

Knowledge Development, Information and Leapfrogging

“In formal logic, a contradiction is the signal of defeat: but in the evolution of real knowledge, it marks the first step in progress toward victory.”
Alfred North Whitehead

Abstract. This paper presents a theoretical framework for examining the nature and role of information as it relates to knowledge development. The central concept of this framework is the notion of information as representations of individual knowledge in cultural contexts. The framework presented is based on W. V. Quine’s naturalized epistemology. Quine’s theory is adapted to reflect the differences between knowledge and information in terms of value relationships, as opposed to logical relationships. This theoretical framework is then used to identify key characteristics of information and related key skills relevant to knowledge development. Finally, several practical implications of this approach to knowledge development are discussed, especially in the context of “leapfrogging” development.

Introduction. The purpose of this paper is to explore the theoretical underpinnings of current knowledge development strategies as they relate to our increasingly knowledge and information driven societies. The focus will specifically be on the role and nature of information as they apply to knowledge development and the significance of increasingly sophisticated information and communication technologies (ICTs). Attention will also be given to the applicability of knowledge development strategies to “leapfrogging” international development.

The key research questions to be addressed in this paper are:

- What are the nature and role of information as it relates to knowledge development?

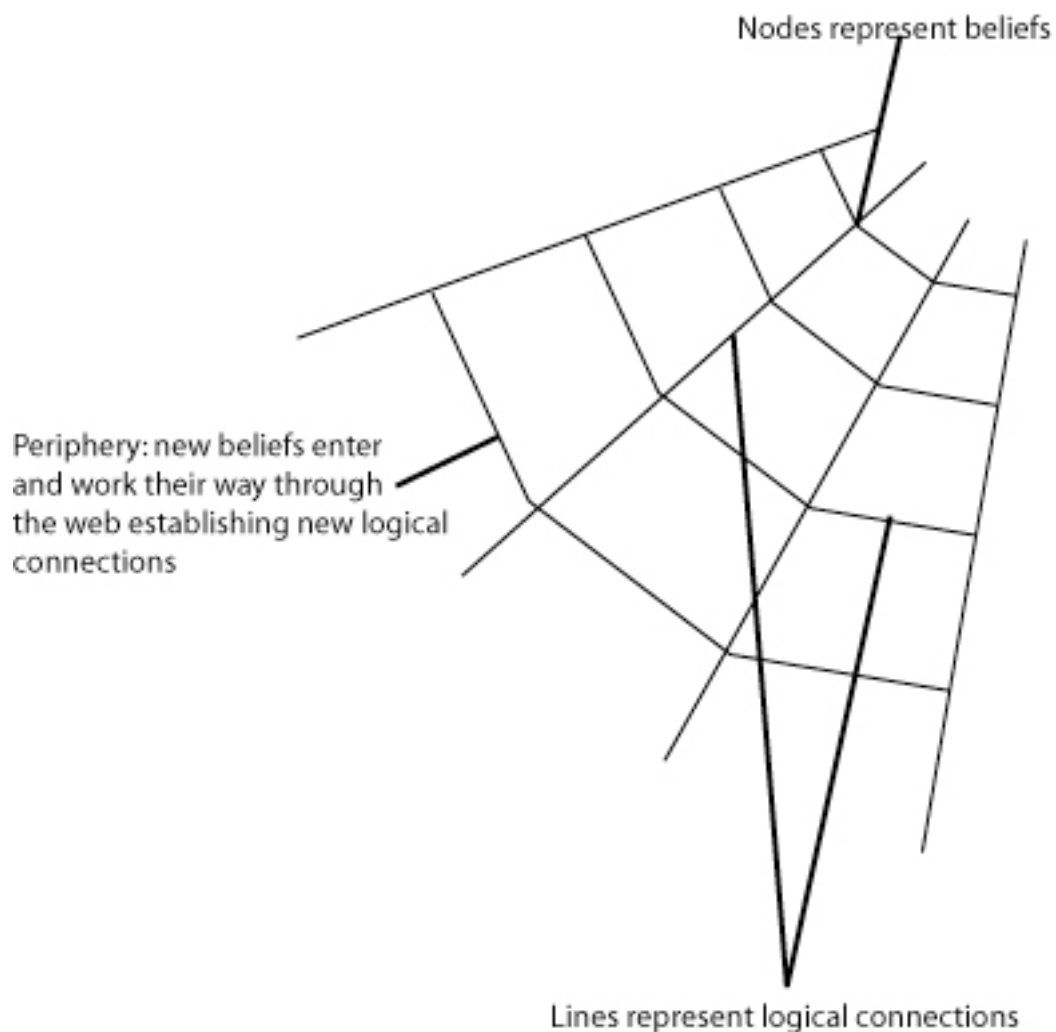
- How can a better understanding of information facilitate efficient knowledge development in an “information age”?

