Literacy and Computer Literacy: Analyzing the NRC's *Being Fluent with Information Technology*

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Background

As Alvin Toffler expressed it in 1980, the world is experiencing a third wave of technological and social transformation. Manuel Castells (1996) characterizes what is emerging as a network society, organized around information and communications technology.

The second wave industrial revolution was associated with broad efforts to expand literacy so as to incorporate people into urban work and life: the establishment of public schools, public libraries, the expansion of print publication, and the concept and promotion of the three Rs. Today we see policymakers and scholars, public institutions and grassroots movements, striving for broad computer access and asserting that being able to use a computer is a requirement for democracy and participation in the workforce.

The United States has invested a great deal of public and private resources to install information computer technology (ICT) and adjust our culture and society to it. In the public sector, schools have been wired and computers have been installed, first in dedicated labs and then in classrooms. Essentially every public library outlet in the US provides Internet access to patrons, and libraries show patrons how to browse the Web. Computers loaded with mostly Microsoft software, using online services provided mostly by AOL Time Warner, can be found in six of ten American homes. As a nation, what are we teaching when we teach computers? What should we teach? What is computer literacy?

The scientific establishment addressed this last question in a policy report commissioned and published by the National Research Council in 1999. The report, *Being Fluent with Information Technology,* was authored by five computer scientists and two education scholars. This paper will discuss the NRC report in light of current thinking regarding literacy and computer literacy.

The authors use the term *fluency* rather than *literacy*, giving the following brief explanation, which this paper will discuss later:

> Generally, computer literacy has acquired a skills connotation, implying competency with a few of today's computer applications, such as word processing and email. Literacy is too modest a goal in the presence of rapid change, because it lacks the necessary staying power. As the technology changes by leaps and bounds, existing skills become antiquated and there is no migration path to new skills. . . . To adapt to changes in the technology . . . involves learning sufficient foundational material to enable one to acquire new skills independently after one's formal education is complete. This requirement of a deeper understanding than is implied by the

> rudimentary term computer literacy motivated the committee to adopt fluency as a term connoting a higher level of competency. (NRC, 1999, p. 2)

The committee also decided not to argue that information technology fluency was required of everyone, but to focus instead on college graduates, whom it equated with "individuals who want to be able to use information technology effectively" (p. viii).

Fluency with information technology, the report concludes, requires three types of knowledge: contemporary skills, foundational concepts, and intellectual capabilities (p 2). Details of these three areas are in table 1.

Table 1. Components of fluency with information technology (NRC 1999 p 4).

Intellectual capabilities

1. Engage in sustained reasoning
2. Manage complexity
3. Test a solution
4. Manage problems in faulty solutions
5. Organize and navigate information structures and evaluate information
6. Collaborate
7. Communicate to other audiences
8. Expect the unexpected
9. Anticipate changing technologies
10. Think about information technology abstractly

Information technology concepts

1. Computers
2. Information systems
3. Networks
4. Digital representations of information
5. Information organization
6. Modeling and abstraction
7. Algorithmic thinking and programming
8. Universality
9. Limitations of information technology
10. Societal impact of information and information technology

Information technology skills

1. Setting up a personal computer
2. Using basic operating system features
3. Using a word processor to create a text document
4. Using a graphics and/or artwork package to create illustrations, slides, or other image-based expressions of ideas
5. Connecting a computer to a network
6. Using the Internet to find information and resources
7. Using a computer to communicate with others
8. Using a spreadsheet to model simple processes or financial tables
9. Using a database system to set up and access useful information
10. Using instructional materials to learn how to use new applications or features

Research questions

As we have seen, the NRC authors very briefly set aside the two terms literacy and computer literacy. Their explanation of this, together with the footnotes and contributor biographies (there is no bibliography), suggests that they did not take into account various schools of thought concerning literacy. This paper is a review of the literature on literacy that will contradict the committee's view that literacy is "too modest a goal" in the face of the information revolution. As a result, this paper will use the terms information technology (IT) fluency and computer literacy interchangeably and ask the following three questions:

- What does research tell us about literacy and computer literacy that adds to or expands the NRC report, incorporating a broader multidisciplinary approach?
- What definition of computer literacy might result?
- What research might then be on the agenda?

Eleven theses on literacy

A review of the *Journal of Literacy Research*, the *Journal of Adolescent and Adult Literacy*, and books spanning more than 20 years of literacy research suggested 11 theses that could inform further work on the question of computer literacy or IT fluency. Some are represented in the NRC report; others are not. In some cases particular sections of the report could be expanded to address a thesis. Elsewhere a new section is needed to discuss a given thesis.

Table 2 summarizes the arguments made here. For each of the 11 theses the table indicates 1) particular literacy scholarship which expresses the thesis, 2) whether the NRC report includes this aspect of what we have learned about literacy, and 3) a suggested strategy for incorporating this knowledge into an enriched conceptualization of computer literacy. What follows is a discussion of each thesis.

Table 2. Eleven theses and their relationship with the NRC's *Being Fluent with Information Technology*.

