

What role can educational multimedia play in narrowing the digital divide?

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ABSTRACT

This paper explores the assertion that the development of educational multimedia has a key role to play in effectively reducing the impacts of the digital divide particularly in the context of developing nations. This assertion is based on the premise that the global diffusion of Information Communication Technologies (ICTs) should not be guided by a technologically deterministic approach but situated in the context of an appropriate development and critical theory of technology approach, which takes into account a broad range of social, cultural, political and economic enabling factors. Such an approach is a feature of a social and community informatics framework. Within this context, facilitating the development of electronic literacy, culturally relevant online content and interfaces through the development of educational multimedia can assist the process of social inclusion within developing countries. Before examining the role of educational multimedia in this context, the paper critically analyses the concept of the digital divide and why ICTs have come to be seen as the panacea to the problems of global development.

Keywords: *Learning Region; educational multimedia; electronic literacy.*

INTRODUCTION

Amongst the recent pressing issues relating to the phenomenon of globalisation is an overwhelming call to arms to address poverty and inequality in developing countries by facilitating the global diffusion of Information Communication Technologies (ICTs). ICTs are seen as the electricity of the informational age and access to them as all important to the process of development. For example, Castells refers to those sections of the community least connected to ICTs as the 'black holes of informational capitalism' (Castells 2000, p. 165). The buzzword that has found its way into common parlance and public policy arenas to label this issue is the 'digital divide', which has been defined in its simplest form as:

the division of the world between those who have access to new information and communications technology (ICT) and those who do not (Quibria et al. 2002, p. 1).

There can be no doubt that the digital divide has attracted the attention of decision makers worldwide and generated a plethora of public addresses, reports, policies, and plans, complete with an interesting array of clichés, that attest to the importance that is placed on addressing this issue (Council of Regional Organisations of the Pacific (CROP) 2002; Baker 2001; Miller 2001; Murelli 2002; United Nations 2002; World Bank & AusAID 2001). In many quarters, 'crossing', 'breaching' or 'reaching' across this 'chasm' is perceived as the panacea to development problems. At the highest international level, ICT public policy based on a digital divide framework has been adopted by various agencies such as the World Bank, UNESCO and the United Nations, and at the G8 Meeting on Okinawa in 2000 (Mamtora 2001, p. 3; Norris 2001, p. 40; UNESCO 1997).

Specific reference to the role of ICTs in addressing development goals is included in the United Nations Millennium Development Goals¹, and the Secretary-General of the United Nations, Kofi Annan, has said:

...a wide consensus has emerged on the potential of information and communications technologies (ICT) to promote economic growth, combat poverty, and facilitate the integration of developing countries into the global economy. Seizing the opportunities of the digital revolution is one of the most pressing challenges we face (United Nations 2002).

In Australia, *The Virtual Colombo Plan* was launched by AusAID and the World Bank in 2001 with its goal:

To use the opportunities presented by Information and Communication Technologies (ICTs) to improve education and access to knowledge in developing countries (World Bank & AusAID 2001, p. 21).

Clouding the issue of defining the digital divide is that it is not just a gap that exists between developed and developing nations, but also within nations and thus also creating inequality for marginalised communities within developed nations. This aspect of the digital divide reflects a more complex understanding of a centre - periphery model of development, whereby centres of power as well as peripheries of marginalisation exist within all countries. Thus Rogers W'O Okot-Uma, Chief Programme Officer, Commonwealth Secretariat refers to the digital divide as:

the relative differential in access to information and communications technologies (ICTs) between and within regional groupings (Murelli 2002, p. x, emphasis in original).

Whilst the digital divide is clearly an issue affecting all countries of the world, for the purposes of clarity in this paper I will be focusing on the digital divide as it impacts on developing nations.

