

This is a reprint from a paper published in the Proceedings of the IADIS International Conferences
IADIS, <http://www.iadis.org>

CONSIDERING THE COGNITIVE AND SOCIAL IMPLICATIONS OF CHILDREN'S INTERNET USE

Kirsty Young

University of Technology, Sydney
PO Box 222 Lindfield NSW Australia 2070

ABSTRACT

Throughout history the development and widespread use of new technologies has impacted upon human cognition and social structures. By integrating a range of cognitive and socio-cultural theories we are better able to understand the impact of technological tools on individuals and their local and global communities. An integrated theoretical approach enables us to more comprehensively ascertain the potential of the Internet to significantly impact upon individual's cognitive processes and the larger social implications of this global phenomenon. This paper is broadly focused and, rather than exploring a single theory in depth, instead aims to promote the value of applying what we have learned from a number of cognitive and socio-cultural theories to more fully understand the unique and complex Internet-mediated learning environment. The paper concludes by presenting a study which has applied the proposed integrated theoretical model which resulted in a profile of the young, competent Internet-user.

KEYWORDS

Children, Internet, cognitive theory, socio-cultural theory, informal learning

1. CHILDREN AS INTERNET-USERS: A CASE FOR STUDY

Research in the field of Internet-mediated learning extends across a broad range of fields. Children, as confident Internet users, are becoming an area of research interest due to the high levels of informal Internet usage evident in some countries around the world (enGauge, 2003; Pitman, et al., 2002; Aisbett, 2001). Children of the current generation can provide unique insights given many have known no other society than one with ubiquitous Internet-usage.

The necessity for research aimed at uncovering the impact of Internet-mediated learning experiences on our children can be understood if we consider the following principles:

- (a) tools (such as the Internet) have the power to affect human cognition;
- (b) tools (such as the Internet) impact upon the future development of societies;
- (c) tools (such as the Internet) can change the skills necessary to participate in one's community.

To investigate this potential of the Internet there is a need for exploratory studies which examine the ways in which its usage can affect individual cognitive development and the longer-term social implications of this. Research in this area could be enhanced through the development of a strong theoretical framework; one that takes account of current understandings developed through cognitive and socio-cultural perspectives of learning.

This theoretically integrated, yet exploratory, approach to research has been developed on the premise that we need to examine the developmental experiences which are actually evident in the Internet-mediated environment rather than trying to fit competent Internet-users into pre-existing developmental moulds or merely predicting the potential changes in cognition and socio-cultural practices. Indeed, as Adams and Hamm (2000) identify, books, television and computers have previously been examined to identify their role in mediating human existence, it is now the turn of the Internet. This paper now moves to identify the place of cognitive tools generally and more specifically the place of the Internet as a culturally valued cognitive tool.

2. THE INTERNET AS A CULTURALLY VALUED COGNITIVE TOOL

2.1 The Impact of Cognitive Tools on the Human Mind

Cognitive tools exist in two forms: physical (eg. printing press) and psychological (eg. shared symbols). They develop to serve the needs of a community and, over time, can have a profound impact on the development of human cognition and society generally.

Miller (2000) and Wertsch and Rupert (1993) suggest that some tools mediate new patterns of thought and mental functioning and, importantly, that the human mind has evolved over thousands of years as a result of the tools developed and valued in society. Taking this as true we must consider the potential impact of the Internet as a new, culturally valued cognitive tool.

At this point in time there is much conjecture on the ways in which technologies may impact on the human mind. Some, such as Creighton (2000), present a broad view in suggesting that Internet-mediated learning is having a profound impact on how we, as a society, acquire and master new skills and absorb information. Others, are more precise in identifying the impact of technology on children. Oppenheimer (1997), for example, reports the view of William Winn who contends that high-tech children think differently from the rest of us "... *they develop hypertext minds. They leap around. It is though their cognitive strategies were parallel, not sequential*" (p. 13). Oppenheimer (1997) also identifies a contrasting view held by some psychologists "... *that the computer screen flattens information into narrow, sequential data. This kind of material, they believe, exercises mostly one half of the brain – the left hemisphere, where primarily sequential thinking occurs...*" (p. 13).