Thesis and related scholarship	Included in NRC report?	How might NRC report be expanded to incorporate this thesis?
1. Literacy is a technical skill. *Kaestle et al., OECD and Statistics Canada, Scribner*	Yes	
2. Literacy is conceptual. *de Castell and Luke, Freire and Macedo, Hirsch*	Yes	
3. Literacy is historical. *de Castell and Luke, Finn*	Yes	
4. Literacy is social. *Barton, Freire and Macedo, Lave, Scribner, Vygotsky, Whitin*	In part	Examine and conceptualize computer literacy as an aspect of life within a community of practice, and/or as an attribute of a sociotechnical environment.
5. Literacy is intertwined with power. *Barton and Hamilton, diSessa, Freire, Hirsch, Lessig, Papert, Resnick, Scribner, Zinovyev and Pleshakova*	In part	Particularly with regard to programming as computer literacy, examine the new social reality of programming as collaborative public good (free software/open source), as an example of computer literacy that shapes the world rather than conforms to it.
6. There is a literacy divide between school and home. *Finn, Hawkins and Paris, Heath, Nagle*	No	Do not assume that standards are equally well applied across school systems, and look to out-of-school computer literacy practices for their influence.
7. Bridging different literacies is desirable. *Blackledge, Street, Warschauer, Willinsky*	No	Examine the barriers to computer literacy that result from differences in culture and power and socioeconomic structures.
8. Literacy theory is in crisis. *Eglash, Gee, Jones*	No	Examine computer literate people as social agents rather than subjects. Rely on multiple schools of thought (e.g., regarding literacy).
9. Literacy problems suggest that democracy is threatened. *Bolter, Gee, Jury, Lankshear, McLuhan, Naisbett, Tuman, Williams*	No	Take into account all social strata when defining computer literacy in order to address the problem of who is being left behind as social bifurcates economically and socially.
10. Literacy theory is cultural hegemony. *Cassirer, Eglash, Gee, Goody and Watt, Hutchins, Ong, Schaff, Schilpp, Scribner*	No	Acknowledge that computer literacy is not superior to other literacies or to orality, only different.
11. The digital format integrates literate forms of communications with non-literate forms. *Anderson-Inman and Reinking, Castells, Gee, Tuman*	No	Examine computer literacy in the rich contexts it inhabits, alongside of other oral, visual, written "symbols, sites, tools, objects and technologies."

1. Literacy is a technical skill.

Being Fluent explains that IT fluency includes skills. For the NRC authors, skills mean the ability to use certain hardware and software to accomplish tasks (1999, p. 18). Of the three aspects of fluency in the NRC report, the third aspect, which lists specific tasks that an IT-fluent person should be able to do, addresses this thesis.

An earlier paradigm in the research literature concerning literacy, one that still holds in some situations, is that literacy is a technical skill. For instance, historians examining primary documents would identify a person as illiterate who had signed a document with an X rather than writing his or her name; this has given rise to certain estimates of literacy rates in various localities at various times. During World War I, the US armed forces promulgated the concept of functional literacy, which meant possessing the reading and writing skills needed to meet the task of soldiering (Scribner, 1984/1994, p. 15). A standard test could measure these skills across a huge population. More recently, an international survey research project has measured literacy rates in 24 countries. This project helps set policy and spending priorities for governments, international agencies, and donors. For these surveys, literacy is defined as "a particular capacity and mode of behavior: the ability to understand and employ printed information in daily activities, at home, at work and in the community--to achieve one's goals and to develop one's knowledge and potential." The survey presents participants with questions about such sample items as a train schedule or a newspaper clipping. The survey team organized literacy skills into three domains: Prose literacy (text), document literacy (forms), and quantitative literacy (arithmetic) (OECD and Statistics Canada, 2000, p. x).

Kaestle et al. provide the following definition of literacy: "the ability to decode and comprehend written language at a rudimentary level--that is, the ability to say written words corresponding to ordinary oral discourse and to understand them" (1991 p. 3). Kaestle et al. also define two types of literacy: literacy in the schools, reading achievement; and literacy outside the schools, functional literacy (1991, p. 77). (Note here that the setting in which literacy is practiced is creeping into the definition; I will say more about this below.)

Scribner names the technical approach to literacy "literacy as adaptation, [a] metaphor . . . to capture concepts of literacy that emphasize its survival or pragmatic value" (1984/1994, p. 15). With this definition, the individual practicing literacy is conforming to a preordained standard.

2. Literacy is conceptual.

The authors of the NRC report do not stop at the technical skill aspect of computer literacy: "Fluency with information technology requires three types of knowledge: contemporary skills, foundational concepts, and intellectual capabilities" (1999, p. 2). The authors explain that the list of intellectual capabilities in Table 1 is domain-specific (1999, pp. 17-18). In including those intellectual capabilities, they mean to say that IT fluency means the ability to exercise those intellectual capabilities *with respect to information technology*. As a result, we can reorganize those ten capabilities with the ten capabilities they categorize as foundational concepts.

Being Fluent thus recognizes that literacy is not a context-free, value-neutral set of skills: rather, being literate "has always referred to having mastery over the processes by means of which culturally significant information is coded" (de Castell & Luke, 1983/1994, p. 374).

