is that they presented many things as either-or which may, in fact, have been both-and. Evolution is often embracing rather than replacing. McLuhan acknowledged this to the extent that his dictum about the medium is the message was a claim that every new medium uses the previous medium as its content. Hence the telegraph uses print as its content; print uses writing as its content, writing uses speech as its content, speech uses thought as its content. Even so McLuhan also remained fascinated how new media nonetheless tend to push earlier modes into obsolescence (cf. figure 1).

Disciplines	Grammar	Dialectic	Rhetoric
Aspects of Language	Structure	Logic	Effects
Technologies	Speech	Printing	Television

Figure 1. Key elements in Marshall McLuhan's approach.

3. Technologies: Speech, Printing, Television

Another of McLuhan's ideas was that media such as writing, print and radio are effectively technologies in themselves (not just the pens, printing presses and transmission stations/receivers which make these possible), and as such can be seen as extensions of man. In McLuhan's view these media/technologies were aligned with the basic disciplines: speech with grammar, printing with dialectic and television with rhetoric. In other words each new medium led to specific new technologies/ instruments, connected with a specific discipline or a specific aspect of language. On closer reflection it becomes clear that McLuhan's particular approach with respect to the *trivium* led him to emphasize only certain dimensions of the technologies. McLuhan associated printing with logic (dialectic). But printing can also be linked with effects or rhetoric as in the case of propaganda (leaflets). Or it can be linked with structure as when books are treated as simple content. Television can focus on rhetoric and propaganda, but it can also provide structure and logic: it can offer content, context and communication.

4. Orientations: Content, Context, Communication

In our view the advent of digital media mark a fundamental change in the relations between these disciplines and technology. Once knowledge is in digital form one can change media. Hence, one can potentially take a printed text and publish it as an oral speech, as a written manuscript or even as a cuneiform tablet using techniques of stereo-lithography.

The advent of writing and even more so print fixed our attention on one of the senses, namely, sight as opposed to hearing used in speech. Digital media are potentially linked with all five senses: sight, sound, touch (force feedback), smell (e.g. Digiscent) and taste (e.g. Trisenx). Once one has digital versions of the senses, they are interchangeable. Hence, one can potentially translate digital visual stimuli into audio or tactile stimuli. These two developments, the ability to inter-change media and sense inputs/outputs have fundamental consequences for the future of technology and indeed will change radically our interactions with the world.

To appreciate these changes more fully, it is useful to begin by looking somewhat differently at the traditional disciplines. We can see them as means of distinguishing between orientations concerning content, context and communication. In the past, these disciplines focussed on one, largely to the exclusion of the other. Instruments and technologies were developed accordingly. Hence there were devices which dealt with (capturing) content such as the camera, and devices which focussed on communication such as the telephone. This led to content industries (publishing) and communication industries (telephone, television and radio broadcast industries).

It was gradually recognized that this view of technology as having a single purpose was simplistic. A camera, which was associated with capturing content in the form of recording specific objects, could also be for context, insomuch as it showed the environment in which an object was situated, and it could also be used for communication, as in news broadcasts. This is also the case with the pen, which can be used to produce content when writing books; to create context when adding annotations and to create effects as in ornamental writing or in propaganda.

It is noteworthy that McLuhan did not spend much time analysing technologies such as the pen or the camera which are connected with all three domains. In retrospect we can see that his approach led him to emphasize unique aspects of a given technology rather than their connectivities. A first consequence of the two developments outlined above is the phenomenon of convergence. Those in the content industries and those in the broadcast industries now find that they are in different parts of a single chain or process. Thus Time-Warner joins America On Line (AOL). Vivendi buys Universal and so on.

Some think this is the end-product of the digital revolution. In our view, this is only the beginning of something much more basic. Implicitly, the nature of instrument making and of technology is fundamentally changing. In the past devices were concerned with one of the three disciplines or orientations. Now devices are increasingly concerned with connectivities between content, context and communication.

Simple examples are evident today. In the past, television and telephones were seen as being very different. Television was broadcast, telephones were narrowcast. Television was seen as a technology for broadcasting content and the telephone was a technology for communication. Today, however, we have television programmes such as Big Brother where the content, namely, who stays in the programme, is dictated by viewers' responses via telephones. Meanwhile, the telephone, which was a communication medium is now becoming both a content and context medium through built in multimedia devices (e.g. Docomo's *Imode*).