Knowledge is initially defined as the, largely tacit, sum of our individual experiences that affects our understanding of the world around us and the ways that we interact with that world. In this sense, knowledge development is understood as a process involving the internalization of information that seeks to expand that base which we draw upon in such interactions. There are many types of information that affect our knowledge development. Examples include perceptual information that we receive from our environment, genetic information that informs our physical attributes, and data interpretive information, such as when we translate readings from scientific instruments into human-readable form. The type of information specifically being addressed in this paper is information generated by humans for human consumption and is initially defined as representations of an individual’s knowledge. The definitions of these concepts will be articulated in further detail in individual chapters in this paper.

Following these theoretical explorations we will turn our attention to some practical implications, specifically how theory can be applied to facilitate “leapfrogging” development. The notion of leapfrogging development refers to rapid development that bypasses traditional notions of necessary stages of modernization. Leapfrogging is most commonly associated with the availability of cheap off-the-shelf ICTs to provide access to the information society without having to invest in expensive infrastructures, such as communications landlines, fiber optic cable, etc (Alhassan, 2004). The concept of leapfrogging will be reexamined in light of our articulated understanding of information and knowledge development.

Theoretical Framework. For the purpose of exploring the relationship between information and knowledge a theoretical framework is used which is based on W.V.O. Quine's theory of "naturalized epistemology" (1969). Quine rejected traditional notions of knowledge and truth. Instead he suggested a theory that is based on the concept of knowledge as a logically connected web of beliefs, with a periphery through which new experiences enter and connect with existing beliefs. Figure 1. explains how Quine's theory views knowledge and how new knowledge is created.

Figure 1. - Quine's view of knowledge as a web of beliefs



This simple picture illustrates how Quine views knowledge. For new knowledge to occur, beliefs enter at the periphery and confront the web of beliefs as a whole. To become established within the framework of existing beliefs, they meet and are challenged by existing beliefs, and through the connections to other beliefs, the entire framework. Near the periphery are weaker beliefs and stronger, more fundamental beliefs are toward the center.

In this model truth is seen not as “absolute truth”, rather as a logical coherence (not to be confused with “coherence theory of truth”) between internal beliefs and external experiences. What is significant about Quine’s theory is that it allows us to regard knowledge as something unique to an individual, but informed by the individual and surrounding cultures of that individual. Since knowledge in this view is unique to the individual, we do not have direct access to an individual’s knowledge. We only have access to that which is revealed in an individual’s dispositions, meaning that we can question an individual and their disposition to respond affirmatively or negatively reveals their beliefs.

The significance of the implications of Quine’s notion of a web of beliefs also has to take into consideration what Quine called the “indeterminacy of translation” (Quine, 1997). This theory assumes that language is a social construction affected by the ontological relations between individuals and their surroundings and as such can never be fully translated between the cultures that inform language. Hence, if an American were to question a Greenland Inuit about snow, the American would have difficulty judging the full extent of the Inuit’s knowledge about snow since each of their cultures relate to snow in very different ways (Barnett, 2004). While it is fairly easy to relate to this problem when considering very different cultures, this also poses a difficulty for our interactions with individuals with whom we share a culture. If knowledge is not directly accessible, and accessible in its entirety, we cannot assume, even for those with whom we share a

culture, that we relate to physical objects in the same way. There has two significant implications. Firstly, we can only assume that knowledge that is informed by others can only be understood in a general sense, since we have no way of evaluating all of the relations that are implied in such an exchange. Secondly, if we are to be able to judge an individual's knowledge, this can only be done by judging that person's knowledge as a whole, not in parts, which is obviously an impossible task.

Quine's theory of knowledge places central emphasis on sentential logic since he assumes that beliefs can be formulated as sentences exposing an individual's dispositions. Therefore what connects individual beliefs within the web of beliefs is formal sentential logic. The problem with this is that we do not rely entirely on formal language structures to formulate our beliefs or to expose them to others. For instance, we may use various art forms, such as painting or music, to convey our thoughts, and such forms of communication may also inform our beliefs. But, in the case of these forms of communication, sentential logic simply does not apply. Nor is it reasonable to assume that our dispositions toward, or informed by, works of art can effectively be conveyed in formal language structures, since our attitudes towards such phenomena are more likely to be affected by our current emotional states than our existing beliefs (Hagberg, 1998). Following from such observations, Quine's 'periphery' intuitively seems overly simplistic. It does not take into account the different types of relationships we establish with our immediate surroundings and other individuals. For instance, it is not realistic to assume that what a mother tells her child goes through the same process in being integrated into a web of beliefs as that asserted by an individual of lesser authority.