As Hirsch puts it, "part of language skill is content skill." He advances two kinds of literacy: Cultural literacy (common cultural knowledge) and linguistic literacy and says a person "cannot have one without the other" (1983/1994, p. 111).

Freire's most quoted expression, "To read the word is to read the world," also communicates this. Freire and Macedo explain this: "Reading does not consist merely of decoding the written word or language; rather, it is preceded by and intertwined with knowledge of the world. Language and reality are dynamically interconnected" (1987, p. 29).

I will return to this concept later, in thesis 10.

3. Literacy is historical.

Being Fluent recognizes that information technology evolves (NRC, 1999, p. 17) and new relevant concepts emerge (p. 18) and thus IT fluency will change over time. The report identifies "contemporary skills" in order to emphasize that IT fluency requires the development of new skills as new hardware and software emerge.

Literacy researchers have made the broader observation that culture changes; thus, literacy is historical. Another way of expressing this is to say that the definition of literacy changes over human history. De Castell and Luke (1983/1994) examine American education and identify three type of literacy. First, classical literacy: being able to read Greek and Latin, to practice rhetoric, make an analysis of key texts (notably the Bible), and to be familiar with a defined literature. This was the literacy of a gentleman, and it included some oral, non-written activity. Second, progressive literacy: being able to express oneself in writing and use the written word to communicate, to be part of a given social milieu and realize one's potential. John Dewey was a particular advocate of this form of literacy. Third, technocratic literacy: the functional literacy that affords a person survival skills and minimum competencies, especially in the workplace. Skinner is invoked, phonics is used, and it is a literacy that decontextualizes language. Each of these literacies, as practiced in American education, had their epoch: classical in the 19th century, progressive in the early 20th, and technocratic most recently.

Finn (1999) periodizes mass literacy in England into two periods following the spread of the printing press in the mid-1400s. The first stage, where he sees the practice of literacy for liberation, lasts to the 1700s. By the mid 1500s it was illegal for someone of lower status than a yeoman to read the Bible, but the corresponding societies reflect a mass literacy practiced in taverns and seen by the authorities as unruly. The second stage is marked in the 1800s by a crackdown on the societies and the spread of what Finn calls the literacy of the state schools. Here the state assumed control of reading and writing, taking it away from the pamphleteers and the newly literate poor themselves. A new literacy for domestication, regulation and discipline emerges, including the mass sales of sensational periodicals.

4. Literacy is social.

Being Fluent asserts that IT fluency is personal (NRC, 1999, p. 17). By this the authors mean that people will be computer literate with respect to their own needs, interests, and goals. Computer literacy will be different for a lawyer or historian as compared to a scientist or engineer (p. 17). In other words, the social setting in which a person works and lives will influence what computer literacy is for that person. This begins to answer this thesis. But let us see what else the literature tells us.

Vygotsky approaches the social dimension of literacy in his own way:

> Writing should be meaningful for children; an intrinsic need should be roused in them, and writing should be incorporated into a task that is necessary and relevant for life. Only then can we be certain that it will develop, not as a matter of hand and finger exercises, but as a really new and complex form of speech. (as cited in Whitin, 1988/1994, p. 254)

This is analogous to the NRC report's concept of IT fluency. Computer-aided design likely wouldn't be meaningful for a lawyer, and chances are he or she would not master a system of CAD software. Legal database search skills wouldn't be meaningful for an engineer; hence, he or she wouldn't be likely to master the associated concepts and skills. We see the same thing in teaching introduction to computers: when learning is a matter of hand and finger exercises rather than part of activity that is meaningful for a given student, that student will tend to forget everything between class sessions.

But there is something more to this thesis. Scribner's study of literacy began with her ethnographic study of the Vai people. The Vai, whose technological development places them in the Iron Age although they are also part of modern Liberia, read and write in three languages: Vai for their own cultural and community life, Arabic for their spiritual life as Muslims, and English for their dealings with the state of Liberia. Each written language is used for different, sometimes contesting, purposes. Based on examining the Vai literate life, Scribner conceptualized literacy as not an individual skill but a set of socially organized practices (1984/1994). This is analogous to Lave's (1991) conceptualization of learning as carried out by a community of practice rather than by individuals. Thus, using the written word is more important *as an aspect of Vai life* than as a *skill* the Vai possess. Barton characterizes this as an argument that literacy can be understood only in the context of the social practices in which it is acquired and used (1994, p. 24-25).

This suggests something beyond the *Being Fluent* conception of computer literacy. Experience as a student at a graduate school of information (formerly a library and information science school) suggests that computer literacy involves being a part of a community that uses ICT. As part of that community, the infinite and changing domain of knowledge and skills is within reach. Thus, part of computer literacy at SI is knowing how to learn new software, or knowing where or whom to go to for new concepts and skills. This suggests that computer literacy means being a part of a community of practice. Another way of describing this is Hutchins' conception of the cockpit that thinks--socially distributed cognition. Perhaps computer literacy is not in one person but is distributed: between the machines, the support staff, the manuals, and the social relationships. These social relationships might include students, faculty, and tech support staff but might also include being a fellow techie who understands that knowledge about ICT systems is something a group of people have, not one individual. As a result, computer literacy is about belonging to an invisible fraternity that has this orientation towards ICT, talks a particular language, and is hence able to solve problems together. Perhaps there are many such fraternities.