There is no doubt that in statistical terms inequality in access to ICTs does exist between developed and developing nations. Most frequently the statistical disparities between countries regarding ICT are based on measures of access to hardware and connectivity and the figures present a picture of developed world dominance in ICT access. For example the Digital Divide Network Website cites the following 2001 Nielsen/ Netratings statistics as evidence of the digital divide:

There are an estimated 429 million people online globally...of those 429 million, fully 41% are in North America. Also, 429 million represents only 6% of the world's entire population...The United States has more computers than the rest of the world combined...When assessed by region, Internet use is dominated by North Americans: 41% of the global online population is in the United States & Canada, 27% of the online population lives in Europe, the Middle East and Africa (25% of European Homes are online), 20% of the online population logs on from Asia Pacific (33% of all Asian Homes are online)...Only 4% of the world's online population are in South America (Benton Foundation 2004).

THE CONTESTED NATURE OF THE DIGITAL DIVIDE

More recent attempts to measure the extent of the digital divide suggest that this picture is more complex and dynamic. In 2003 the International Telecommunication Union introduced what it called the 'first truly global ICT ranking' based on indicators from 178 countries. The Digital Access Index (DAI) measures the 'overall ability of individuals in a country to access and use

Information and Communication Technology' and distinguishes itself from other indices by broadening the definition of 'access' to include a number of new variables, such as education (literacy and school enrolments) and affordability (Internet access cost). This index provides a far more complex scenario which has Korea in the top five rankings², jumping 20 places in the last 4 years, and the other Asian Tiger economies (Taiwan, Singapore and Hong Kong) in the Top Five biggest gains category (International Telecommunication Union 2003).

As the DAI suggests a picture is emerging regarding the digital divide and its indicators which is far more complex than has been suggested in the past. The appearance of a surprising number of developing nations amongst the top rankings and the biggest gains in the DAI lends more weight to a reconceptualisation of the digital divide both in defining the phenomenon and the factors which contribute to it.

Contrary to Kofi Annan's assertion of a consensus of the potential of ICTs to assist the development process there is considerable debate about how to realise this potential. A number of commentators have questioned whether the use of the term digital divide is actually an appropriate or useful one to use as a basis for policy and decision making, since the difficulties in defining the digital divide make it difficult to devise solutions (Bridges.org 2003; Mitchell 2002). Others specifically argue that the digital divide is defined too narrowly in terms of physical access to hardware and connectivity to the exclusion of other development and ICT enabling factors and that to formulate solutions on this basis, simply by increasing the numbers of computers, telephone lines or Internet access that a country has, is flawed (Cisler 2000; Gurstein 2000, p. 5; Mamtora 2001; Warschauer 2003b).

Behind these debates lie differences in perceptions of what ICTs represent and what access to them means, underpinned to some extent by comparative theories of technology. According to Feenberg an instrumental theory (also known as a neutralist approach) of technology is probably the most commonly held belief and is one which views technology as a 'tool' without any inherent value (Feenberg 1991, p. 5). Since ICTs are deemed to be neutral and their value lies in how they are used, proponents of this theory would support a one-size-fits-all policy of universal employment of ICTs (Ebersole 1995). Substantive theory (also known as a determinist or autonomous approach), on the other hand argues that technology is not neutral and in itself it has a positive or negative impact (Feenberg 1991, p. 6). Warschauer extends the analysis particularly with reference to technological determinism which he says encourages the idea that:

the mere presence of technology leads to familiar and standard applications of that technology, which in turn bring about social change (Warschauer 2003a, p. 44).

To draw a link between theories or approaches to technology and digital divide public policy measures - on the basis of an instrumental or deterministic approach the digital divide could be seen as a simple question of access to the physical constructs of ICT and solutions based on increasing the diffusion of these physical constructs.

In relation to ICT public policies, Warschauer criticises both theories on the basis that they underestimate the interrelationship of ICTs with social, political, economic, and cultural factors. As such he is a proponent of the critical theory of technology proposed by Feenberg in which:

technology is viewed as a site of struggle, and investigations of technology implementation seek to uncover underlying power relations that shape how technology is used (Warschauer 2004, p. 2).