The intention here is not to respond directly to these criticisms but to take them into consideration and instead of viewing Quine's theory as a definitive model of knowledge as such, view it rather as a representative model. As a representational model we can regard Quine's theory as pertaining to representations of our knowledge, i.e. information (Thayer, 2002). This would seem to be in keeping with Quine's overall thinking about knowledge in general in that the assumption that we do not have direct access to an individual's knowledge can be taken to pertain to any attempt to represent that knowledge as well. In considering Quine's model along these lines we can address the previously mentioned criticisms from a very different point of view. We can view the web of beliefs as information formulated and construed in multiple cultural contexts. Therefore, they are more subject to cultural values and norms than formal logic. This view changes the nature of the connections between beliefs and the nature and role of the periphery. What then connects our beliefs can be described in terms of cultural norms and values in addition to logic. Truth, for instance, can be defined as a socially constructed concept on which we base our logical valuations. The periphery of our web of beliefs becomes a boundary for a cultural unit. This can be formulated in terms of bounding a personal culture, a social culture, a professional culture, etc. Webs of belief are then seen as being nested within each other and intricately connected across cultural domains, not only at the periphery, but at several points that can reach deep into the center of a web of belief. Regarded as information, the nodes within our web are easily revealable and accessible, no matter how deeply embedded they are, and can be separated from our wider web of beliefs and from ourselves. A web of beliefs regarded as informational representations of knowledge is further described in Figure 2.

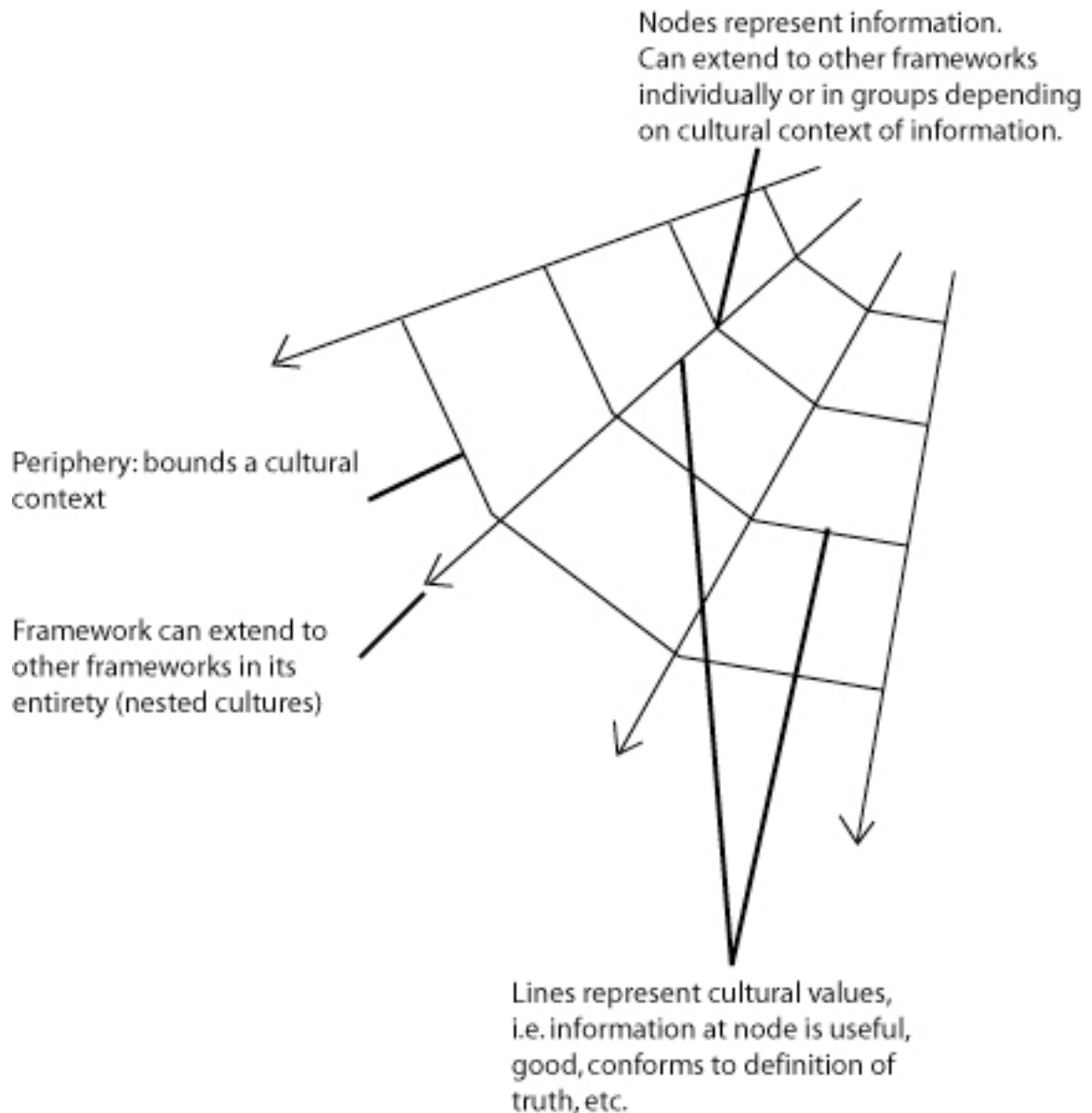


Figure 2. Nodes represent information as components of a whole, individually identifiable and separable from the system as a whole. System as a whole can connect with other systems as a whole. Nodes of information can also connect outside the system to other systems.