So perhaps we could examine computer literacy as learning that any given fraternity of computer users exists and apprenticing as a member: learning the geek way, to a greater or lesser extent. As for the computer literacy embedded in the hardware or software, we can take for example how help information can be accessed in most software, or on certain websites: teaching people how to access that increases their computer literacy in that they can acquire just-in-time solutions. With this orientation, IT fluency is possessed not so much by a person as by a particular sociotechnical setting.

5. Literacy is intertwined with power.

Being Fluent addresses some but not all of the concepts of literacy intertwined with power.

With Scribner and the Vai, we have already seen that power (in this case the Liberian state) dictated the practice of English literacy.

Barton and Hamilton express it as follows:

> There are different literacies associated with different domains of life. Literacy practices are patterned by social institutions and power relationships, and some literacies are more dominant, visible and influential than others. Literacy practices are purposeful and embedded in broader social goals. (2000, p. 8)

The project of *Being Fluent,* a blueprint for IT curriculum development nationwide, reflects this aspect of literacy as power. Students who become IT fluent, the report says, will have the power to navigate their way through work and life.

The following experience from the Russian revolution illustrates another aspect of the interconnection between literacy and power:

> Recalling how she taught Red Army men in the front lines to read and write, D. Elkina, a member of the Extraordinary Committee [for the Elimination of Literacy], said the old primer was clearly unsuitable.
>
> "As I read the first sentence in the primer--'Mary ate porridge'--I was interrupted by a loud, derisive voice: 'There *was* Mary, and there *was* porridge, but now there is neither porridge nor Mary.' And the fellows used such strong language that the Red Army men burst into guffaws, while I turned crimson with annoyance.
>
> "For a moment I did not know what to do, how to restore order. . . ."
>
> Elkina compiled a primer that reflected the revolutionary ideas which had roused people to struggle. "We are not slaves, we shall win," one soldier told her. And these were the first words in the primer printed on wrapping paper at the army printing shop. . . .
>
> One political worker from the headquarters, [when he returned to the evacuated headquarters found] the walls were inscribed at random with the words "We are not slaves, we shall win," written in big letters in coal. When he asked the telephone operator what these words meant, the latter replied, "Our fellows wrote that before leaving, When the White skunks come, they said, they will know that they will not remain here long!" (Zinovyev & Pleshakova, 1962, p. 13-14)

Here we have two events mediated by the same text (the soviet primer) illustrating the interconnection between literacy and power. The new primer was necessary to teach Elkina's students to read, because the soldiers could only ridicule the first book because the society it reflected was the one they were vanquishing. And then the retreating army was all the stronger for the graffiti communiqué to the invaders.

This aspect of literacy as power emphasizes making one's world rather than conforming to a world made by others. The NRC report touches briefly on this when it explains why programming skills are included in IT fluency:

> Furthermore, while not every *personally relevant application* [italics added] will be available as prepackaged software, a person with a basic knowledge of programming

> may be able to "script" a solution using some of the large number of software building blocks now available commercially. (1999, p. 47)

They emphasize the thinking skills that programming enhances and the personal freedom to play with and build on commercial software. They explain that programming for one IT-flluent person might be limited to writing HTML code while another might be writing code in C, Java, or Fortran. The NRC report partly adopts the thinking of diSessa (2000), Resnick (1994), and Papert (1980) but does not advocate that everyone learn programming in the sense of a standard programming language.

The problem with *Being Fluent*'s treatment of programming is that it does not imagine either the *socially relevant applications* (Linux is the most prominent example) that people can write themselves if they are programming-literate, or the paradigm shift from software as commodity to software as collaborative public good. To the extent that programming skills are widespread, people are able to write the world as they write the word, borrowing from Friere's famous aphorism.

Scribner acknowledges both these aspects of literacy as power: a potent tool in maintaining the hegemony of elites and dominant classes in certain societies, while laying the basis for increase social and political participation in others. . . . an instrument for human liberation and social change (1984/1994, p. 18). Hirsch, who argued against multiculturalism and for a particular canon, understood this: "Literacy is not just a formal skill; it is also a political decision" (1983/1994, p. 111). This has been illustrated in the cases of school board textbook battles and book banning.

It might be hard to imagine implementing computer programming across the college curriculum the way we have implemented writing. Part of this is the trouble with how we teach computer programming, which pedagogy has been critiqued as abstract and elitist. But if our lives will be lived as much online as off, if code is the new architecture (Lessig 1999), then the power differential between the programmers and the rest of us is so wide that we may need to reconsider, if we want to maintain not just mass employability but democracy. Future NRC reports should sum up the experiments and evaluations regarding computer programming education as well as the impact of social programming á la Linux and propose a way forward.