While it is unknown exactly the ways in which technologies may affect human development the Internet is certainly a tool with the potential to have some impact, given its unique features make it unlike any learning environment (formal or informal) previously available.

Review of literature on the effects (or predicted effects) of hypermedia, multimedia and Internet environments (see, for example, Breck, 2002; Driscoll, 2002; Windschidtl, 1996; Nielson, 1995) suggests there are five main areas to be considered:

- (1) demands on human senses, perception and memory;
- (2) communicative issues;
- (3) issues of information distribution, access and retrieval;
- (4) quality and quantity of available information;
- (5) levels of interactivity and learner control.

These issues can be more fully understood upon review of literature related to the cognitive effects of specific hypermedia and multimedia environments. From an educationalist perspective four theories are useful in understanding the complexity of learning in the Internet-mediated environment:

- (a) Cognitive Load Theory (Brunken, et al., 2003; Paas, 2003; Mayer & Morneo, 2002 1998);
- (b) Dual-Coding Theory (Mayer & Morneo, 2002, 1998; Paivio, 1991, 1971);
- (c) Cognitive Flexibility Theory (Jonassen, et al., 1997; Mishra, et al., 1996);
- (d) Flow Experience (Konradt & Sulz, 2001; Csikszentmihalyi, 1990).

Analysis of these four theories highlights numerous areas which could human learning as a result of the design features of the Internet and unique nature of online content. The overview presented below does not explore the four theories in detail. Instead, the purpose is to identify those component/s of each theory which are explicitly related to the structural design of the Internet and have the potential to impact upon cognitive development. These factors include:

- (a) the impact of abundant of online content (*cognitive load*)
- (b) the impact of the non-linear nature of online content (*cognitive load*)
- (c) the impact of simultaneous presentations of visual and verbal representations (*dual-coding*)
- (d) the impact of instantaneous availability of multiple perspectives of a concept/topic (*cognitive flexibility*)

- (e) the impact of concepts being presented in their complexity (*cognitive flexibility*)
- (f) the impact of increased interactivity (eg, feedback, learner control) (*flow experience*)
- (g) the impact of distractors (eg, technical problems, advertising, etc) (*flow experience*)
- (h) the impact of self-motivated, goal-directed online activity (*flow experience*).

Although the scope of this paper prohibits me from exploring the above points in detail, knowledge of them is, however, instrumental in understanding cognitive experiences during Internet-mediated activity. This knowledge, in turn, enables us to focus our research on specific areas of potential impact on children as a result of sustained, long-term Internet-usage.

2.2 The Social Implications of Culturally valued Cognitive Tools

The potential of technologies to impact upon human development is not limited to areas of individual cognition. Also affected is the way in which we view the world as a result of active engagement with technologies such as the Internet. Indeed, learning with tools can be viewed as enculturation into the society in which the learning takes place (Putman & Borko, 2000). This is considered a two-fold process whereby society also changes through the ideas and ways of thinking that individuals and groups bring to the situation (Putman & Borko, 2000). Considering these ideas, it becomes imperative that we also take the social implications of Internet-mediated learning into account when trying to uncover learning experiences of competent users.

Three theories that are particularly useful in exploring the social implications of Internet-mediated learning include:

- (a) Situated Cognition (Greeno, 1998; Brown, Collins & Duguid, 1989);
- (b) Distributed Cognition (Barab & Plucker, 2002; Hutchins, 2000, 1995; Moore & Rocklin, 1998);
- (c) Activity Theory (Stetsenko & Arievitch, 2004; Lim, 2002; Engeström, 1999, 1993).

Integration of these three theories allows us to take account of both the individual's cognition and also the greater socio-cultural implications of Internet-mediated activity.

