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Virtually incomprehensible: pros and cons of WWW-based communication and education

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1. Introduction

This article is about education and the communication technology of the World-Wide Web (WWW). The authors' intention is to strike a balance between evangelism about the Web as miraculous panacea, and Luddite rejection without engagement. The authors are suspicious of both technophilia and technophobia.

Education is, of course, not homogeneous. It happens in a multitude of different ways, at different levels and for different ends. For the purposes of this article, in an effort to frame the argument with as much generality as possible, the focus is not on specific forms of education. Whether education is thought of as teacher or learner directed, so-called 'outcomes based' or having some other focus, does not matter for the purposes of this article. The main concern is with the suitability of the WWW as a technology for educational purposes broadly conceived.

Before launching into the argument about education and the Web, some observations about the history of the Web may be useful.

Historical accounts of the development of the Internet and the WWW are contested spaces in which scientists turned evangelists and militarists turned multi-millionaires, and even

presidential candidates in the United States of America, jockey for recognition as 'the true fathers' of the technologies in question. Crucial innovations in the formative development of the WWW include NCSA's Mosaic and CERN's WWW. The motivations for developing these browsers or hypermedia spaces remain important influences shaping human communication enabled by the Web as we know it today. The European Laboratory for Particle Physics, or CERN, released the WWW – developed by Tim Berners-Lee (now based at MIT) – which was a common virtual space in which documents, text and other media could be shared. The original motivation behind this development was CERN's need to facilitate communication between scientists collaborating on LEP (Large Electron Positron Collider) projects aimed at understanding the composition and nature of sub-atomic matter. On the other hand the original motivation for the development of the ancestors to today's Internet was a military interest in developing a system of communication which was robust in the face of local damage to arbitrarily chosen parts of that system. It should not need pointing out that neither of these objectives – military robustness or the desire to facilitate communication between groups of experts already sharing a common discourse – are at all educational.

It is also noted that the WWW is growing at a rapid rate and the number of pages (not sites) presently stands at over one billion (see http://www.google.com) and continues to grow. A socio-cultural change has occurred between the desire for scientists to share information on particle collisions and the desire for 'netizens' to use the WWW. Every aspect of social, economic, cultural and individual life is caving in, or has long since done so, to the demand that it have a 'presence'. Sometimes there is a real or potential opportunity (e.g. eBay.com); sometimes there is some perceived benefit of Web-based information (e.g. the arXiv.org e-Print archive). In other cases, even if there is no clear advantage, a presence is thought desirable for the reason that one or more competitor has one. Often Web content does not even have a moderately reasonable justification, as the tedious ranks of rarely updated personal pages consisting of 'a few skateboarding pics and some cool links' attest.

Educational institutions (or, more specifically, tertiary ones) have, at least until relatively recently, been near the front of Internet and Web technological developments (Zakon 2000). It is not surprising, therefore, that these institutions are the home of many attempts to use the Web as a didactic or educational instrument. Besides the fact of long exposure to those technologies, there is of course the matter of the chief motivation for most forms of 'distance-based' educational 'delivery' which is the attraction of economies of scale.

Distance education as a concept has evolved over the last few decades and is now almost inseparable (correct or otherwise) from other educational phenomena. As an example of the hybridized nature of distance education – as well as its primary economic characteristics – a SAIDE definition of distance education (SAIDE 2000) reads:

'The term "distance education" describes a collection of methods for the provision of structured learning. Its object is to avoid the necessity for learners to discover the curriculum by attending classes frequently and for very long periods in order to listen to it being spoken about. This does not mean that there is no face-to-face contact, but that most communication between learners and educators is not face-to-face. Instead, it makes use of different media as necessary. Distance education, therefore, provides techniques of educational design and provision that – under certain circumstances – can bring better chances of educational success to vastly more people at greatly reduced costs…'

SAIDE points out that in the international literature, there is a conflation of distance education and open learning concepts and the organization is at some pains to differentiate between open and closed systems of distance education, particularly where technology enhanced delivery mechanisms prevail.