The web of beliefs regarded as representational information now presents itself as a good model for exploring the relationship between information and knowledge.

Defining information. Our initial definition of information is simple and does not describe how information affects us as individuals or how we formulate information to effectively exchange knowledge. There are several different views of information and probably an infinite number of types of information (Shannon, 1948). The type of information we are presently concerned with is that which is produced by humans, based on their knowledge, for the express purpose of informing others. This type of information is further delineated as semantic information, i.e. information that is meaningful to the receiver such that it effectively informs that individual about something. Information that attempts to inform an individual about something which they already know, that they do not learn anything new from, is not semantic information. Likewise, information that is based on cultural values that the receiver does not share, may also fail to inform, and therefore is not regarded as semantic information. In recent years the subject of semantic information has received a fair amount of attention, especially in the field of philosophy (Dretske, 1999; Floridi, 2004). The definitions that have been proposed have been steeped in philosophical tradition and draw their assumptions from the need for logical consistency and absolute definitions of truth. Therefore they do not recognize the cultural aspects of information and information exchange. The result is that these definitions fail to make a clear distinction between information and knowledge and fail to provide practical insights into how information fuels knowledge development.

Gregory Bateson proposed a definition that ignores truth claims and leaves room for cultural considerations when he suggested that “Information is a difference that makes a difference.” (1972). What is particularly significant about Bateson’s definition is that it acknowledges that we are always being presented with information whether it is

intentional or not, but that not all of that information receives our attention. Furthermore, it explains in simple terms why some information does not register with the receiver. In contrast, Dretske (1999) bases his definition on computational probabilities, derived from Shannon (1948), which would seem to suggest that information exchange is always intentional and purposeful. This does not conform with the real ways that we encounter and learn from information, which can often be quite unintentional. Furthermore, Bateson's definition fits nicely with the reformulated model of Quine's theory of a web of beliefs as culturally construed informational representations of knowledge. But for our purposes, we still need to determine what constitutes a difference and how that difference comes to "make a difference".

"A difference", in Bateson's sense, is understood as semantic information, i.e. information that has been encountered in a manner where it presents itself as something meaningful to the receiver. This does not imply that the information being received is necessarily being taken at face value. In fact, it would seem reasonable to assume that any information, whether it presents a difference at the explicit level or not, has the potential to yield significant semantic information. For instance, we may receive information that echoes something that we already know, but the fact that it is being received in a specific manner, or under certain circumstances, may be significant. In other words, it may make a difference to a receiver that information is being provided by a specific individual, and that the implied information that this individual is knowledgeable about the relevant topic, or what is revealed about their understanding of the topic, may be significant. But, this is entirely dependent on the emergence and recognition of differences, and as such, largely dependent on our individual attitudes towards

differences, i.e. we can choose to seek out differences when none are apparent or we can choose to ignore them.

Then there is the other half of the equation, concerning the ability of an identified difference to have an impact on our beliefs, i.e. to “make a difference”. This element of information processing is much more dependent on our cultural and social conditioning. While it would be absurd to maintain that our attitudes, as previously described, are not also a product of our cultural and social conditioning, it is useful to make a distinction between the way these two facets of information processing are affected. While we can be open to recognizing the differences presented by different points of view, this does not necessarily entail that we are accepting of those differences to a degree where we allow them to have an impact on our beliefs. Acknowledging the different ways our culture impacts our ability to process information allows us also to identify key factors of our conditioning that affect our willingness, or ability, to learn from the information we receive.

Cultural values and norms and difference. There is no reason to argue that knowledge cannot be transferred across cultures. The evidence of this being successfully carried out both consciously and unconsciously stretches from modern times as far back as we have been able to identify social structures amongst man and his predecessors. But, this is not always a simple, or peaceful, process. Today, we are faced with the task of transporting certain knowledge to societies in need, so that they survive and flourish in a rapidly changing global society. But, we must also acknowledge that, at an individual level, there is a need to prepare, not only those in the under-developed regions of the world, but also in the developed regions. An important part of this preparation concerns

the need for ICTs and sufficient knowledge to make effective use of them. Another aspect concerns the ability to effectively utilize information for our own individual knowledge development and that of others. By examining the flow of knowledge through the ages between different societies we can identify key characteristics of information and the transfer of information that affect knowledge development. The numerous cases presented in *Knowledge Across Cultures* (Hayhoe and Pan ed., 2001) reveal common cultural attributes that affect the transfer of knowledge: authority, validity and relevance. No doubt, a more detailed set of attributes can be identified (Meyer, 2005), but for the sake of simplicity these three are considered to broadly represent a more detailed set.