Again, scope of this paper will not enable full review the theories, however, after extensive review of related literature the following seven points have been deemed relevant for consideration in understanding the impact of the Internet:

- (a) over time the Internet has evolved as a cognitive tool which is reflective of today's society - at both the local and global levels;
- (b) access to, and subsequent mastery of, the Internet exposes individuals to the rules, values and beliefs evident in today's global society;
- (c) the Internet is a tool which promotes goal-directed activities (motivated by either the user's own goals or the goals imposed by others);
- (d) engagement with the Internet allows one to access and contribute to distributed knowledge across society;
- (e) engagement with the Internet develops mastery of the tool – a merging between user and the Internet;
- (f) cognitive tools, such as the Internet, have the power to transform individual cognitive processes and learner attitudes and behaviours;
- (g) individual actions using the Internet have the power to influence its further development and use – the Internet will continue to grow and evolve to reflect changes in society.

From this it is suggested that the learning, which occurs during Internet-mediated activity, results from the complex, interwoven relationships between individual, tool (the Internet) and society. These relationships are now explored in the Internet-Mediated Learning Model discussed in what follows.

3. DEVELOPMENT OF AN INTERNET-MEDIATED LEARNING MODEL

As a result of this integrated theoretical approach to understanding Internet-mediated learning the Internet-Mediated Learning Model depicted in Figure 1 below was developed to capture the relationships which exists between individual, tool and society.

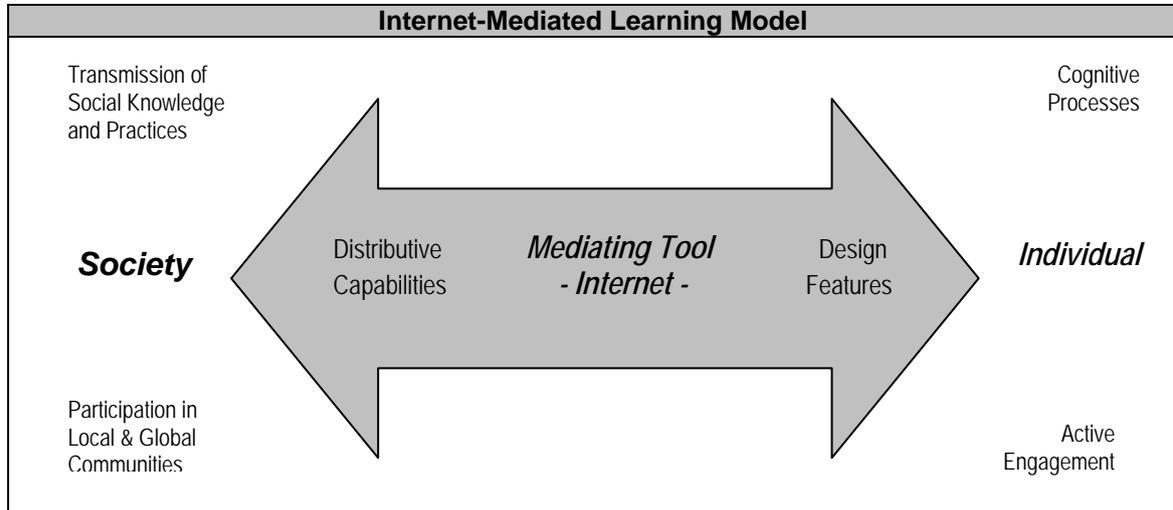


Figure 1. The Internet-Mediated Learning Model

This model highlights the place of the mediating tool (in this instance the Internet) to impact upon society through its distributive capabilities (socio-cultural theories) and impact upon individual learning due to its unique design features (cognitive theories). Importantly, this model reflects the two-way relationship that is been expounded by the integrated theoretical framework that the individual’s engagement with the Internet impacts upon its future development and its development subsequently impacts upon both the development of individual cognitive processes and society generally.

Importantly, to evaluate learning through this Internet-Mediated Learning Model we must consider the interwoven relationship between the three elements making up this learning system and these considerations are depicted in Table 1 below:

Table 1. Considerations of the Internet-Mediated Learning Model

Society	Mediating-Tool	Individual
Considerations: - the social knowledge and practices which are transmitted via the Internet - access of users to participate in local and global communities	Considerations: - the design features of the Internet - the distributive capabilities of the Internet to off-load tasks and increase individual performance.	Considerations: - the cognitive processing capabilities of the learner - the active engagement of the learner in goal-directed activity

As can be seen in Table 1 above, considerations of *society* include:

- (a) The need to acknowledge how the design of the Internet allows for transmission of social knowledge and practices across the global community.
- (b) The capacity of the Internet to allow individuals active participation in their local and global communities. Suggested by Situated Cognition, Distributed Cognition and Activity Theory it is this form of participation which enables individuals to become active members of their communities.