The pen was a device for creating content, while the camera was a device for copying content. A new device such as the *Quicktionary* uses a pen-like device as a camera to provide content with context, using an electronic dictionary. The Anoto pen combines pen and camera functions to produce both content and context.

Such developments have given rise to at least two extreme predictions. One school believes that such trends are all part of the above mentioned convergence and that we are moving increasingly towards a new universal device in the tradition of the Swiss-Army knife. Meanwhile, another extreme predicts the opposite: that this will lead to an almost unending prolifieration of instruments, gadgets and devices. A glance at todays's market suggests that the latter view cannot simply be dismissed. What interests us here, however, are the methodological implications and potentials of these trends.

In this context it is important to include the Internet. Analysts constantly remind us that it took many decades to reach 50 million telephone users, less time to reach 50 million television users and only a decade to reach 50 million Internet users. Few

have noted that in the last six years there has been a tenfold increase in that number. As of December 2001 there are 529 million users. Never in history has one technology had such an impact. Even if less than 10% of the world population possess their own devices, through machines in public spaces (schools, libraries) and Internet cafés the impact of the internet is much greater.

5. Knowledge: Enduring, Collaborative, Personal

The Internet began largely as a communication device, a sort of asynchronous telephone, in the form of e-mail. This blossomed into a series of alternative forms of personal knowledge: MUDs, MOOs, MUSHs. Meanwhile, the Internet emerged as a new tool for collaborative work and collaborative knowledge. As such it became a context device, in that it allowed a networked group of individuals to add their own comments, annotations to a given document. In the past decade, the Internet has also become a content device. Increasingly it includes digital versions of the enduring knowledge in memory institutions (libraries, museums and archives).

In the past, enduring, collaborative and personal knowledge were very distinct categories, belonging to memory institutions (and academia); discussion groups and personal correspondence respectively. Enduring knowledge was the almost exclusive domain of professionals: professors, doctors, lawyers who knew and handed down their content. During the Renaissance and the Enlightenment, and even the 19th century, discussion groups outside the realm of academia were largely concerned with recreational activities: i.e. they did not challenge the authority of those in power who were responsible for the tradition (*tradeo* is literally to hand down) of enduring knowledge. Exceptions were the Freemasons and subsequently a number of political discussion groups or cells. Meanwhile, one's own views, personal knowledge, were private and neatly separated from public claims, and views.

Given the trend towards greater connectivities between content, context, and communication, there is increasing interplay between enduring, collaborative and personal knowledge. Evidence thereof is apparent on many fronts. In the realm of medicine and health, for instance, the Internet provides individuals with 1) enduring knowledge from memory institutions (e.g. the World Health Organization) ;
 2) discussion groups in the form of list serves and virtual communities, which arrive at their own collaborative knowledge concerning how best to treat and cope with a particular disease or condition and 3) the personal recommendations of individuals, sometimes trained medical doctors (e.g. DrKoop.com), sometimes not. In the past there was only one source of medical knowledge, the official medical doctor as unquestioned expert (in a long lineage from earlier shamans, witch doctors, and medicine men). Now there are three sources and even official, medical doctors need to take into consideration (sometimes misleading) knowledge which a patient may have acquired from elsewhere.

This trend is evident in other domains such as law or the environment. In the mid 1990s students near Paris gained access to satellite images of nearby forests and were able to contradict the claims of environmentalists and politicians with respect to the effects of acid-rain. Experts remain, but their role is altered, or as an some put it, the role of teaching is changing to learning, and the role of the teacher is changing "from the sage on the stage to a guide on the side."

In the past, teaching occurred in a specific place: the classroom. The teacher actively lectured or spoke: students passively listened and wrote in notebooks. At the end of the year they produced subsets of the notebooks in a final exam. Already in the 1970s, Mcluhan pointed to a shift in his *City as Classroom*, but as noted earlier this presented as an opposition something that should be seen as complementary: i.e. the trend is not from a past in classrooms in buildings to a future where classrooms are in the open air of cities, but rather one where learning takes place both inside and outside the classroom. Hence, we have "home-"work (for both the library and home) and we have field trips and other assignments which force us to study outside the walls of school/university.