This view is also supported by Wiseman who states:

Ultimately, the Internet is best understood as creating a new set of relationships and places, rather than as a high-technology tool. It is one more global arena in which struggles over the distribution of resources, power and information will be fought out (Wiseman 1998, p. 85).

There is also some empirical evidence to suggest that rather than narrowing the digital divide, amelioration based on simple technological deterministic solutions to the digital divide can exacerbate inequities within countries since those who benefit the most are the elite who can afford the technology and skills to make effective use of it and those who are already marginalised become more so (Cisler 2000; Mamtora 2001, p. 8; Warschauer 2003b, p. 7). A good example of this is in Bangalore, India where a growing software development industry has brought prosperity to those employed in the industry whilst increasing the public health problems, corruption and real estate prices impacting on the poor (D'Souza 1996, p. 25). This phenomenon is also supported by Warschauer who says:

India has one of the largest and most developed information technology industries in the world. This industry has created a tiny group of multimillionaires and a small middle class of network and software engineers, computer programmers, and computer-assisted design specialists. At the same time, though, the benefits of the information technology revolution have had very little trickle down effect on the country's overall population, most of which lives in desperate conditions in rural areas (Warschauer 2003b, p. 23).

It is not surprising that technological determinism with respect to ICTs has its drawbacks since these experiences mirror somewhat that of previous development interventions. For example, the Green Revolution, which was heralded as solving global development inequities in agriculture, was initially embarked upon with a 'one-size-fits-all', deterministic and top-down approach whereby money and agricultural equipment was delivered to developing countries in the hope of reducing poverty only to find that equipment was abandoned due to the lack of skills in how to use it and the expected trickle down effect did not eventuate as little attention was paid to other social, political and cultural factors that impacted on their adoption. Subsequent interventions, which focused on broader development goals and a community-driven, bottom-up approach, were far more successful. Consequently it is not so much a debate about whether the digital divide exists but rather the effectiveness of measures to deal with it. The learning curve of what works and what doesn't regarding development interventions ultimately leads us to consider a model of ICT diffusion which focuses on appropriate and locally contextualised development underpinned by a critical theory of technology.

Whilst theoretical stances of technological determinism or neutrality (instrumentalism) fail to explain the reality of ICT diffusion, empirical evidence shows that social purpose, social context and social organisation is critical to an understanding. The social embeddedness of technology is what distinguishes the field of Social Informatics. The central tenet of social informatics is what a number of authors refer to as 'social shaping' of technology (Kling 2000; Loader & Keeble 2004, p. 39; Taylor 2004; Schuler 1996). Social Informatics helps to explain why ICTs and the diffusion of ICTs operates differently in different contexts, because it takes into account that there are different social relationships and factors operating in these different contexts. In a Social Informatics framework both the technological artefacts and social relationships are considered to be interdependent and are woven into an integrated socio-technological model. In Social Informatics, looking at what people do with technology rather than what they have is pertinent for making effective use of ICTs for social change and social inclusion. As an extension of Social Informatics there have recently been developments to focus on Community Informatics which Gurstein defines as:

the application of information and communications technologies (ICTs) to enable community processes and the achievement of community objectives including overcoming "digital divides" both within and among communities (Gurstein 2002, p. 1).

However, whilst the rhetoric of policies and programs outlined by international bodies does reflect a broader social and community perspective, the indicators employed to measure progress are consistently based on numbers of computers and connectivity (United Nations 2004).

ICTS AND SOCIAL INCLUSION

What a number of stakeholders have now recognised is that 'access' to ICTs needs to be defined in broader terms (Bridges.org 2003; Carvin 2000; Clement & Shade 2000; Mamtora 2001; Warschauer 2003b). The problem with an access fix to the digital divide is that it is simplistic and does not take into account other enabling factors. As a policy stance it can also be reduced to a marketing ploy and becomes an approach about receiving and consuming rather than producing and distributing. Granted access is the foundation stone of ICT diffusion but it is not the whole solution. Gurstein argues that ICT implementation is not simply a question of access to ICTs but of how they are accessed, by whom, under what circumstances and for what purposes?