Authority. What is important in judging the value of information is its source and the channels it travels through on its way to a receiver. This constitutes the authority by which we judge the information. Authority is very important in this respect because it is on the basis of this authority that we justify our actions. For this reason, information has to have an element of transparency that allows us to trace its flow. Furthermore, the source of the information must receive recognition as being authoritative on the topic concerned (Olsson, 2005). Two examples of the importance of authority and how it functions are the transfer of Western medical knowledge to China (Kanwen, 2001) and the transfer of scientific knowledge from Islamic societies to Christians (Berggren, 2001). The two cases present very different examples of the role of authority in the transfer of knowledge. The case concerning China involves subtle manipulation and cultivation of authority over a period of time by dedicated “idea champions”, those medical practitioners who were aware of the benefits of Western medicine and the obstacles to its adoption in China. In the latter case, concerning Islamic scientific knowledge, the process

is somewhat more straightforward, but nonetheless it has its twists and turns. The scientific knowledge involved actually originated with the ancient Greeks and in hindsight it would appear that the role of the Islamic societies was one of preservation. But, it is not so simple, because the changes that had taken place in Europe and the Middle East over the period in which the knowledge was not available to the Europeans were quite significant, enough so that it took considerable time and social and cultural change in the West for the knowledge to return to Europe. These changes involved the rise of Christianity, the integration of certain elements of ancient Greek philosophy in Christian beliefs, and the rediscovery that Islamic scientific knowledge was founded on that same philosophy, and hence deemed acceptably authoritative. And yet, the transfer was not without its dark sides and many were persecuted by the Christian church in the process.

Validity. Validity in this sense does not refer to logical validity in terms of alethic values. We can consider it more of a “common sense” validity, i.e. judgments of whether information received can be integrated into the receiver’s belief system without upsetting things too much. Validity in this sense can be evaluated at many different stages in the transmission of information. Validity can be judged on the basis of the belief system of the transmitter of the information, i.e. ‘does the information accurately reflect their beliefs, or might they be lying?’. It can also be judged on the basis of the receiver’s belief system, i.e. can the receiver’s belief system accommodate the assertions contained in the information being transmitted? For instance, if a fundamental Christian tells us that God does not exist, this lacks validity because we don’t believe that the statement accurately reflects their beliefs. Likewise it is reasonable to assume that if a fundamental Christian is

told that God does not exist, this information will lack validity because their belief system simply cannot accommodate such a belief. This gets even more complicated when we consider the multiple cultures that affect how we process information. We all have our own personal culture, but we also are affected by our family culture, our societal culture and so forth. For information to have a reasonable impact on a receiver's knowledge there has to be acceptable validity throughout these cultural contexts.

Relevance. This concerns the practical aspects of knowledge, and again applies to both the sender and the receiver – if the information being transmitted has no perceived practical benefit for the receiver or that the sender has no, or limited practical experience related to the information, it is highly unlikely that it will have a significant impact on their belief system. For instance, information about how to use a trawler to increase fish catches is not likely to have a great impact on people living in a desert. Again, there is a need to consider this from the points of view of the multiple cultures affecting our beliefs. We can easily imagine that an individual may have many reasons to find the information relevant – they may be planning to relocate or they are trivia buffs. In this sense, we can say that relevance involves not only recognition of significance in information, there is also a process of establishing significance involved (Anderson, 2005). This illustrates the key difference between validity and relevance in that relevance can be at entirely opposite poles at the different cultural levels, but still be effective, whereas validity must be established at all levels. In the case that validity is established in one cultural context, but not another that the receiver of the information has regarded themselves as a member of, they are effectively separating themselves from the culture that rejects the validity.

For information to be effective in transferring knowledge, all of the criteria, authority, validity, and relevance, have to be established. There are many examples that illustrate this. One is a study conducted by Julian Orr that is described by Brown and Duguid (2000). Orr's study revealed that Xerox technicians had established a culture where information was exchanged in a manner that resulted in the formation of a highly effective knowledge development network. Orr described an occasion (Brown & Duguid, 2000, pg. 103-105) where the documentation provided to a Xerox technician failed to produce a solution to a problem. The technician then contacted a specialist and they exchanged information throughout the day, constantly inching closer to a solution by developing a common understanding of the root of the problem. The process described involves all three of the attributes of information described in this paper. Another example can be found in the open source software development movement, which when viewed as a learning community is very much based on this structure (Mulgan, Steinberg & Salem, 2005). These examples illustrate the existence of self-organizing collaboration structures that seek to maximize the "difference making" potential of information exchange by effectively pooling different points of view.

Multiple cultures. People are affected by multiple cultures. We have our own personal culture, a family culture, a societal culture, and so forth, that all impact our knowledge development through the cultural values and norms that each culture promotes. We have suggested that belief systems are defined by each of these cultures. But, this raises the question of how we can exist in multiple cultures, each promoting its own values and norms, and still expect to be able to maintain a consistent system of beliefs. Dretske (1999) suggests that information is nested in an informational signal.