We noted how patients and private individuals now use the Internet to access 1) enduring, 2) collaborative and 3) personal knowledge and use this to question their medical doctors. Medical students use the same resources to question medical doctors who are their teachers. There is evidence that this is happening in all fields of learning.

Educational theorists have many technical terms and buzzwords for this phenomenon. They speak of a trend away from passive education towards active learning. They speak of students as knowledge builders (junior versions of knowledge workers), as frequently explain the process as constructivism. Learning, they claim, is no longer copying what is handed down. It is more about problems than about facts. Learning is a process of searching, finding, discussing, annotating, commenting, in order ultimately to construct or build one's own knowledge package.

Some theorists claim that the process is much more important than the content: that learning to learn is more important than learning something specific, in which case, context and communication are all and content is no longer king. If that were so our memory institutions would be useless. A quick look back to experiments such as the Cultural Revolution is chastening in this respect. The educational theorists are very right to emphasize the importance of context (discussing, commenting, annotating in seminars and/or virtual communities). In retrospect this is nothing new: Plato and the Sophists before him emphasized the importance of discussions. The revolution underway is about new connectivities between content, context and communication.

This emerging world of connectivities goes far beyond the simple phenomenon of being connected, on-line, networked etc. It entails a basic change with respect to how we relate to both the physical world and to our knowledge thereof. It entails a re-organization of the whole of knowledge. In short, it entails new approaches to content, context and communication.

To understand the magnitude of these changes it is useful to use the example of a printed book as a point of departure. One can look at a printed book as typically having two or three layers. The first layer is the text proper. A second layer contains footnotes, which are effectively a version of primitive hardwired hyperlinks, primitive because they sometimes require looking to the bottom of the page, sometimes to the end of a chapter and sometimes to the end of the book.