However, the reality is that not all institutions (educational and commercial) are armed with SAIDE's insights, and hence, these institutions embrace 'distance education' and 'technology enhanced education' because it appears to cater to the growing demand for flexible forms of access and product, while also handling larger numbers of students at lower costs per student. Hence, it is not as surprising that it can appear to those in charge of any given institution as though the Web presents a major financial opportunity.

Given this background, some questions need to be asked not only about how well but under what conditions or within what parameters the WWW (and related technologies) can be expected to function for educational purposes. These are general questions about the suitability and capabilities of Web technology, given the demands of a particular type of application. The authors ask these questions neither as pure 'knockers' or 'boosters' of the Web but because they think that they are not asked often enough.

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2. **Approach**

For the sake of brevity and simplicity, the major critical contrasts are drawn by reference to a relatively obvious source of comparisons with the WWW, that is, the situation of real, live, embodied human interaction. This perspective is informed by a number of trends in recent research in cognitive science, cognitive anthropology and linguistics. One major result of much of this research is increased attention to and understanding of the ways in which cognition of all types is physically and culturally situated and distributed. These findings create difficulties for what could be called the 'cybernetic' model of communication which dominated much work on cognition and language during the twentieth century. This model in turn exercised considerable influence on the development of various information technologies, on the early development of such fields as knowledge management and, finally, on thinking about the possible educational applications of information technology.

By drawing comparisons and contrasts in this way, the primary focus in this article is on the specifically communicative aspects of the educational process. Since a (if not the) major benefit of Web technology is supposedly its power to extend and enhance communicative capacities, the authors fight the present battle on what the evangelists might think of as their home ground. On the other hand since humans are social beings, the question of what benefits might be expected to follow from the adoption of any particular technology has to begin by establishing how humans actually communicate. Particular attention is therefore given to the social aspects of real-world, live human communication. While it is clear that the WWW is a type of tool, it is also an environment or 'virtual space' that:

- permits forms of communication;
- is not the same type of environment as a physical space; and
- has communicative possibilities quite distinct from those afforded by live embodied interaction.

By focusing in this way, attention is diverted away from an emphasis on the content which is communicated and the material infrastructure necessary for that to occur towards the mechanisms of communication themselves. As a preliminary justification for this, it must be noted that as living, evolved and social beings, humans have had millions of years of selection for operating in a physical environment interacting with other humans. The paradigmatic formative interactions are all real-time and relatively unmediated, compared to the more conventionalised and dislocated possibilities represented by such technologies as writing, telephony, television and the Web.

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3. **'Cybernetic' models of communication**

A widespread conception of communication is that it is the exchange of actually or potentially self-contained messages in some sort of code, which contain, when decoded, some kind of propositional or representational content. Such theoretical orientations have their more recent roots in seventeenth century approaches to reason and language, and have since been developed and refined through various theories of grammar, reference, thought and language, including those of Frege (1952), Saussure (1959), Chomsky (1986) and the founders of Cybernetics and Systems Theory. Cybernetics, often glossed over as the 'theory of messages' (Weiner 1954), was a particularly important and representative example for this research, considering the influence of cybernetic and systems theoretic notions on much thinking about the Web, and the functioning of computers and interactions between humans and computers.

Standard cybernetic models of communication require that each communicator is regarded as something with some kind of 'content' inside it, which translates or codes that content into some conventionally structured collection of signs, and is then capable of transmitting that content in some form. The coded transmission can, supposedly, in turn be unpacked by another communicator and then understood, so that the recipient ends up with (more or less) the 'same' content inside it. This can be called the 'semiotic post-office' model of communication. If it is right, then the WWW as a technology looks like it is in a very strong position, since it massively extends our capacity to send and receive coded messages, or semiotic postcards. With the Web it is possible for a given postcard simultaneously to be accessed by an arbitrary number of readers, but it is also possible for any number of readers to access the content at times and rates optimally suited to their own needs, and so forth. Given the manifest fact that individuals are likely to have differing optimal learning rates and schedules, this also looks very good for the Web as an educational technology. Weiner, the architect of cybernetics, makes clear that from a cybernetic perspective it is the 'signal' or message which is important, rather than how that signal might be carried, or what steps are involved in its transmission:

'To me, personally, the fact that the signal in its intermediate stages has gone through a machine rather than through a person is irrelevant and does not in any case change my relation to the signal' (Weiner 1954:16).