6. There is a literacy divide between school and home.

Being Fluent conceptualizes IT fluency as something that schools and colleges will teach all students. The authors praise the national elementary and secondary school science and math standards for being deep, rich, and not dumbed down (NRC, 1999, p. 40). What they do not examine is the problems with implementing standards, if they are to be more than a tool for ranking schools and communities. Up to 90 percent of students are failing standardized proficiency tests in certain urban and other areas. Since computers have captured the public imagination perhaps more than science did in the Sputnik era, computer literacy standards might be a way to bring everyone up. The community technology movement certainly sees computers as a way to level the playing field for poor kids.

Schools have been the site of a great deal of literacy research, which has pointed up a literacy divide. Nagle gives us one side of the picture when she observes, "School literacy is the written and social language that is sanctioned in school" (1999, p. 174). Unsanctioned literacy is practiced as well: graffiti is just one example of unsanctioned literacy.

Heath (1980/1994) studied two different communities within one city and found that in one case community literacy dovetailed with school literacy practices, and in the other case community literacy practices were different. Thus school and community can practice two different literacies. She also found that where teachers did not recognize this, they mistook students who practice only community literacy for illiterates, and student achievement suffered.

Finn (1999) identifies not one but four types of literacy sanctioned in school: powerful, informational, functional, and performative. Powerful literacy is literacy where a student can create, understand, and control texts and other information formats, and Finn finds this to be taught to the powerful, to students who would form part of the elite. This literacy generally builds on middle class literacy practices in the home. He reports that working class students, taught only the other three forms of literacy, develop an oppositional (us versus them) identity, in resistance to the school system (p. 124).

Computers are used in some schools for creative, project-based, inquiry-oriented, and/or team endeavors and in others for drilling the three Rs. This seems worth examining: an echo of the powerful literacy/functional literacy split that Finn identified. Plus, only some students come to school with home computer experience, and Lankshear (1997) reports that the out-of-school technology skills are a key determinant of professional success with computers. In light of this, it seems important for *Being Fluent* follow-up work to include a sum up of students' out-of-school computer literacy, including identifying the digital divides so that they can be bridged rather than perpetuated. For instance, Hawkins and Paris (1999) found persistent IT skill differences between Black and White college students.

7. Bridging different literacies is desirable.

Being Fluent addresses different types of IT fluency when it discusses the engineer and the lawyer, as we saw above, and in the following passage:

> [A] highly FIT [fluent in information technology] individual may simply decide that it is not worth his or her time to fix a problem, even if he or she could do so. Furthermore, even if an individual with more basic levels of FITness may still need to consult with an information technology expert to solve a technology problem or to describe a technology solution, that basic understand and knowledge will help him or her to interact constructively with the expert. . . . (NRC, 1999, p. 40)

As many computer users will attest, bridging between their IT fluency and that of a computer services staffperson, especially at a moment of technology breakdown, can be frustrating, difficult, sometimes impossible. Bridging challenges in the realm of literacy have been studied and recommendations formulated which we might adapt to computer literacy.

Blackledge (2000) addresses the problem of immigrant literacy, looking at Bangladeshi children in England. He finds that home literacy in the Bengali language, oriented around religion and storytelling, can be linked with English literacy in school, but not in the absence of bridging tools such as school interpreters and bilingual, culturally inclusive books. These two literacies, and the associated divides of class and power, can only be bridged if the teaching staff acknowledged and linked with the home literacy.

Willinsky also notes that control of reading and writing can be explicitly shifted from teacher to student, leading to advancing student literacy in and out of school (as cited in Finn, 1999, p. 140).

Warschauer (1999) found three outcomes resulting from three different ways of teaching English or the Hawaiian language: use of ICT for self-publishing improved learning; if the teacher approached the students as literate people working to gain a second literacy, learning was improved still more; and if the class as a whole explicitly cherished cultural diversity and strove for social equality, then learning was maximized.

Street addresses the literacy transfer problem more generally, but in a way that applies to the problem of bridging literacies:

> The transfer of literacy from a dominant group to those who previously had little experience of reading and writing, involves more than simply the passing on of some technical, surface skills. Rather, for those receiving the new literacy, the impact of the culture and the politico-economic structures of those bringing it is likely to be more significant than the impact of the technical skills associated with reading and writing. . . . People are not "tabula rasa," waiting for the novel imprint of literacy as many campaigns seem to assume. (1992, p. 15)

The cultures and politico-economic structures surrounding various computer literacies (the community of practice) can exert maximum force on a person trying to learn, trying to join that community or navigate across several communities. It would seem very useful for *Being Fluent* follow-up work to examine these cultures and politico-economic structures. Most of all, computer literacy has to explicitly include recognizing and mastering these cultures and structures so that they do not derail learners but in fact learners can use them (and change them) to learn and function better with computers.

8. The crisis in literacy theory can be resolved.

With this thesis, I move from defining literacy to examining the discipline or disciplines that study literacy. We will see that two recommendations for healing the crisis in literacy theory are relevant for the project of developing computer literacy policy.