0.Text

a.Footnotes

Internal
b. Bibliography

External
c. Bibliography

d.Reference
Texts

(levels of knowledge 1-5)
Sites, Groups,
Experts, Individuals

6. Source Text,
Image, Film, etc.

7. Internal
Analyses of Source

8. External
Analyses of Source
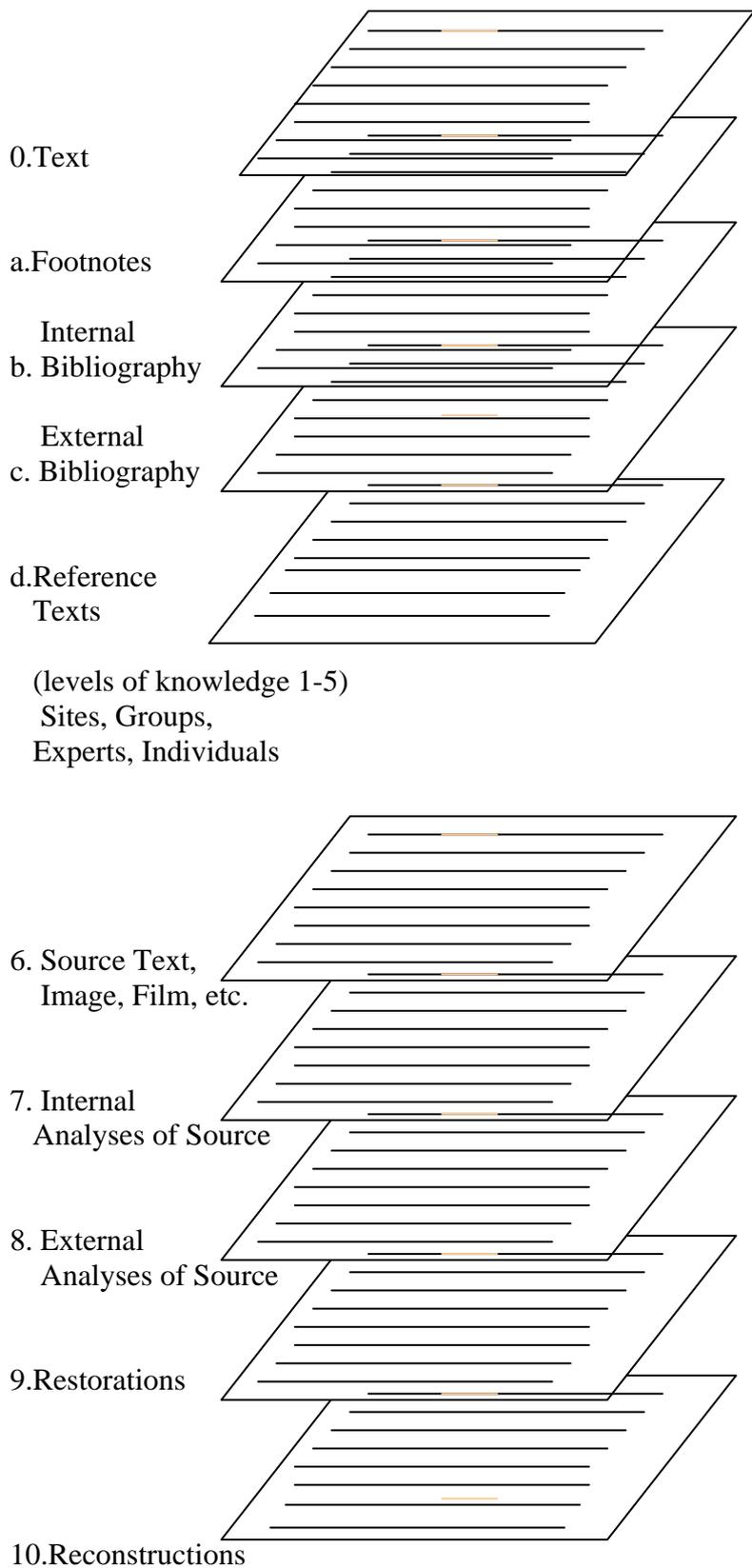
9.Restorations

10.Reconstructions

Figure 3. Schematic outline of some potential links in a networked environment

Once printed they cannot be increased in size or number. Some books have a third layer which provides bibliography for further reading which may or may not be closely co-related with sections of the text.

Digital books have hyperlinks, which are like footnotes except that they can be increased in size and number. Physical books have a linited number of footnotes. Digital books could potentially have footnotes for every word. Footnotes are essentially references to a) further materials on the subject and b) other thoughts or misgivings by the author. Given the developing connectivities between content, context and communication, footnotes of the first type could even be created on the fly (just in time).

A pen like object with a camera would scan a word, and via a wireless internet connection consult a virtual reference room which could provide links to 1) terms in classifications 2) definitions in standard dictionaries; 3) explanations from encyclopaedias, 4) titles and 5) abstracts (linking the text with levels of knowledge 1-5 in layer d in figure 3). The possible role of agents in this process is being explored in the IMASS project.

Much more is possibe. A good printed book has a bibliography. A good digital book can have its own internal bibliography and then link up with external bibliographies in the field (linking the text with layers c, and d). A good printed book in analog form, can provide me with references to sources both in the footnotes and the bibliography. But if I wish to consult any of these I need to go to a library and search for them. A good digital book could potentially offer me links to all the sources online thus saving me a trip to the library (linking the text with layer 6 in figure 3).

It can also give me access to different kinds of secondary literature relating to internal analyses (level 7) or external analyses (level 8). These sources need not be books. They could, for instance, be paintings, maps or other visual material. If my digital book refers only verbally to Leonardo's *Last Supper* or to the Roman Forum, then my pen-like camera can use the words Leonardo and *Last Supper* to find an appropriate image via Google's image search. Further reference materials could also be called up, other paintings by Leonardo, other paintings with the same title, other paintings with a similar theme and so on. If one were doing a systematic study then one could relegate some of these search tasks to agents such that, at the right moment, the materials one wished would be waiting in the manner of interlibrary loan books on one's shelf.

Or perhaps there is an image in my digital book but it shows the state of the image after the latest restoration. Or it could take me to a web cam to show me how it looks at this precise moment, or via nearby web cams, what the rest of the room looks like. Sacred places such as Mount Fuji already have 14 web-cams online. The pen like object could call up earlier images relating to previous states. Or again the pen like object could call up various reconstructions which have been made to visualize how it might once have looked (linking the text at level 0 with level 10 in figure 3).

The pen-like device has a very simple camera which effectively scans only one word at a time. The same principle could, of course, be extended to web cams at one's desk and even to regular, high quality digital cameras. Whereas traditional cameras were passive recording devices, this new kind of camera would interact with its

environment in new ways. Suppose I am on a hike in the woods and encounter a mushroom. Instead of just passively photographing the plant, my new camera captures its image, sends it via wireless internet to a virtual reference room which identifies it as a poisonous type to be avoided or as a particularly delicious edible type. Hence my new camera saves me the bother of carrying the heavy, standard work on mushrooms every time I go on a hike. Potentially it provides me with all the privileges of being in a great reference library, while allowing me mobile freedom to go wherever I like.