Considerations of *tool-mediated activity* include:

- (a) The unique design features of the Internet must be considered for the important role these features play in learning. As highlighted in points (a) to (h) earlier, the Internet has many unique design features that have the potential to impact upon human cognition.
- (b) The Internet is a cognitive tool and the distribution of cognition enabled by this tool can enhance human performance by off-loading certain cognitive tasks. This distribution of cognition also allows the individual to increase their performance by having access to the skills and knowledge of other individuals and groups in society. Both of these elements of distributed cognition should be considered under this model.

Considerations of the *individual* include:

- (a) The individual's cognitive processing capabilities (which will vary from person to person and task to task) must be taken into account.
- (b) The individual's active engagement with the tool must also be considered. Particularly relevant here are issues of flow experience and germane cognitive load which considers the learner's efforts to process and comprehend information. Also here, account must be taken of the individual's desire to actually engage (or not) in socially acceptable activities.

The Internet-Mediated Learning Model presented here thus comprises three areas: individual, mediating-tool and society. Important considerations for each of these areas have been identified to more fully understand this complex and unique learning environment. We must begin to examine Internet-mediated learning by taking account of each of these interrelated areas, rather than trying to isolate the components which comprise the Internet-mediated learning system. By doing this, we can begin to understand the learning which takes place in this environment and subsequently the impact of it across human and societal development.

4. APPLYING THE INTERNET-MEDIATED LEARNING MODEL TO DEVELOP A PROFILE OF THE YOUNG, COMPETENT INTERNET-USER

Taking an integrated theoretical perspective proved particularly useful in a study recently completed by the author which aimed to uncover the experiences of young, competent Internet-users. This qualitative case study comprised five children aged between 10- and 11-years at the commencement of the study. In the first instance each child was observed and asked to 'think-aloud' whilst they engaged in Internet-mediated activities of their own choosing (eg. searching eBay, researching the game of field hockey). In the second phase a follow-up interview was conducted to further explore issues arising from the observational and think-aloud data. From this data a profile of the young, competent Internet-user emerged. Using the Internet-Mediated Learning Model as a framework this profile captures three types of 'citizen' depicted in Figure 1 below.

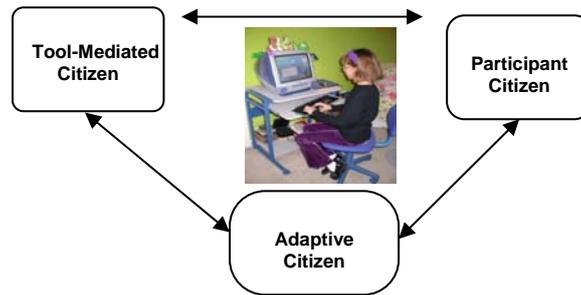


Figure 2. The three ‘citizen’ types of the young, competent Internet-user

The three major categories have defining characteristics that are set in place by eleven secondary categories which emerged from the data. To further explore the eleven secondary categories a significant number of descriptive categories were also established. These various categories are depicted in Table 2 below.

Table 2. Overview of the descriptive categories which build the Profile of the Young, Competent Internet-User.

Profile of the Young, Competent Internet-User	
Participant Citizen	
1. Global Citizen	<ul style="list-style-type: none"> Awareness of the global nature of online content Awareness of the impact of global distances on activities Awareness that language variations exist across cultures Awareness that Internet access is not available to all people Awareness that the Internet is used to share information across local and global communities
2. Commercial Citizen	<ul style="list-style-type: none"> Understanding of economic values Consumerism: exposure to online advertising <li style="padding-left: 20px;">knowledge of brand names and commercial organisations <li style="padding-left: 20px;">understanding of online shopping activities
3. Communicative Citizen	<ul style="list-style-type: none"> Skill in the use of email Skill in the use of messenger services and chatrooms Understanding of global communicative standards
4. Abiding Citizen	<ul style="list-style-type: none"> Understanding of the rules of usage
Tool-Mediated Citizen	
5. Technician	<ul style="list-style-type: none"> Demonstrating levels of competence (master v. apprentice) Demonstrating efficient practices
6. Security Guard	<ul style="list-style-type: none"> Use and understanding of signing-in and passwords
7. Integrator	<ul style="list-style-type: none"> Ability to integrate various human senses Ability to integrate different online and offline activities Ability to integrate available hardware and software
8. Design Analyst	<ul style="list-style-type: none"> Skill in analysis of Web site layout Understanding of use and limitations of Internet Understanding of skills and knowledge required or facilitated by Internet use