The key element in all of this is not "access" either to infrastructure or end user terminals (bridging the hardware "divide"). Rather what is significant is having access and then with that access having the knowledge, skills, and supportive organizational and social structures to make effective use of that access and that e-technology to enable social and community objectives (Gurstein 2003).

An access fix also implies a one-way bridge approach in which the 'haves' on one side supply the 'have nots' on the other. Eglash on the other hand promotes a two-way bridge approach whereby cultural resources are shared and ICT users become producers of cultural heritage knowledge (Eglash 2002). Thinking in these terms allows us to combine social critique with an appreciation of cultural resources and is more socially inclusive.

Social inclusion therefore is dependent not on equal resource share but on equal participation in the use of the resources. To illustrate this point, socioeconomically disadvantaged groups who have been provided with unlimited ICT resources may remain marginalised from the information society as they do not have the supporting mechanisms to effectively use these resources. On the other hand, socioeconomically disadvantaged groups with few ICT resources have made effective and meaningful use of communal ICT resources. The flip side of this is that socioeconomically advantaged groups with unequal access to resources can be marginalised by other factors. As Miller says:

Access to the technology and the availability of infrastructure to facilitate its use are undoubtedly the most important and first steps to narrowing the divide, but access alone is not enough to address the problem. There are numerous other factors that come into play in the quality of people's access, such as education and training, language and literacy, bandwidth, hardware and software, and even Web design (Miller 2001, p. 2).

THE ROLE OF EDUCATIONAL MULTIMEDIA

Inherent in the concept of social inclusion is the notion that education generally is both a factor behind the digital divide and a means to overcome it and it follows that, if we accept a Social and Community Informatics perspective, educational multimedia has an important role to play in promoting social inclusion and narrowing the real digital divide.

In canvassing the digital divide based on a social and community informatics framework in the context of education multimedia development, three interrelated issues emerge which prevent effective use of ICTs in developing countries. The first issue relates to the skills and practices required to make use of ICTs e.g. the level of electronic literacy. The second issue relates to the tools or products of educational multimedia e.g. lack of relevant online materials. Finally there is the question of the cultural relevance of dominant models of interface design.

Electronic Literacy

In the same way that basic literacy has long been promoted as the key to closing the development gap between rich and poor³, proponents of social inclusion through ICTs propose a focus on electronic literacy as a key to overcoming the digital divide. This reflects the argument that access to physical hardware is of little use if you don't have the means to use it effectively and meaningfully (Carvin 2000; Gurstein 2003).

Electronic literacy⁴ includes basic text related literacy and is a prerequisite to effective use of ICTs. In a parallel process to understanding the concept of literacy, electronic literacy has itself evolved from a notion of being able to operate a computer and performing computer drills through to more constructivist approaches to multimedia development (Jonassen 2000). Warschauer for example refers to the concept in its plural and in very broad terms:

electronic literacies are not isolated from the types of literacy practiced with print but rather involve added layers that account for the new possibilities presented in the electronic medium of computers and the Internet. Electronic literacy is actually an umbrella term that encompasses several other generic literacies of the information era, including computer literacy, information literacy, multimedia literacy, and computer-mediated communication literacy. These new literacies stem in part from the new technological features of the computer but also from the broader social setting in which computers are used (Warschauer 2003b, p. 111).

Since electronic literacy is a key to unlocking the access to ICTs, it is important that projects in developing countries incorporate proposals to assist the development of electronic literacies in the broadest sense; encompassing not only the operational aspects of using a computer such as opening and saving files, navigating, word processing and Internet searching but also the development of higher order skills situated within a cultural context. Of all the aspects of electronic literacies, multimedia literacy and computer-mediated literacy have particular relevance for developing countries since they are strongly linked with the process of democratising education. Not only does educational multimedia reflect preferred learning styles based on audio-visual preferences but multimedia literacy enables users to become producers of information and this, as we will see, has implications for the diversity of online content (Gurstein 2003, p. 7; Worcman 2002, p. 2; Warschauer 2003b, pp. 115 - 116).