This notion of nesting would seem to be applicable to the concept of multiple cultures as well, although in a somewhat abstract sense. The intention is not to suggest that any culture is entirely contained within another, rather that it is useful to think of a culture as being framed within another to gain perspective and apply another point of view, which is important for identifying differences. The three attributes of information and how they affect the difference making potential of information, and most importantly how we can maximize that potential, can be understood in terms of nesting cultures within cultures.

Before we expand further on this notion we have to reveal a specific ontological assumption underlying this notion of information, culture, and knowledge development, and the relationships between them. This is that essentially the objects of our knowledge are the same, but that different cultures relate to them in different ways. This goes back to Quine's theory of the indeterminacy of translation. Although an Inuit may have 150 ways or more of expressing the concept of snow based on different attributes of snow, and in English we have only a handful at best, this does not mean that an Inuit perceives, in an ontological sense, many different types of snow that an English speaker does not. The English speaker may not explicitly identify those attributes of snow in thought or linguistically, but is still capable of recognizing them and they still exist in the English speaker's understanding of the world. Given this ontological assumption we can further explore this notion of multiple cultures and their nesting and the implications for knowledge development.

When we are confronted with information based on different cultural values than those of our immediate culture, with the intention of identifying differences for potential difference making, we seek to identify connections that we can make between our own

belief system and the belief system on which the information in question is based. We do this not by attempting to break through the periphery of the web of beliefs, nor siphoning information through the periphery of our own web of beliefs, rather we try to nest our belief system within the other incrementally by identifying informational components to which we can relate and establish connections between the two systems. Over time, we can, and probably do, establish connections with a multitude of belief systems within which we can nest our own systems to be able to apply different cultural contexts for the express purpose of identifying differences and how those differences make a difference.

This is similar to the incremental development cycles that drive open source software development (Mulgan et al., 2005). It is in this incremental manner that information is exchanged, because differences make a difference incrementally. Even if an individual makes a conscious decision to adopt a belief system that is different than theirs, for instance in the case of a religious convert, it is not realistic to assume that one system replaces the other as a whole, rather that this is a slow process of identification and internalization of information, one bit at a time. The nesting as described, is best understood in this context as a fluid process, in which we allow our personal culture to be framed by other cultures depending on our need for different points of view at a given time.

Learning in an information age. Realizing that the evolution of a system of beliefs is based on the identification of differences and incremental internalization of information sheds light on how certain groups are able to create self-organizing groups capable of rapid and efficient knowledge development. The best examples of such groups are found in the open source software movement and related communities that function primarily

on the Internet. These groups have established ways of working together that maximize the authority, validity and relevance of information by forming hierarchical organizations, promoting open exchange and incremental change, the product of which is made immediately available. But, there is one significant difference between the way the open source software movement and other related communities function, i.e. that open source software is about software source code and software source code knows no cultural boundaries because it involves formalized programming languages. In other open source related projects, such as Wikipedia (<http://www.wikipedia.org/>), language, and hence culture, may hinder the rapid development seen in open source software projects, because there is not as great a range of differences being put into the pool of information.

Making culture transparent. To truly maximize the range of differences being put into a pool of information we need to look for ways to increase cultural transparency in terms of language, meaning and reference. Of these three, language is the most difficult because it involves a need for translation from one language to another, and this is not an easy task. Of course, English being the *lingua franca* of the Internet, coupled with the fact that more and more non-native English speakers learn English as a second language, does affect this issue. Nevertheless, there are other issues, for instance those related to the theory of indeterminacy of translation, that remain a concern. The other option is to rely on machine translation, and indeed there are a number of free translation services available on the Internet today, such as the Babel Fish Translation site (<http://babel.altavista.com/>). But, these provide notoriously bad translations for all but the simplest texts and cannot be relied upon for useful translations in a knowledge development context. Another option is to augment the linguistic capabilities of the users

or machine translations using formal multilingual and cross-cultural aware ontologies in embedded metadata, as is proposed by the W3C's *Semantic Web* initiative.

The Semantic Web. Tim Berners-Lee and his colleagues describe the *Semantic Web* as "... an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation." (Berners-Lee, Hendler and Lassila, 2001). The *Semantic Web* is based on ontologies and metadata frameworks that describe aspects of the information available on the web that is not explicitly presented in the information itself. This can include such information as author, date of publication, keywords, description, etc. The range of ontologies currently available make it possible to describe aspects such as these in fairly great detail. They introduce a level of transparency that makes it possible to identify relevant information in a very targeted manner, especially in the case of keywords and descriptions. By effectively using ontologies, which are not commonly used in targeted metadata, such as multilingual thesauri, information can be made transparent, not only in terms of descriptive elements, but in terms of cross-cultural commonalities and differences. A good example of this type of ontology is the UN's ISCED classification system for education (UNESCO, 1997). It covers the wide range of types of education and educational disciplines offered throughout the world and assigns them numerical identifiers. So for instance, when an American discusses upper-secondary education with an Icelander, that Icelander may assume that the American is talking about a four-year education from age 16-20 covering all general education requirements for entry into university. But, the American may be using the term upper-secondary to refer to American high school, which is very different than what is referred to as upper-secondary

education in Iceland. Describing these educational levels in terms of ‘ISCED level 3A’ or ‘3B’, bypasses the cultural contextualization embedded in language, making it more straightforward to understand what is being referred to.