Gee (2000) describes the academic tendency known as New Literacy Studies as a turn from a focus on examining the individual (influenced by behaviorism) or individual minds (influenced by cognitive science) towards examining social and cultural interactions surrounding literacy. This is parallel to a similar turn in library and information science. He asserts that New Literacy Studies is not, despite appearances, an unmasking of hierarchy, power and social injustice, and explains that the new approach is often situational, which is perfectly in tune with what he calls "new capitalism"––the network society––which measures knowledge as value added and people as portfolios. His recommendation is for literacy studies to reacquaint itself with the individual *in the context of* the social and the cultural, the individual as the *agent* of the situation, the interactions, the literacy, the language, etc.

As an example of this we can take Jones (2000), who documents a relatively new literacy event which transpires in English and Welsh when farmers bring their cows to market in Wales and a government representative talks them through a written form mandated by European Union meat quality regulations. She uncovers how the new literacy practice transfers knowledge and power from the farmer and the local market to the international authority.

To apply this to the study of computer literacy, we might usefully consider the individual practicing or learning computer literacy as an agent rather than a subject of an educational system, a job market or workplace, etc.

Taking this approach, Eglash (2001), writing about the digital divide, has observed that technological knowledge exists on both sides of the divide and that when we approach bridging the divide with that orientation, we might succeed in adapting ICT to the needs of a community rather than imposing ICT on that community.

Gee (1999) aims at healing a fissure in literacy research in his analysis of another NRC report, *Preventing Reading Difficulties in Young Children* (Snow et al., 1998). The report argues that training in phonemic awareness in early elementary grades results in higher reading scores, which indicate students' preparedness for high-skill, high-technology work. Training in phonemic awareness emphasizes the psycholinguistic aspects of reading: phonological awareness, decoding, word recognition, and literal comprehension, as against a sociocultural approach to language and literacy. Gee predicts a crisis: that third graders will pass reading tests but won't be able to use language, reading or writing to learn, master content, work in the new economy, or think critically about social and political affairs. He argues that relying on all schools of thought among literacy scholars to analyze the literacy data would suggest different, more effective policies.

What the ensuing debate over this report illustrates is that by and large, schools and governments are operating within the older framework of functional literacy and not incorporating more than 20 years of newer literacy theory. These newer theories are invisible in the world of institutional practice--individual teachers may practice them, but within often hostile or countervailing dominant practices. In response to this, the New London Group/Lancaster Group network of scholars argues for advancing scholarship, and others such as Finn argue for advancing practice in the schools, each in relation to those they have observed being cut out of the picture.

> New Literacy Studies approaches literacy as part and parcel of, and inextricable from, specific social, cultural, institutional, and political practices. Thus, literacy is, in a sense, "multiple": literacy becomes different "literacies," as reading and writing are differently and distinctively shaped and transformed inside different sociocultural practices. Additionally, these sociocultural practices always have inherent and value-laden, but often different, implications about what count as "acceptable" identities, actions, and ways of knowing. They are, in this sense, deeply "political." (Gee, 1999, p. 356)

Conceptualizations of computer literacy that depend on the broader literature, including all schools of thought regarding literacy, will be more robust.

9. Literacy problems suggest that democracy is threatened.

The NRC report on reading and the NRC report on computer literacy share a silence. Gee observes that the reading report omits mention of the actual bifurcation of the job market into a large number of insecure, unskilled jobs and a narrow segment of knowledge work, which suggests that the economy does not require high literacy skills across the population.

Similarly, Lankshear (1997) studied the acquisition of literacy by a light-manufacturing cooperative in Nicaragua, and found that their literacy skills, oriented around modern business practices, became irrelevant when the local market was opened to global players and the cooperative was swept away by the competition. In a study of computer usage by Australian schoolchildren, he also found that students' out-of-school literacy and computer practices played a key role in determining who the "symbolic analysts" would be, regardless of what the school taught. Lankshear asks:

> If only the relatively small proportion of knowledge workers necessary for modern economies-the value-adding "symbolic analysts" of the new work order-actually *need* high order literacies; if, beyond "demands for basic numeracy and the ability to read," routine production and in-person service work call primarily "for reliability, loyalty, the capacity to take direction and . . . a pleasant demeanour," why *wouldn't* we expect "literacies" to mean for most students "basic competencies," and "technological literacy" to mean "keyboarding skills"? (1997, p. 5)

Lankshear is among those who fill in the details of the contradictory predictions by McLuhan--that ICT will require less mass literacy--versus Naisbett and Tuman--that ICT will require more literacy across the population. (McLuhan & Naisbett as cited in Scribner, 1984/1994; Tuman, 1992, p. 4.)

Bolter provides a definition of computer literacy and also predicts a polarization across the population:

> Computer literacy is the ability to read and write in the computer medium and an understanding of how the computer fits into the long tradition of the technologies of writing. The elite . . . will use the machine in their work and probably for their recreation as well. The computer illiterate will at best be passive users/readers of the machine. They may be able to enter data--as cashiers now do for cash registers . . . but they will not be able to write with the machine across the spectrum of semiotic communication. If the computer enters their leisure hours [as with video games, it will allow] users little opportunity for symbolic communication. (1991, pp. 223-224)

Jury asserts that literacy education is "necessitated by the economic, social, and political pressures that are increasingly familiar to people everywhere" (1999, p. 364). He argues that educators should take into account the literacy demands of an engaged civic life as opposed to the demands of the job market. The d3 workshop (Digital Divide Doctoral Students) arrived at the same recommendation regarding the digital divide: that programs to eliminate the divide operate from actual social needs and not only workforce needs (Williams, 2001).