Semiotic postal service theories of communication are largely unsupportable for a range of reasons, mostly related to the fact that they ignore, devalue or misunderstand some very important features of how we actually communicate. The theoretical considerations and empirical evidence which indicate that this is so form a large body of literature, justice to which cannot be done with any brevity. Nonetheless it is possible to select a number of highlights from recent and relevant work, and note what it suggests.

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4. **'Real' communication**

In the first place there is growing evidence that live conversation exploits a range of resources not considered by semiotic postal service models. Cowley (1997, 1998) and others (Couper-Kuhlen 1996; Brazil 1997) have shown how interacting humans make extensive and joint use of pitch and timing over very small intervals, in ways which are both irreducible to any system of formal units (often not even making use of traditionally recognised 'words'), and at the same time significant, even crucial, features of the unfolding conversation.

The features in question manifest with extreme accuracy (time intervals in the hundredths of a second, pitch accuracy within one or two Hertz) and involve co-ordination (either affiliative or agonistic) across more than one individual. A crucial consideration here is that these features are not under direct and fine conscious control. In Hofstadter's (1985:632) sense they are part of the truly interesting part of cognition, that which takes place in less than 100 milliseconds.

Related work on emotion, affective display and social life strongly indicates that similarly sub-cognitive behaviours involving facial expression, gesture, vocal intonation, etc. are crucial factors in establishing, mediating and negotiating ongoing social relations (again both affiliative and agonistic). [See in this regard the work of Snowdon (1999), Frank (1988) and Hirshleifer (1987), the latter two of which situate emotional display within the theoretical economic perspective of strategy and bargaining. A crucial feature of this work is the demonstration that affective display cannot have its regulatory effects when under conscious control, since were it so it would immediately collapse to the level of formal 'communication' and hence present the possibility of being a bluff.]

What the work on conversation and emotion indicates very clearly is that social relations between humans make extensive use of resources which are readily available in real-time embodied interaction. No-one could seriously maintain that the resources represented by, inter alia, the possibility of changing text colour or style, or adding in 'emoticons' such as the ASCII smile [:-)] can rival the potential of real-time pitch matching and mismatching, micro-timing and affective display. In any event, such a suggestion misses the crucial point that in live interaction affective and other aspects of behaviour work precisely because they are not under direct conscious control, whereas the manipulation of type to make it bold etc. so clearly are.

Since such a crucial aspect of the educational process is establishing relations of trust and co-operation, it is to be expected that a communicatively impoverished medium will be prone to various defects from this point of view. Misconduct in live interaction is quickly (as good as immediately) noticed and typically censured. One very plausible explanation for the phenomenon of 'flame wars' is precisely that high speed media which have no such constraints are just not regulated in the ways that live interaction is, that misbehaviour simply fails to carry a balanced set of penalties. Certainly a formalized system of 'netiquette' can reduce the likelihood of such incidents, but the question remains whether formal and conscious restraint is to be preferred to the real thing.

It is, in any event, likely that formalized or consciously adopted systems will necessarily be weaker than those arising in real and constrained social settings. The work of Axelrod (1984) shows quite clearly that cooperative strategies are optimal in situations where the likelihood of meeting the same individual again is relatively high, or where the cost of misbehaviour is significant compared to the advantages. It is, therefore, entirely unsurprising that Cronje (1996) notes that his 'virtual classrooms' worked better when students had been able to form relations of trust prior to the commencement of on-line learning. Cronje also refers to the work of Hiltz and Wellman (1997) who distinguish 'instrumental' and 'social supportive' relationships, noting that information and communications technology (ICT) media are better for the former, worse for the latter.