Adaptive Citizen	
9. Efficient Worker	Efficiently scanning for key words Efficiently skimming texts
10. Researcher	Competence in searching and navigating for information Ability to compare different tools for different purposes
11. Director	Patience and Persistence Focus on direction Self-regulation/self-monitoring toward goals

These categories present a comprehensive picture of the various cognitive skills and social knowledge of these young, competent Internet-users. This is not to say that the skills and knowledge are only as a result of engagement with the Internet but certainly these skills and knowledge are evident during a range of informal, child-driven Internet activities.

4. CONCLUSION

Taking an integrated theoretical approach which incorporates contemporary understandings of both human cognition and the socio-cultural implications of learning lends itself to exploring the multi-faceted complexity of human learning in an Internet-mediated environment.

This approach to research is particularly useful at this point in time when there is much conjecture on the benefits or limitations of online learning experiences. I believe the way forward is to continue to watch and listen to children as they use the Internet to achieve personally relevant goals. We need to move away from our 'adultist' attitudes toward technologies (Holloway & Valentine, 2003, p. 156) and consider more carefully the skills, knowledge and behaviours of the future generation which are being developed during their informal and unstructured engagement with the Internet. This is particularly so as we do not yet know what impact the skills, knowledge and behaviours being developed through media such as the Internet, may have on the long-term cognitive development of children and across their lives.

Importantly, we cannot view the experiences of the individual and the Internet in isolation. The interactions between human and tool can have far-reaching consequences on local and global communities and, over time, impact upon the social structures. In developing an in-depth understanding of Internet-mediated activity we must, therefore, be mindful not only of individual cognitive processes but also the wider socio-cultural implications of Internet usage.

The Internet-Mediated Learning Model presented here is designed to capture the complexity of the Internet-mediated learning environment by taking account of the individual, the design of the tool (Internet) and related social issues. As can be seen from the profile of the young, competent Internet-user which has also been presented, using this Internet-Mediated Learning Model is useful in capturing many facets of 'learning' which is evident when the Internet is used in ways reflective of the ordinary practices of the community.

REFERENCES

- Adams, D and Hamm, M. 2000. *Media and Literacy: Learning in an Electronic Age – Issues, Ideas and Teaching Strategies*. C C Thomas. Springfield.
- Aisbett, K. 2001. *The Internet at Home: A report on Internet use in the home*. Entertainment Insights for the Australian Broadcasting Authority. Sydney.
- Barab, S. and Plucker, J. A. 2002. Smart People or Smart Contexts? Cognition, Ability, and Talent Development in an Age of Situated Approaches to Knowing and Learning. *Educational Psychologist*. Vol. 37. No. 3. pp. 165-182.
- Breck, J. 2002. *How will we learn in the 21st century*. Scarecrow Press Inc. Maryland.
- Brown, J. S, Collins, A. and Duguid. 1989. Situated Cognition and the Culture of Learning. *Educational Researcher*. Vol. 18. No. 1. pp. 32-42.