Computer-mediated communication (CMC) literacy also has the potential to shift power bases for developing countries. The Internet acts as a medium of communication for geographically dispersed people, and provides opportunities for online networking. This can be an empowering process for marginalized groups with the potential to level the playing field of disadvantage which may be caused by geographical dispersion (Council of Regional Organisations of the Pacific (CROP) 2002; Learnlink) .

A successful example of this process is provided by the case study of *Running Drik*, a photo library in Dhaka, Bangladesh, which set up an electronic mail network called *DrikTAP* for its own networking purposes. As the use of the services grew the network expanded to eventually

include other local and international NGOs, activists and universities. The network's services diversified from email to bulletin boards, online searching and conferencing (using of Bangla language) and training programs. Ultimately the organisation began to take on the role of electronic post office for the community. The critical mass of users in the network meant that although the organisation used the network to undertake anti-government activism, the government was reluctant to close it down. As Alam comments:

...DrikTAP has become a powerful way of talking to the outside world. and more importantly to each other... In a small way we are witnessing a shift in the balance of power (Alam 1996, p. 15).

CMC literacy also plays an important role in the facilitation of online learning and distance education which has the 'potential to extend learning opportunities to millions who would otherwise be denied a good education (World Bank & AusAID 2001, p. 7). However, even if we overcome the issue of the basic literacy levels that online learning supposes, the potential may not be realised if we do not address the cultural factors. For example whilst online networking may be a practice that finds parallels with social networking preferences of indigenous communities, online learning that lacks avenues for social support through face-to-face instruction may not be successful (Warschauer 2003a, p. 46.). Furthermore, I suspect from my own experience in a Pacific context, that the Western protocols of CMC do not allow for the kinesics that forms an integral part of a number of languages. Addressing the issue of kinesics in CMC is an area of research which holds promise for the efficacy of CMC and online learning in developing countries.

Online Content

Whilst developing electronic literacy is fundamental to the effective use of ICTs, it should also be supported by the development of relevant online content. Currently there is a discrepancy between the potential of educational multimedia and the reality of its content which precludes its widespread use. For example the majority of online content currently emanates from the US, is text based, and written in English. Not only does this exclude those in developing countries with low basic literacy levels but it is also of questionable cultural relevance. This is a problem that developing country leaders are keen to overcome. As South African President Thabo Mbeki remarked in 1995⁵:

"... we are also extremely interested to ensure that we are not mere importers and consumers of a predetermined content. Rather, we also want to be producers and exporters and therefore active and significant participants in the creation, production and formulation of content ..." (Miller 2001, p. 4).

My own experience working with teachers and students in developing countries⁶ indicates that the audio-visual potential of educational multimedia facilitates learning styles that seem to be more in accord with non-Western cultures which have a strong emphasis on oral communication, audio-visual preferences and collaborative learning. This notion is further supported by Warschauer's experiences with teachers and students in Hawaii (Warschauer 1998), Turk and Trees design of an information system to contain cultural heritage information for an indigenous community in WA (Turk & Trees 2000) and Jonassen et al in the context of Navajo children in the United States:

Navajo children lack apparent reasons to learn in traditional learning modes. Producing multimedia materials can help. The key to constructive learning is ownership. Navajo children have no ownership in traditional transmissive approaches to learning, because the context has little meaning in their cultural context.....Perhaps the most interesting conclusion from this study was that collaborative multimedia production was so effective

in this situation because the Navajo culture is a cooperative, non-competitive culture (Jonassen et al. 2003, p. 177).