To be realistic, it must be acknowledged that ontologies of this sort are very expensive to create and maintain and their usefulness is disputed. Shirky (2004), maintains that ontologies do not effectively facilitate categorization of information because they do not effectively reflect changes in the subject matter that they are intended to describe. Shirky does have a point and illustrates it with excellent examples of library cataloguing ontologies that are horribly outdated and ethnocentric. But, there is a difference between the role of ontologies being proposed here and the library cataloguing ontologies mentioned by Shirky, in that the latter is intended to help the user locate relevant information and in the former the intention is to increase transparency of information. The consequence, in terms of developing such ontologies, is that a cataloguing ontology cannot be partial. It has to cover a broad range of topics, in fact as broad a range as is conceptually possible, and it has to do so all at once. On the other hand, a contextual ontology can evolve incrementally over time, in the same way as an individual develops cultural nesting capabilities. This would make the creation of such contextual ontologies an ideal proposal for an open source project. We are already seeing evidence of this type of activity, called “tagging” (CNN, 2005), rising out of need due to the vast amount of information available and the increasing difficulty of locating relevant information. But, to be an effective tool for increasing contextual transparency, that specific goal would need to be made explicit, i.e. to explicitly enlist users of information to assign tags related, not to how they locate information, but to the ways that they understand

information as constituting differences in their personal cultural context. The resulting pool of ontological identifiers could then be made available for tagging to establish the cultural context from which the information is derived, and then to recontextualize the information incrementally by the addition and modification of those tags over time.

Practical considerations. The notion of information and how it relates to knowledge development put forth so far suggests a number of relevant practical considerations of significance to international development, education, and organizational knowledge management. The most notable is that it reveals a number of key skills related to knowledge development in an information society. Among these are:

- The ability to recognize difference,
- the ability to make that difference “make a difference”,
- the ability to manipulate value structures to increase the informational significance of information,
- the ability to recontextualize information for one’s own purposes and others’.

These all relate to skills that can be cultivated by providing enabling environments and training. Once mastered, these types of skills can lead to greater efficiency in the personal use of the vast amounts of information available to individuals in today’s information rich society.

In terms of international development, these considerations have important implications for how development is facilitated, and especially in relation to leapfrogging development. It has been suggested that adoption and access to the technologies is in and of itself not enough. This was expressed by participants in the 46th Session of the International Conference on Education (ICE). Here are examples of what some of the participants had to say about the issue (UNESCO, 2003):

“Information is one thing; education is another. Access to information alone is not enough.” Elie Jouen, Education International.

“...equipment and access to data are not enough; the real issue is to develop critical thinking and an ethical dimension.” Vaiva Radasta Vebraite, Vice-Minister of Education, Lithuania.

What has been suggested in this paper is in line with the specific issues identified at the 46th Session of the ICE, but it also goes somewhat further. The assumption underlying the common understanding of leapfrogging development is that access to information will facilitate rapid development. If we think about the consequences of this view, what is being implied is that what under-developed regions will benefit from is the information already available, i.e. mostly produced by and oriented toward the highly industrialized “Western” regions of the world. This view runs the risk of promoting dependency, not the previously prevalent economic dependency, rather information dependency (Alhassan, 2004). It should be made a priority to promote the adoption of technology, not because it enables access to information, but it enables people to share information and take part in developing common understandings and sympathetic knowledge, i.e. sympathetic to the vast number of cultural contexts represented by the individuals in the world.

Consequently, the focus should not be on developing mere information ‘consumers’, and not only on developing critical thinking, but on nurturing critical actors, able and willing to have an impact on knowledge development worldwide. It would not be unreasonable to require this to be an explicitly addressed component of any international development, or international education efforts.

The key skills related to cultivating globally competent critical actors do not require significant investment in technology, and training in these skills can start before any wide scale ICT infrastructure is implemented. For instance a single computer operating a wiki type of system, can be set up and used in conjunction with the teaching of reading and writing skills by encouraging learners to relate their experiences and community knowledge in such an environment. The same system could be used in teaching foreign language skills by encouraging students to practice relating those experiences and knowledge in other languages than their own. Individuals trained in such a manner would be well equipped to be integrated into a broader information society when the technology becomes available, not only as users of the information already available, but as contributors to a common understanding.

Conclusions. In this paper I have attempted to tackle the flimsy theoretical foundations on which current discourse about knowledge development and how it is fueled by information are based. I have formulated a theoretical argument for the cultural aspects of information use, creation and exchange and how these relate to knowledge development. The primary strengths of this theoretical approach are,

- it acknowledges the ever increasing saturation of our modern societies with information,
- information is defined in terms of cultural values as opposed to ‘knowledge’,
- it builds on the multicultural existence of individuals and societies and defines this as a strength,
- knowledge development is defined in terms of the creation, use, and synthesis of information in cultural contexts
- provides a model for how incremental knowledge development takes place.