Thus, a thorough definition of computer literacy would acknowledge the problem of the bifurcation of the job market and society itself and set a realistic course towards computer literacy for everyone, without narrowing the focus to any social elite.

10. Literacy theory is cultural hegemony.

One of the threads in *Being Fluent* is that learning programming teaches abstract thinking:

> [T]he continual use of abstract thinking in programming can guide and discipline one's approach to problems in a way that has value well beyond the information technology-programming setting. . . . [T]he ability to think abstractly, and to understand one's experience using abstractions, can be benefits that arise from an understanding of abstraction in programming. (NRC, 1999, p. 48)

The report here demonstrates a hegemonic orientation towards the non-computer literate. Literacy and language scholarship have dealt with this problem and have established that all human cultures, oral, literate, or computer-intense, depend on abstract thinking.

Much writing about literacy postulates a hierarchy between the literate and the illiterate. Scribner reflects on the belief in literacy as a "state of grace" unattainable by the illiterate, quoting for example a UNESCO report as asserting that illiteracy binds a person to concrete thinking while literacy promotes logical reasoning and critical thinking (Scribner 1984 p. 20-21). In the widely cited *Orality and Literacy,* Ong states, "Abstractly sequential, classificatory, explanatory examination of phenomena or of stated truths is impossible without writing and reading" (1982/1988, p. 8). In an equally influential essay, "The Consequences of Literacy" (1963/1968), Goody and Watt wrote that literacy "enforce[s] a more objective recognition of the distinction between what was and what is," (p 34) between myth and history, and liberates man from the "tyranny of the present" (Spengler, as cited in Goody and Watt, p 53). Literacy, they assert, and particularly literacy based on the Greek alphabet, enables logical thinking.

More recent scholarship has established that oral cultures are *different* from written ones but not lower on some social evolutionary ladder, not lower except by ethnocentric measures, than either the Greeks or the Europeans. We can turn to Cassirer for help with this. Cassirer established that all human cultures reason and reflect and make abstractions, or else they are not using language (Schilpp, 1949' also Schaff, 1973). Hutchins (1996) provides a dramatic illustration of this when he compares ship navigation in the US Navy, with its emphasis on markings on printed maps using mathematical tools and complex ship location devices manipulated by entire teams of people, with traditional Polynesian navigation systems. Polynesians have for generations navigated across open seas using a system based on oral information (especially put to song), a single pictorial diagram drawn in the dirt for teaching purposes, and the central concept of "imaginary" islands.

Thus we need to discard notions that computer literacy, including programming, is in any way a state of grace relative to other literacies or to orality; Eglash's (2001) two-way bridge across the digital divide is a guiding principle here.

11. The digital format integrates literate forms of communications with non-literate forms.

The ideology of literacy's superiority is especially objectionable and damaging at a time when several scholars testify to a new relationship between oral and literate forms of communication. Anderson-Inman and Reinking observe that the network stores and delivers audio, moving and still images, text, and any combination thereof. And the recombining can be instantaneous and endless. Electronic text is "modifiable, enhanceable, programmable, linkable, searchable, collapsible, and collaborative" and these seven aspects impact on notions of literacy (1998, p. 678). Tuman credits advancing technology with an "increasing ability to provide fast and natural communications of text, voice, and graphics" (1992, p. 4).

Castells explicitly theorizes that literacy-as-hegemony is made obsolete by the practical integration of all these forms of information:

> By implicitly and explicitly establishing a social hierarchy between literate culture and audiovisual expression, the price paid for the foundation of human practice in the written discourse was to relegate the world of sounds and images to the backstage of the arts. . . . A technological transformation of similar historic dimensions is taking place 2,700 years later, namely the integration of various modes of communication into an interactive network. . . . for the first time in history integrat[ing] into the same system the written, oral and audiovisual modalities of human communication. .

> . . and its potential interactivity is changing and will change forever our culture. (1996, p. 328-329)

Speaking from within literacy studies, Gee observes that examining how reading and writing are differently and distinctively shaped and transformed inside different sociocultural practices brings non-literate communications into view:

> [Literacy] practices always fully integrate language, both oral and written, with nonlanguage "stuff," that is, with various sorts of nonverbal symbols, sites, tools, objects, and technologies. Thus, the New Literacy Studies seek, as well, always to study literacy and literacy learning as they are integrated with oral language, social activities, material settings, and distinctively cultural forms of thinking, knowing, valuing, and believing. (1999, p. 356)

Gee offers here one methodology (among many, certainly) for shattering the hierarchical stereotypes concerning literacy, and by analogy, computer literacy, and bringing educational policy and practice in sync with the forceful, emerging reality of the network society.

What this suggests is that we examine computer literacy in the rich contexts it inhabits. What else are people doing alongside of practicing computer literacy?