Another issue related to the development of online content is the disproportion of English language used online. This is largely due to the historical and social context of the Internet which was developed in the US, using ASCII code which only supports fonts based on the Roman alphabet. Languages which require the use of diacritical marks are disadvantaged (Warschauer 1999, p. 92). Although the number of indigenous language web pages is growing the current dominance of English online remains a disincentive to marginalised groups to go online. Allied with the issue of language relevance is the question of cultural relevance of online content. Empowering communities to engage in their own web authoring not only supports constructivist educational principles, it also contributes to the diversity of knowledge and languages on the Internet and has the potential to preserve cultural histories based on oral traditions (Learnlink; Turk & Trees 2000). However, as Worcman points out there are inherent dangers:

it is important to consider the way in which the creation of these collections assists the process of strengthening the identities of the communities...It is undeniable that when the oral traditions of a community without a written language are recorded, that community's history will be preserved. But preserved for whom? How can repeating the colonialization and appropriation of a group's culture, such as that which occurred previously with physical resources, be avoided when its knowledge is being recorded for the virtual world? (Worcman 2002 8, p. 3)

Interface Design

Finally, another aspect of educational multimedia development which impacts on the efficacy of educational multimedia in developing countries is interface design. Miller, for example, outlines a number of web authoring principles to overcome the constraints (Bandwidth and electronic literacy) associated with marginalised groups based on experiences with the Centre for the Study of Violence and Reconciliation (CSVR), University of Witwatersrand, South Africa. As general principles she proposes avoiding large graphics files and photographs, plug-ins such as Adobe Acrobat and Flash, frame based web pages, and non-protocol hyperlinks (rollover features). In addition she advocates for printer friendly colour choices and sustainable content, which she defines as content requiring minimal maintenance (Miller 2001). Whilst these principles may be contested and some may become less important as access to bandwidth increases, they are a good starting point from which to consider the adaptation of interface design.

Related to interface design is importance of cultural metaphors in interface design. Both the Turk & Trees (2000) and Learnlink case studies of community informatics initiatives in indigenous communities incorporate the design of culturally relevant desk top icons and graphical user interface metaphors as elements of their educational design.

CONCLUSION

Kofi Annan's assertion of the potential of ICTs to facilitate the development process for developing countries is a valid one. However the notion of the digital divide, the factors contributing to it and the solutions pertaining to it are widely contested. A technologically deterministic perspective of the digital divide proposes solutions based on access as defined by the physical constructs. This appears to be the reality of much public policy to date and unfortunately appears to be exacerbating the digital divide within countries. What is required to address the digital divide is a social and community informatics perspective, based on a critical theory of technology, which places greater emphasis on broader development goals. Using a

social and community informatics perspective, the role of education and educational multimedia, and in particular the issues of electronic literacy, online content and interface design, is fundamental. In a practical sense these issues can be addressed by facilitating indigenous and non-Western cultures to be actively engaged in the development of their own online content and interfaces thus also promoting democratisation of education and diversifying the nature of online knowledge and languages.

Notes:

- ¹ Target 18: In cooperation with the private sector make available the benefits of new technologies, specifically information and communication (United Nations 2004).
- ² The top five rankings in order with Index rankings are: Sweden (0.85), Denmark (0.83), Iceland (0.82), Republic of Korea(0.82), and Norway (0.79) (International Telecommunication Union 2003).
- ³ Although there have also been considerable debates about the notion of literacy and its correlation with socioeconomic levels, a detailed consideration of this lies outside the scope of this paper.
- ⁴ Warschauer summarises the proposers of alternative names for computer related literacy as electronic literacy (Craver, 1997); digital literacy (Gilster, 1997); technological literacies (Lankshear and Knoble, 1995); multiliteracies (New London Group, 1996); metamedia literacy (Lemke, in press) (Warschauer 1999, p. 117).
- ⁵ "South Africa and the Information Superhighway," Statement to the G7 Ministerial Conference: *Information and Society*, Brussels (24 February 1995) cited in Miller 2001).
- ⁶ I have worked on curriculum development projects in Malaysia, Tuvalu, Nepal and Papua New Guinea.