The implications of this theoretical approach are that it allows us to identify key elements of information processing, as they relate to knowledge development. This in turn, allows us to identify key skills associated with information processing. These can be cultivated by promoting environmental and organizational conditions conducive to this sort of information processing, or in formal and non-formal educational settings. The growing importance of ICTs for knowledge development and the vast amount of information that these technologies make available, underlines the benefits of this approach. Furthermore, it allows us to anticipate the needs of those who currently have limited access to ICTs. Hence, they can be better prepared for integration into a knowledge driven society on equal terms with those who are already coming to rely on these technologies as their primary source for knowledge development.

This theoretical approach can serve as a framework for future research to better understand how information promotes knowledge development and the more practical issues related to the education and training requirements associated with the knowledge society.

References.

- Alhassan, A. (2004). *Development Communication Policy and Economic Fundamentalism in Ghana*. University of Tampere, Tampere.
- Anderson, T. D. (2005). Relevance as process: Judgements in the context of scholarly research. *Information Research*, 10(2).
- Barnett, A (2004). For want of a word. *New Scientist*. Retrieved May 2, 2005, from web: <http://www.newscientist.com/channel/opinion/mg18124326.200>
- Bateson, G. (1972). *Steps to an Ecology of Mind; Collected essays in anthropology, psychiatry, evolution, and epistemology*. San Francisco: Chandler Pub. Co.
- Berggren, J. L. (2001). Historical reflections on scientific knowledge: The case of medieval Islam. In Hayhoe, R. and Pan, J. (Eds.). (2001). *Knowledge Across Cultures: A contribution to dialogue among civilizations* (pp. 127-138). Hong Kong: University of Hong Kong/CERC
- Berners-Lee, T. (1999). *Weaving the Web: The original design and ultimate destiny of the world wide web by its inventor*. San Francisco: Harper.
- Berners-Lee, T., Hendler, J. and Lassila, O. (2001), The Semantic Web, *Scientific American*, May 2001
- Brown, J. S. and Duguid, P. (2000). *The Social Life of Information*. Boston, MA: Harvard Business School Press
- CNN (2005). Tagging helps unclutter data. Retrieved May 2, 2005, from CNN web site: <http://www.cnn.com/2005/TECH/internet/05/03/social.tagging.ap/index.html>
- Dretske, F. I. (1999). *Knowledge and the Flow of Information*. Stanford: CSLI Publications
- Floridi, L. (2004). Information. In Floridi, L. (Ed). *The Blackwell Guide to Philosophy of Computing and Information* (pp. 40-61). Blackwell Publishing
- Hagberg, G. L. (1998). *Art as Language: Wittgenstein, meaning and aesthetic theory*. Ithaca, NY: Cornell University Press
- Hayhoe, R. and Pan, J. (Eds.). (2001). *Knowledge Across Cultures: A contribution to dialogue among civilizations*. Hong Kong: University of Hong Kong/CERC
- Kanwen, M. (2001). East-West medical exchanges and their mutual influence. In Hayhoe, R. and Pan, J. (Eds.). (2001). *Knowledge Across Cultures: A contribution to dialogue among civilizations* (pp. 177-197). Hong Kong: University of Hong Kong/CERC
- Meyer, H. W. J. (2005). The nature of information, and the effective use of information in rural development. *Information Research*, 10(2).
- Mulgan, G., Steinberg, T. and Salem, O. (2005). *Wide Open: Open source methods and their future potential*. London: Demos

Olsson, M. (2005). Meaning and authority: The social construction of an 'author' among information behaviour researchers. *Information Research*, 10(2).

Quine, W. V. (1997). *Word and Object*. Cambridge, MA: MIT Press

Quine, W. V. (1969). *Ontological Relativity and Other Essays*. New York: Columbia University Press.

Shannon, C. E. (1948). A mathematical theory of communication. *Bell System Technical Journal*, 27.

Shirky, C. (2004). Ontology is overrated: Travel agents, libraries, links, and tags. Retrieved May 2, 2005, from web:

http://www.shirky.com/writings/ontology_overrated.html

Thayer, T. (2002). The limitation of computers in the management of knowledge. In Nyhan, B. (Ed). *Taking Steps Toward the Knowledge Society: Reflections on the process of knowledge development* (pp. 124-129). Luxembourg: Office for Official Publications of the European Communities

UNESCO (2003). *Education for All: Have we failed? – A summary of the ideas and contributions arising from the forty-sixth session of UNESCO's International Conference on Education*. Geneva, Switzerland: UNESCO, International Bureau of Education

UNESCO (1997). *International Standard Classification of Education: I S C E D 1997*. Retrieved May 2, 2005, from UNESCO web site:

http://www.unesco.org/education/information/nfsunesco/doc/isced_1997.htm