Proposals for future research

Rather than reaching the original goal of a definition of computer literacy, we now have a set of eleven theses on literacy. Those that are not considered in *Being Fluent* suggest further research to flesh out what computer literacy is and should be. The last task of this paper is to map out a coherent research program that would take those suggestions and organize them towards some answers.

Lankshear proposes a definition of computer literacies which is also helpful here:

> "Technological literacies" may be defined as social practices in which texts (i.e. meaningful stretches of language) are constructed, transmitted, received, modified, shared (and otherwise engaged), within processes employing codes which are digitized electronically, primarily, though not exclusively, by means of (micro)computers. This definition can encompass involving handheld games, video games, electronic translators, electronic organizers, compact disc players, and the like. . . . Our main interest . . . is with *extant communications and practices of reading, writing, viewing, manipulating, communicating, etc. digital texts*, and their potential integration into critical forms of literate practice. (1997, p. 141)

First, this definition is not bound to the current technology of networked personal computers. Second, he proposes to find out what technological literacies are currently in practice. In other words, what are people doing now? If we knew this better, we could more easily say what people need to be able to do and thus map out national policy regarding computer literacy. Thus, having reviewed *Being Fluent,* our point of departure is now: what are people already practicing as far as computer literacy?

It is interesting to note that Lorenzetto and Neys report a similar approach taken by the Cuban literacy campaign of 1961. In preliminary work in 1959-60, literacy workers adopted primers and methods developed by Echegoyen, Laubach, and Soler. Evaluating in late 1960, the Cubans decided to develop and use instead a primer

> whose revolutionary and political content would not only have an adequate motivation from an historical and psychological point of view, but also would equally express this motivation in a comprehensible form and as close as possible to the language and expressions of the Cuban farmer. (1965, p. 18)

To guide the development of this primer, they collected the vocabulary and the outlook of the farmers by means of a poll and tape recordings.

Many people in the US have already acquired and/or maintained a computer literacy that works for them. As I have conceptualized it in my theses on literacy, people have joined a community of practice (thesis 4) that has designed or evolved a culture and politico-economic structure (thesis 7). They practice computer literacy in the context of particular social activities. The research that I propose here gathers data from people regarding how they acquire and practice computer literacy. I would propose to start with five overarching questions. These questions could be answered by means of the following methods:

- observation (ethnography, user studies)
- interviews
- document review
- participation
- literature review

As for which communities to examine, it is helpful to use the framework developed elsewhere (Williams, 2001a):

- personal computing: use of ICT at home
- private computing: use of ICT at work
- public computing: use of ICT at libraries, schools, community centers, copy shops, cybercafés, airports, apartment complexes, and so on . . . everywhere besides in the home or at the workplace

Personal computing, according to federal survey data, is associated with socioeconomic classes. Private computing is associated with the technical division of labor. Public computing gives a biopsy of the entire society. Public computing is widely distributed with respect to socioeconomic residential patterns, according to a recent study (Williams & Alkalimat, in press):

- Commercial (privately sponsored) public computing follows socioeconomic classes (more to higher incomes)
- Government-sponsored public computing is distributed without regard to socioeconomic classes
- Community-sponsored public computing is distributed to the highest and the lowest socioeconomic classes (leaving out the middle levels)
- University or college sponsored public computing is distributed to the future technical elite

The NRC report, by focusing on college students and what they need for the jobs they will enter, based its recommendations primarily on personal computing and private computing. I am proposing research that focuses on public computing sites. Examining communities at work in public computing sites will be a corrective to the *Being Fluent* report.

At the same time, exploring what people do at public computing sites, and who they are, is likely to suggest how important public computing is to society. By using the eleven theses on literacy to explore current computer literacy practices, the research would shed light on the policy decisions made in the 1980s and 90s to fund public computing (especially via schools, libraries, and community centers) and then in this decade to defund these projects. The budget-cutting decisions are being made without recourse to research findings. So the research would answer several needs.

Table 3 below lays out three communities of practice and five areas of questions to explore in each.

Table 3. Outline of proposed research.

Community of practice	**Questions to explore**
1. A community technology center in an African American community. 2. Students using computers at an urban junior high school. 3. Computer users in a local branch library.	Purpose: What is the community trying to accomplish? What tasks are involved? People: Who is in the community and who isn't? What are the important skills or traits that a newbie brings? How do you tell a newbie from someone who has mastered the work of the community? Technology: What is the hardware and software, or other technology, in use? What do people think about it? How do they feel about it? Learning: How do new people in this community learn? Are there teachers? Does everyone teach? What documents, devices, books, movies, and other cultural artifacts help people learn? Organization: Is there specialization/division of labor in the community? How do people communicate and collaborate?

Conclusion: Moving forward on the basis of *Being Fluent*

Being Fluent is a short but rich text that is a good start for thinking about computer literacy. Every contribution to the problem of what to teach and learn about ICT is a stone in the stream that we are trying to cross, to enable us to design and inhabit a new world of bits for the greater good. What this paper has attempted is to synthesize a certain amount of theory, using *Being Fluent* as a sort of sluicebox, in order to formulate a program for further data gathering and analysis. To the extent that we can reach across disciplines and examine the widest possible range of theory and practice (data), we will formulate the most important questions and get the clearest possible answers.

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