REFERENCES

- Alam, S. 1996, 'On-line lifeline', *New Internationalist*, vol. 286, December, pp. 14 - 15.
- Baker, P. M. A. 2001, 'Policy bridges for the digital divide: assessing the landscape and gauging the dimensions', *First Monday*, [online], vol. 6, no. 5. Available from: http://firstmonday.org/issues/issue6_5/baker/index.html [15/04/04].
- Benton Foundation. (2004), *Digital Divide Network* [online], Benton Foundation. Available from: <http://www.digitaldividenetwork.org/content/sections/index.cfm> [27/05/04].
- Bridges.org. 2003, *Spanning the international digital divide* [online], Bridges.org. Available from: <http://www.bridges.org/index.html> [4/06/04].
- Carvin, A. 2000, 'More than just access: fitting literacy and content into the digital divide equation', *EDUCAUSE Review*, vol. 35, no. 6, pp. 38 - 47.
- Castells, M. 2000, *The Information Age: Economy, Society and Culture. Vol 3: End of Millennium*, 2nd edition, Blackwell Publishing, Malden, MA, USA.

- Cisler, S. 2000, 'Letter from Cambridge: digital nations and eDevelopment meetings', *First Monday*, [online], vol. 5, no. 11. Available from: http://firstmonday.org/issues/issue5_11/cisler/index.html [15/04/04].
- Clement, A. & Shade, L. R. 2000, 'The access rainbow: conceptualizing universal access to the information/ communications infrastructure', in *Community Informatics: Enabling Communities with Information and Communications Technologies*, M. Gurstein (Ed), Idea Group Publishing, Hershey, USA, pp. 32 - 51.
- Council of Regional Organisations of the Pacific (CROP). 2002, *Pacific Islands Information and Communication Technologies Policy and Strategic Plan* [draft], ICT working Group.
- D'Souza, D. 1996, 'Silicon valley east', *New Internationalist*, vol. 286, December, p 25.
- Ebersole, S. 1995, *Media determinism in cyberspace*, [online], Regent University. Available from: <http://www.regent.edu/acad/schcom/rojc/mdic/md.html> [05/06/04].
- Eglash, R. 2002, 'A two way bridge across the digital divide', *The Chronicle of Higher Education*, [online], June 21, The Chronicle Review. Available from: <http://chronicle.com/free/v48/i41/41b01201.htm>
- Feenberg, A. 1991, *Critical Theory of Technology*, Oxford University Press, New York.
- Gurstein, M. 2000, 'Community informatics: enabling community uses of information and communications technology', in *Community Informatics: Enabling Community Uses of Information and Communications Technology*, M. Gurstein (Ed), Idea Group Publishing, Hershey USA, pp. 1 – 30.
- Gurstein, M. 2002, 'Community informatics: current status and future prospects - some thoughts', *Community Technology Review*, [online], Winter – Spring. Available from: http://www.comtechreview.org/article.php?article_id=56
- Gurstein, M. 2003, 'Effective use: a community informatics strategy beyond the digital divide', *First Monday*, [online], vol. 8, no. 12. Available from: http://firstmonday.org/issues/issue8_12/gurstein/index.html
- International Telecommunication Union. 2003, *ITU Digital Access Index: world's first global ICT Ranking*, [online], ITU. Available from: http://www.itu.int/newsarchive/press_releases/2003/30.html [02/06/04].
- Jonassen, D. H. 2000, *Computers as Mindtools for Schools: Engaging Critical Thinking*, 2nd edition, N. J., Merrill, Upper Saddle River.
- Jonassen, D. H., Howland, J., Moore, J. L. & Marra, R. M. 2003, *Learning to Solve Problems with Technology: A Constructivist Perspective*, 2nd ed., Merrill Prentice Hall, Upper Saddle River, N. J.
- Kling, R. 2000, 'Learning about information technologies and social change: the contribution of social informatics', *The Information Society*, vol. 16, pp. 217 - 232.
- Learnlink . n.d, *Taking Ownership: Strengthening Indigenous Cultures and Languages Through the Use of ICTs*, Learnlink, Washington DC.