If I am bad with names, I can have a database made of my colleagues and acqaintabces such that a miniscule version of my camera, in the tradition of James Bond, can recognize them for me. Potentially it could do the same for strangers, checking images of wanted persons, in order to re-assure me that the particularly menacing person entering the room is not a known serial killer.

My new camera is thus much more than a recorder of objects (content). It provides me with knowledge of their contexts, not just spatially by showing me their environment; but also with respect to knowledge about the object by adding the equivalent of a caption which identifies the object. Potentially it can add various annotations to further contextualize the object. For the sake of ease we shall call the device a "cam-puter."

In the 1960s, the advent of pocket calculators introduced an enormous debate. Their protagonists saw them as devices to extend the capacities of the mind. Their detractors saw them as a threat to the continued independence of the human mind. Ultimately the new invention helped teachers prove that there was a lot more to mathematics than adding, subtracting and multiplying.

My new cam-puter will have an analogous effect. An advanced version will be a new form of mobile or wandering encyclopaedia which will affect most aspects of my life. A few examples: To return to health, if I see funny spots on my face, the cam-puter can inform me that they are measles and what to do about them. As a tourist, if I see an unknown building, the cam-puter can "phone up" or more accurately "internet up" an answer. If I am shopping and see something that seems far too expensive, my cam-puter can go on line and compare prices.

If I am studying or even in the classroom, my cam-puter can potentially check out all the facts I might want. As with pocket calculators there will inevitably be some old fashioned teachers who will forbid the use of cam-puters in the classroom, or even computers, on the grounds that this brings unfair advantages. But if everyone in the classroom has access to the same technology, then it is not a question of unfairness. The criteria for what is learning merely shifts: less an emphasis on raw facts, more an emphasis on what one does with them. The educational theorists have a point after all.

Our topic is new connectivities between content, context and communication. The cam-puter is essentially about new links between content and some forms of context, between the physical world, enduring knowledge and some formal captions or annotations. Cam-puters effectively shift a number of functions traditionally associated with the professor and the professional into a mechanical device that connects me to the cumulative knowledge of memory institutions. In itself it leaves

me as passive as when there old professor. Worse it deprives me of the pleasure of protesting, although it does leave me with the freedom to simply turn off my knowledge source.

For real learning, more is needed. I need to be able to make my own comments about what I am seeing and experiencing. It is handy to have my cam-puter remind me, (or tell me for the first time) that the church in the me is Notre Dame de Paris, and even handier to be provided with gory details about when it was built, burned down, rebuilt, restored and so on, but what impression does it have/leave on me? What is my personal knowledge of the church? If I am a student of art history or architecture at the Sorbonne, or with a class of fellow students from abroad, then there is an interest in comparing notes and discussing Notre Dame either in a virtual community, a real classroom or both. What is our collaboraitve knowledge of Notre Dame and how can that be shared for personal, professional and group learning? How can the cam-puter be developed into a collabora-puter and a communi-puter?

In the past my technologies for learning were fairly simple. I listened to professors, read books, visited objects and sites and recorded my "findings" in a notebook, which was usually thrown away the moment school was over, because it was mainly other persons facts anyway. Today we have electronic books (content); electronic notepads and electronic block-books designed for some kinds of comment and annotation (context); computers for list serves, chat-rooms, and other kinds of collaborative tools (other aspects of context) and then multimedia cell-phones, video-conferencing units and computers (communication).

The literature speaks of a need for personal knowledge packages. Needed is a seamless connectivities between content, context and communication: a combination of the functionalities of a notepad, computer, cam-puter, collabora-puter and a communi-puter, in order to arrive at a 21st century equivalent of the old-fashioned notebook. Moreover, in an era of lifelong learning this has to be infinitely more comprehensive than a lined paper booklet, and yet almost as simple to use. To be a real tool for learning I need to be able a) to access and store subsets of enduring knowledge, b) engage in and store essential elements of collaborative discussions, on-line forums, virtual communities and c) annotate and comment on a and b in arriving at a new kind of personal portfolio of my own insights, projects, essays, articles and potentially multimedia versions/equivalents of traditional books, television programmes or films.