Further difficulties for the semiotic postal service view arise when the role of language in learning, and cognition is considered more widely. It is well documented that people who 'talk to themselves' while learning some task typically perform better at the task than those who do not. [In this regard see Berk and Garvin (1984), Bivens and Berk (1990), Berk (1994), all discussed in Clark (1997, chapter 10).] From a semiotic postal service perspective this behaviour is pointless, and the phenomenon of improved performance associated with it

mystifying. If speech, like any other communication, is the transmission of something already 'in the head', then talking to oneself can never be anything but redundant. Similarly, if that is what communication is, it can hardly be expected that self-directed speech could make any difference to the efficiency with which some cognitive skill already 'in the head' is performed.

If we relinquish the assumption that speech is about sending messages, though, we may be in a position to discover something important about learning. Clark (1997, 1998) argues that rather than seeing language as primarily the communication of existing thoughts, we should regard it as primarily being a distributed (i.e. important public) resource for reshaping cognitive tasks and also as a way of thinking. The child who speaks while learning is not speaking about the learning, the speaking is rather a way of doing the learning itself, that is to say, a way of highlighting aspects of the problem, prioritizing attention and action, and reshaping memory (Clark 1997:197).

Clark's wider work on cognition brings together a wide range of resources to make a powerful case for the view that cognition is situated in a range of ways, that it exploits the fact that thinking beings are embodied and located in an environment. The typical 'lift, rotate, move around' process of working out whether a given piece will fit into some part of a partially completed jigsaw puzzle is a clear example, where a cognitive task is pursued in a way which enables environmental manipulation to modify and, in this case, simplify the cognitive task at hand (Clark 1997:36). In a variety of ways thinking, learning and memory are all embodied and environmentally situated, and rely heavily on the availability of a rich and relatively stable environment, which is both a source of information via several sensory modalities and an arena which can be exploited as, in Clark's words, 'scaffolding' for transforming the nature of any given cognitive problem.

The preceding work is complemented by the work of, for example, Hutchins (1995). In a long and detailed study of cooperating teams of people who solve the computational problems associated with navigation, Hutchins shows that the computational task is distributed between both individuals and solved through the organization of the physical environment in which navigation is conducted. Particularly damning for the cybernetic approach to communication is Hutchins's studies of the actual conversation between members of the navigation team, when he notes that 'traditional information theory fails us when we approach spoken language [for the reason that] ways of encoding and decoding the messages are negotiable at the time of communication' (Hutchins 1995:140; 232–239). Hutchins's work also clearly demonstrates that there are competences which are not, and cannot be, exercised by a single individual and that these cannot be learned apart from the appropriate environment and its occupants (1995:287).

To conclude, real, live communication, learning and interaction exploit a variety of environmentally distributed cues and sources of data from a range of sensory modalities which are synthesized in real-time and are of critical importance. Such cues include but are not limited to pupil size, timing, pitch, body orientation, gesture, direction and duration of gaze. Most of these cues are, by the standards of the semiotic postcard theory, either not messages at all, or are incomplete from the perspective of the individual communicator, and are in any event largely manipulated unconsciously. They carry meanings and/or have effects, and important ones for social beings like ourselves, but they do not work like semiotic postcards.

Kozma (1987:22) maintains that 'to be effective, a tool for learning must closely parallel the learning process; and the computer, as an information processor, could hardly be better suited for this.' Whether that is indeed the case depends on what kind of computer is meant. If 'computer' indicates some technology for processing representational symbols in sequence,

and periodically exchanging messages composed of such symbols with the outside world, then, according to this study, such systems will not 'parallel' learning processes at all.

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5. **Consequences**

People do send each other such postcards, sometimes. They can and do send letters or e-mail, use morse code, put up road signs, frame constitutions, and post CVs on the Web in the hope of getting better offers.

The point is that this is not the entire communicative story. Having made this point, the following question should be answered: Which aspects of the educational process might benefit from the WWW and which not? Or, put another way, when is situated, real-time, embodied communication needed and when is it better to use encoded messages which operate over indefinite distances in space and time?