- Brunken, R. and Plass, J. L. 2003. Direct Measurement of Cognitive Load in Multimedia Learning. *Educational Psychologist*. Vol. 38. No. 1. pp. 53-61.
- Csikszentmihalyi, M. 1990. *Flow: The Psychology of Optimal Experience*. Harper & Row. New York.
- Driscoll, M. P. 2002. *How people learn and what technology has to do with it*. ERIC Clearinghouse on Information and Technology. ERIC Identifier ED470032.
- EnGauge. 2003. *21st Century Skills for 21st Century Learners*. North Central Regional Educational Laboratory and the Metiri Group. Los Angeles.
- Engeström, Y. 1989. Developmental studies of work as a testbench of activity theory: the case of primary care medical practice. *Understanding Practice: Perspectives on activity and context*. J. Lave (Ed). Cambridge University Press. Cambridge.
- Engeström, Y. 1999. Activity theory and individual social transformation. *Perspectives on Activity Theory*. R. Punamaki (Ed). Cambridge University Press. Cambridge.
- Greeno, J. G. 1998. The Situativity of Knowing and Learning and Research. *American Psychologist*. Vol. 53. No. 1. pp. 5-26.
- Holloway, S. L. and Valentine, G. 2003. *Cyberkids: children in the information age*. RoutledgeFalmer. New York.
- Hutchins, E. 2000. *Distributed Cognition*. Last update: 18 May 2000. Source Unknown.
- Jonassen, D. H. and Dyer, D. 1997. Cognitive Flexibility Hypertext on the Web: Engaging Learners in Meaning Making. *Web-based Instruction*. B. H. Khan (Ed). Educational Technology Publications Inc. New Jersey.
- Konradt, U. and Sulz, K. 2001. The Experience of Flow in Interacting with a Hypermedia Learning Environment. *Journal of Educational Multimedia and Hypermedia*. Vol. 10. No. 1.
- Lim, C. P. 2002. A theoretical framework for the study of ICT in schools: a proposal. *British Journal of Educational Technology*. Vol. 33. No. 4. pp. 411-421.
- Mayer, R. E. and Morneo, R. 2002. Aids to computer-based multimedia learning. *Learning and Instruction*. Vol 12. pp. 107-119.
- Mayer, R. E. and Morneo, R. 1998. A split-attention effect in multimedia learning: Evidence for dual processing systems in working memory. *Journal of Educational Psychology*. Vol. 84. pp. 444-452.
- Miller, E. 2000. Can technology exploit our many ways of knowing? *The digital classroom: how technology is changing the way we teach and learning*. Gordon, D. T. (Ed). Harvard Education Letter. Cambridge.
- Mishra, P. and Spiro, R. J. 1996. Technology, Representation and Cognition: The Refiguring of Knowledge in Cognitive Flexibility Hypertexts. *Cognitive aspects of electronic text processing*. S. deMul (Ed). Ablex Publishing Corporation. New Jersey.
- Moore, B. J. and Rocklin, T. R. 1998. The Distribution of Distributed Cognition: Multiple Interpretations and Uses. *Educational Psychology Review*. Vol 10. No. 1. pp. 97-110.
- Nielson, J. 1995. *Multimedia & Hypertext: the Internet and Beyond*. Academic Press Limited. London.
- Oppenheimer, T. 1997. *The Computer Delusion*. The Atlantic Online.
- Paas, F. 2003. Cognitive Load Theory and Instructional Design: Recent Developments. *Educational Psychologist*. Vol. 38. No. 1. pp. 1-4.
- Paivio, A. 1971. *Imagery and Verbal Processes*. Holt, Rinehart & Winston. New York.
- Paivio, A. 1991. Dual Coding Theory: Retrospect and Current Status. *Canadian Journal of Psychology Outstanding Contribution Series*. Vol. 45. No. 3. pp. 255-287.
- Pitman, S. T. and Herbert, T. 2003. *Profile of Young Australians 2003: Facts, Figures and Issues*. The Foundation for Young Australians. Melbourne.
- Stetsenko, A. and Arieviditch, I. M. 2004. The Self in Cultural-Historical Activity Theory. *Theory & Psychology*. Vol. 14. No. 4. pp. 475-503.
- Wertsch, J. V. and Rupert, L. J. 1993. The Authority of Cultural Tools in a Sociocultural Approach to Mediated Agency. *Cognition & Instruction*. Vol. 11. No. 3. pp. 227-239.
- Windschitl, M. 1998. The www and classroom research: What path should we take? *Educational Researcher*. Vol 27. No. 1. pp. 28-33.