In the past, I captured my formal knowledge in notebooks and my personal experiences in letters, diaries, journals, photo-albums, home movies or even web-sites. Public learning and private relaxation were neatly separate slots. For Shakespeare all the world was a stage. In our day, through the connectivities of content, context and communications, all the world is a learning stage or a stage in learning. We need new kinds of personal knowledge devices which at once contain what we have done, are doing and at the same time connect us to enduring and collaborative knowledge such that we can continue to become, to grow, to learn. Mediaeval knowledge had its *trivium*, mediaeval painting its tryptych. Perhaps modern knowledge needs its electronic version of the tryptych which allows us to experience and visualize these connectivities together.[2]

As in mediaeval paintings such a knowledge tryptych would have three panels or work screens, which can be used in various combinations depending on the task at hand. Sometimes, while searching for material one would use two screens for content with enduring knowledge (e.g. a text and a reference work), and one screen for personal knowledge in the form of notes and comments. At other times the context panel could be used for video conferencing with fellow students or colleagues in order to discuss a problem. In classroom situations, there would be a corresponding wall-size tryptych, such that a teacher and students or a group of students among themselves, are better able to share materials. For situations when one is travelling there might be a mini-tryptych built into a new version of a mobile-phone.

6. Domains: Culture, Knowledge Organisation, Learning

Thus far we have dealt with the obvious. New technologies can help enormously in giving us access to the basic facts about a mushroom, a church, a medical symptom or some other piece of everyday knowledge and provide us with new ways of using this for new personal or collaborative knowledge. These tools become the more important in contexts where knowledge is multi-lingual, multi-cultural and dynamic.

Multilingual

New combinations such as the tryptych-computer are particularly useful if I am travelling in foreign countries. For instance, if I am an English speaker traveling in Belgium, I can point the device at a place name such as Luik and be reminded that this is Liège. If I am traveling in Japan the device can tell me that the sign in front of me says Yokohama. This applies not only to languages but equally to dialects. If I am traveling in Dutch Limburg, the device can give me not only the Dutch word but also the equivalent in the Maastricht dialect. Alternatively, if I encounter a dialect term in my travels, the device can offer a translation into a standard language.

If I am traveling, the device can also find me translators, guides who speak my language. Even before I set out on a journey, the device can find me lectures by persons who have recently been or discussion groups about the country. If I am lost the device can show a map, show me where I am on it. Potentially it can also show me where the nearest bus, subway, train or petrol station is depending on my needs.

If I am reading a text with quotes in Latin, Greek or some other language, the device can use a virtual reference room and –via the *Index Translationum*-- provide me with a translation into English or the language in which I am working.

Multicultural

One of the essential characteristics of the new connectivities is that any existing object in the physical world or any item of knowledge and culture can be augmented with supplementary knowledge and information. Traditionally a printed book presented knowledge from the viewpoint of a given author's culture. Digital knowledge potentially allows the viewpoints of different cultures to be linked.

The night sky offers a very simple example. Using augmented reality I can superimpose on the night sky the Greco-Roman constellation of the stars.

Theoretically, I can also superimpose on the same night sky any of the constellations from other cultures in India, China, Persia, Mexico, and so on. This same principle can theoretically be applied to any object. If I see a statue of a Buddha, the device can potentially inform me of differing interpretations (e.g. Hinayana, Mahayana or Vajracana).

Eventually much more is possible. Cultures are not simply translations into different languages. Some cultures emphasize images (Christianity in most periods); others are near iconoclastic (Islam). Most have different topics which are not discussed. One could create maps of human experience showing which cultures cover which sections. As such augmented culture becomes a way of literally helping me to see the world through the eyes of different cultures

Dynamic

Traditionally knowledge that was written or printed was static. It documented knowledge at a given time and place. Digital texts introduce the possibility of updates without needing to republish the entire work and as such they are dynamic. For instance, a map of the world can update itself as boundaries change. It can even show alternative boundaries. (Kashmir's maps of itself may not be the same as India or Pakistan's maps of the region. Mongolia's maps of itself may be quite different than Russia or China's versions of the same area).