Traditional educational practices clearly make use of elements from both ends of the spectrum. Even before the WWW, a significant part of many learning processes involved learners working, often alone, with passive media and technologies such as text and textbooks. Nonetheless an important part of such education is typically face-to-face interaction, the proverbial 'contact time'. From one point of view, the one to be wary of, face-to-face contact is no more than an expensive and inconvenient way of achieving what could, in principle, be achieved by other means. That would be true only if the sole, or at least primary, function of 'contact time' was the transferral of content. Through this research was shown, however, that live interaction has a great deal more to do with trust, support and coordination, and also that it permits forms of interaction drawing on resources not available by other means, all of which are cognitively useful. If this is correct, then the WWW is an intrinsically weak technology from an educational point of view, even though it may be a powerful and useful part of any given educational process.

There are other reasons to be wary of WWW education. As said, certain types of content and packaging lend themselves to Web-based distribution and Web spaces and others do not. As the right 'formulas' are worked out – by design as much as default – institutions can be expected to offer educational content on the Web in increasingly homogenized templates. Instructional designers and HCI gurus may say that this aids navigation and enhances learner support, but the authors maintain that with this comes a certain blandness and depersonalization of the educational process. This can be called the 'McDonalds' style of education. As with the McDonald's product, education would be required to become homogenized, to 'look and feel the same' (much as those burgers do, or as airports are expected to), no matter where or when it is 'consumed'. A possible consequence, too, of on-line learning is that it may unintentionally encourage learners to develop sensitivity, awareness and skills in the on-line world while neglecting their cognitive and social development in the 'real' world. Taken to its extreme, learners educated entirely in the virtual would be 'disconnected' (to use the technical term) and disengaged from their real-life contexts – often less compelling, less navigable, and with fewer 'exit' routes or optional extras (such as refresh buttons when it does not quite appear right) than are available in the real world.

Based on this study a prediction can be made that apparent, or actual successes of Web-based education will fall into one of two categories: (a) those which are grafted onto the power of 'live' interaction, and where the benefits arise from exploiting the potential of the Web for certain ways of accessing and using materials; and (b) those which are largely self-referential and where the effective communication depends on the fact that the course is in some way

about itself, or more specifically, about the Web.

In the case of (a) it should not be surprising that the acknowledged benefits of Web-based technology could be a powerful benefit to the educational process, given that not all of it takes place in live, real-time social interaction and often requires independent consultation and manipulation of materials of various kinds. The mistake here is to confuse a powerful tool with a possible environment.

In the case of (b) there should also not be surprise. Many of the noted difficulties with social regulation and sanctions for misbehaviour should quite properly be dealt with reasonably well in a virtual situation where virtual morality is on the agenda. It would, though, be an undeniable disadvantage to make all forms of WWW-based education take on the task of partly being 'about' themselves in that way.

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6. **Conclusion**

The provisional conclusion, then, is largely sceptical. The WWW has many uses, and it can be a powerful tool for supporting aspects of education, but it is suggested that, except in unusual cases, it cannot be a sufficient environment and technological tool for education.

A likely rejoinder at this point is that every problem described above could, in principle, be solved by shunting a wider range of data types through at stupendous speeds. Obviously there is more to the WWW than linked hypertext, and the Internet and Web technologies permit an increasing variety of media to be carried and consumed. Nothing that was said above requires the WWW to be limited in those ways.

Furthermore, it would be better to have real-time high quality video and sound, perhaps supplemented by more esoteric technologies for smell, say. Under such conditions users would have a wider range of cues and be able increasingly to approximate the forms of social coordination described above (it is easier to lie in an e-mail than on the phone).

Recall, after all, that a major and undisputed advantage of most Web technologies is that they are not dependent upon synchronization of use on the part of user and publisher. If an attempt is made to remedy the defects described above by trying to get WWW technology to enable real-time social coordination, it would work against one of the greatest advantages of the WWW.

This suggests a more radical conclusion, which is that there is an irreducible tension between the capabilities of the Web and the demands of education, at least for beings such as ourselves.

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