- Loader, B. D. & Keeble, L. 2004, *Challenging the Digital Divide? A Literature Review of Community Informatics Initiatives*, Joseph Rowntree Foundation, Teesside University.
- Mamtora, J. 2001, 'Bridging the digital divide in the islands of Oceania', 67th IFLA Council and General Conference: Libraries and Librarians: Making a Difference, August 16 - 25, Boston, USA .
- Miller, A. 2001, 'Reaching across the divide: the challenges of using the Internet to bridge disparities in access to information', *First Monday*, [online], vol. 6, no. 10. Available from: http://firstmonday.org/issues/issue6_10/miller/index.html [01/04/04].
- Mitchell, M. M. 2002, 'Exploring the future of the digital divide through ethnographic futures research', *First Monday*, [online], vol. 7, no. 11. Available from: http://firstmonday.org/issues/issue7_11/mitchell/index.html [15/04/04].
- Murelli, E. 2002, *Breaking the Digital Divide: Implications for Developing Countries*, Commonwealth Secretariat and SFI Publishing.
- Norris, P. 2001, *Digital Divide*, Cambridge University Press, Cambridge.
- Quibria, M. G., Ahmed, S., N., Tschang, T. & Reyes-Macasaquit, M.-L. 2002, *Digital Divide: Determinants and Policies with Special Reference to Asia*, Economics and Research Department Working Paper Series No. 27, Asia Development Bank, Manilla, Philippines.
- Schuler, D. 1996, *New Community Networks: Wired for Change*, [Online], Addison-Wesley Publishing Company. Available from: <http://www.scn.org/civic/ncn/>
- Taylor, W. 2004, 'Community informatics in perspective', in *Using Community Informatics to Transform Regions*, S. Marshall, W. Taylor & X. H. Yu (Eds), Idea Group Publishing, Hershey, PA., pp. 1 – 17.
- Turk, A. & Trees, K. 2000, 'Facilitating community processes through culturally appropriate informatics: an Australian indigenous community information system case study', in *Community Informatics: Enabling Communities with Information and Communications Technologies*, M. Gurstein (Ed), Idea Group Publishing, Hershey, USA. pp. 339 – 358.
- UNESCO 1997, *UNESCO and an information society for all*, [online], WebWorld: E-Publications. Available from: <http://unesco.org/webworld/telematics/gis.htm> [25/05/04].
- United Nations 2002, *Digital divide still yawns, Kofi Annan tells assembly session on Information and Communication Technologies for Development*, [online], United Nations. Available from: <http://www.escwa.org.lb/information/press/un/2002/june/18.html> [01/05/04].
- United Nations 2004, *Millennium indicators database*, [online], United Nations Statistics Division. Available from: http://unstats.un.org/unsd/mi/mi_goals.asp [01/06/04].
- Warschauer, M. 1998, 'Technology and indigenous language revitalization: analyzing the experience of Hawai'i', *Canadian Modern Language Review*, vol. 55, no. 1, pp. 140 - 161.
- Warschauer, M. 1999, *Electronic Literacies: Language, Culture and Power in Online Education*, Lawrence Erlbaum Associates Mahwah, New Jersey.

Warschauer, M. 2003a, 'Demystifying the digital divide', *Scientific American*, vol. 289, no. 2, pp. 42 - 47.

Warschauer, M. 2003b, *Technology and Social Inclusion: Rethinking the Digital Divide*, The MIT Press Cambridge, Massachusetts.

Warschauer, M. 2004, 'The rhetoric and reality of aid: Promoting educational technology in Egypt', *Globalisation, Societies and Education*, vol. 2, no. 3. pp. 377 – 390.

Wiseman, J. 1998, *Global Nation: Australia and the Politics of Globalisation*, Cambridge University Press, Cambridge, U.K.

Worcman, K. 2002, 'Digital division is cultural exclusion. But is digital inclusion cultural inclusion?' *D-Lib Magazine*, [online], vol. 8, no. 3, Corporation for National Research Initiatives. Available from: <http://www.dlib.org/dlib/march02/worcman/03worcman.html> [27/05/2004].

World Bank & AusAID 2001, *Virtual Colombo Plan: Bridging the Digital Divide: Joint Australian - World Bank Background Study*, Commonwealth of Australia Canberra.

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