Similarly facts can update themselves. An article or book which lists the number of Internet users as 30 million in 1995 needs to be updated to 529 million in December 2001. Some facts are uncontested. Many facts, including statistics about internet users are contested. So we need more than updated lists. We need lists which offer us alternative claims about the same reality, which provide multiple dimensions of access, rather than portals which only offer us one viewpoint.

Ultimately every claim is an interpretation. In the past this meant that one needed footnotes to give reasons for one's interpretation and one's sources (in the form of enduring knowledge), which led to that interpretation. In a networked world, those sources may entail collaborative knowledge (forums, discussion groups, list serves) or personal knowledge and opinions (in the form of comments, notes, suggestions). So the challenge of hyperlinks is to include connectivities to enduring, collaborative and personal knowledge.

In traditional books and other forms of knowledge, the place of publication (famous publisher or unknown publisher), and the place where the materials were stored gave some indication of their significance. Materials in a local library were usually of local interest only. Those in a regional collection had more wide ranging interest. Those in a national or international collection were correspondingly more significant.

In an internet environment all these materials can potentially be manipulated and be on-line. Hence there are new challenges in determining the authenticity of materials, their provenance, the credentials and/or the reliability of the authors. We need new ways of accessing the sources (of enduring knowledge) and at the same time new

Orientations	Content	Context	Communication
Knowledge	Enduring	Collaborative	Personal
Domains	Culture	Knowledge Organisation	Learning
Focus	Access	Interpretation	Learning Processes

Figure 4. Key dimensions in MMI's approach.

ways of contacting those responsible for collaborative and personal knowledge. Ultimately we need new criteria for moving subsets of collaborative and personal knowledge into the realm of enduring knowledge. Even if everyone is potentially a knowledge creator, not everyone will have the lasting significance of an Aristotle or a Plato.

Traditionally knowledge was claims about the world (science), expressions concerning life in the world (art and culture) and about the world beyond (religion). Each claim was a link between words or images and a physical object, artefact or concept. The new connectivities pose the possibility and the challenge that all those claims can be recalled on the fly and that we could, in theory, trace how these change in real time. Just as we can now visualize the fluctuations of the stock market in real time, we could theoretically visualize all changes in real time.

7. Modes: Access, Interpretation, Learning Processes

In the past we needed to learn static names and facts, because this was the most important kind of knowledge we had. In a world, where such static knowledge can be automatically acquired technologically, the nature of education must shift to the modes of creating, contextualizing and communicating knowledge. Access, interpretation and learning processes are now the central questions. How can we define criteria and new tools for these? How can we create new connectivities? These are the kinds of questions whereby MMI hopes to further the pioneering studies of the late Marshall McLuhan.

8. Conclusions

Marshall McLuhan used as his starting point the *trivium* (i.e. the three liberal arts linked with language): grammar, dialectic and rhetoric. He studied the impact of media on the use of these aspects, namely, the structure of language; the logic of language and the effects of language. His analysis was largely in terms of dichotomies, which led him to see oppositions between different media such as speech, writing, print, radio and television.

MMI uses three orientations as its starting point, namely, content, context and communication. MMI studies how electronic technologies (e.g. computers in a networked environment) introduce new connectivities among these, by linking enduring, collaborative and personal knowledge.

These connectivities can be seen as collections of sequential and parallel interacting events that are ultimately shaped as knowledge processes. One sequence of events begins as content (enduring knowledge) which is put into a contextual frame triggering communication. Another sequence starts from communication (in the form of dialogue), providing context (or a framework) for subsequently finding content. A

third might start as a context, which leads to study of content and results in personal communication.

These orientations are linked with different kinds of knowledge. Content is related to enduring knowledge such as the knowledge of memory institutions (libraries, museums and archives). Context is particularly related to collaborative knowledge, which results from work done in collaborative groups. Communication begins as an exchange of personal knowledge.

The domains of MMI's attention are culture, knowledge organisation and learning with a focus on modes of access, interpretation and learning processes (figure 4). In short, MMI studies problems of method and implications of how technologies enable augmented knowledge and culture in the form of new versions of knowledge creation, organisation (classifications, annotations, comments, links, visualizations, reconstructions) and their potentials for learning.

Acknowledgements

Notes
[1] There are interesting parallels with Ted Nelson's fascination with the intertwingledness of knowledge.
[2] This idea has been explored by my colleague Dr Charles van den Heuvel.