An International Approach to Developing Information Technology (IT) Literacy in Schools Based on Critical Consciousness

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Abstract

This paper argues that Information Technology (IT) needs to be demystified, through critical consciousness, for educators to focus on IT as a means to enhance learning. It goes on to define the technical, sociohistorical and political-ideological levels of IT and to identify four theoretical constructs: tutorial, machine-as-human, tool kit and catalyst. Pervading these constructs is the understanding that IT can be used as an ideological agent, which is crucial if we are to connect theoretical foundations with practice. The authors list the foundational premises for a pedagogy of informatics and give practical examples, which emphasize a process of capacitation. Capacitation refers to an ongoing, active process where teachers work together and become empowered and energized through deep collaboration.

Keywords: IT literacy, collaboration, capacitation, critical consciousness, pedagogy of informatics.

I. Introduction

What does Information Technology (IT) mean for educators and students and how do we prepare students for this time of technology proliferation? Too often we see the focus on technology itself, rather than the pedagogical issues and actual purposes for which IT can be used in schools. IT winds up on center stage, shrouded in mystique, and coupled with promises to deliver untold benefits to those who leap onto the bandwagon. How can we, as educators, demystify the use of computers and ensure that information technology is being used to deepen and enhance learning? What concepts and understandings are involved in preparing students and educators to think and act in a high tech society?

We believe it is necessary to develop a political, educational, and moral sense of direction in relation to IT use in schools, in addition to increasing proficiency in using related technologies. It is necessary to develop a pedagogy which encompasses a careful consideration of the problems we face as a high-tech society and the role schools should play.

II. Information Technology Literacy

We build upon the concepts of Paulo Freire (1985), who saw literacy as a process enabling people to be in control and active in their lives instead of acted upon by social, political, and economical forces. IT literacy is therefore far more than learning the skills necessary to use hardware and software. It involves understanding the role IT plays in society, questioning the purposes for which IT is used, understanding how IT intervenes in our lives and relations with others, and being able to choose when and which IT tools are appropriate for a task or problem at hand. IT literacy must prepare learners to increasingly act with more awareness and security in a high tech world as a result of organizing "a more precise form of thinking through a problematical vision of their world and a critical analysis of their experience" (Freire, 1985, p. 14). We agree with Freire that literacy involves understanding life in a way that couldn't be seen before, "a kind of consciousness awakening...a critical comprehension of experience" that contributes to a process of "liberation" (pp. 16-17).

IT literacy therefore involves developing a critical consciousness which enables us to make informed

choices about the way we use and respond to such technologies in our society. Learners move into a position of being able to control the impact of technology, rather that being at its mercy. Freire's description of "conscientization", the simultaneous process of transforming the world through action and grasping and expressing the world's reality through critical reflection and analysis, permeates our definition of IT literacy. IT literacy enables our students to become creators, able to engage in "transforming acts upon the world" (p. 70) rather than using IT to repeat experience.

We believe it is important to address both (1) practical levels and (2) theoretical perspectives of IT literacy in the educative process. The practical includes technical, sociohistorical, and political-ideological levels, while theoretical perspectives help us to identify which conceptions underpin the way we use IT.

1. Practical Levels of IT Literacy

Technical Level of IT Literacy.
There is no doubt that we must teach students specific skills in relation to use of hardware and software as part of the process of becoming IT literate. These are the building blocks which students can use to create new ways of thinking and acting. If we combine the perspectives of Freire (1970; 1985), Vygotsky (1962; 1978) and Leontiev (1978), the development of IT literacy must include consideration of the social and historical roots of associated tools and the way they have come to be used, plus joint problem solving using such tools with more experienced partners. Technical skills must be taught in the context of real world problems that need to be solved (Scribner, 1985; Rogoff, 1990), and consideration be given as to how and why that problem exists in the first place (critical consciousness). This will enable students to develop an awareness of the usefulness and applicability of IT tools, and bring their own creative dimension to tasks as they focus on their goals rather than actual technology use.

Sociohistorical Level of IT Literacy.
The sociohistorical level of IT involves understanding and discerning IT as part of a general process of cultural evolution, (Leontiev, 1978). This level involves knowing that computers and information are socially produced by people and that IT has the potential to transform people's lives. Contrasting differences in life before and after use of IT can help students to make some of these connections. For example, the work of an architect differs enormously since the advent of IT in comparison to the days when all drawings were developed by hand. Previous social relations among people are also being transformed by the role that IT now plays in connecting and forming social networks within institutions and between groups of people.

Political-Ideological Level of IT Literacy.
We become IT literate in a political-ideological sense through critical consciousness. This involves examining the strengths, potential, benefits, weaknesses, limits, and costs of IT. When we do this we are questioning accepted world views about technology (part of dominant ideologies) and opening space to create different views of technology use (that could become part of counter-ideologies). This aspect of literacy enables us to actively intervene by reinventing uses of IT so that teaching and learning is served by IT, not driven by it.

2. Theoretical Perspectives and IT Literacy.

We, the teachers, are ultimately responsible for selecting learning and teaching strategies based on sound theoretical foundations—and rejecting those guided by fashion, corporate, and commercial interests. Understanding that IT is a sociohistorical device and can be used as an ideological agent is crucial if we are to connect theoretical foundations with practice.

IT is potentially a very powerful sociohistorical device because it is able to register information and actions and circulate these extensively. Information and data can therefore be appropriated more easily than in the past. IT also has the potential to mediate relationships with other people and as such contribute to the social construction of learning. Understanding IT as a sociohistorical device calls attention to the social quality of student learning. When we understand IT at this level we can avoid the danger of what Kreuger, Karger, & Barwick (1989) call the cultivation of "thought in isolation" (p. 113). They remark: "What is learned, then, is passivity and alienation from oneself and others, and that the most fruitful relationships with people will be as passive and impersonal as the solitary interaction with the computer" (p. 114). IT literacy enables us to go beyond the isolation of the machine and create spaces of interaction, collaboration and interdisciplinarity.

Because IT can be used as an ideological agent, we must question the dominant ideologies which pervades its use. People's actions appear neutral but they are always serving someone else's interests, depending upon who is driving IT programming,

development and use. IT is neither neutral nor passive as it plays the role of ideological agent (Bowers, 1988; Noble, 1991; Jurema & CostaLima, 1993). It can make a difference depending on who uses it—it can also be abused. IT can be a weapon to sharpen and serve wars, or a means to facilitate peace.

The following theoretical constructs describe different conceptions underlying the use of computers in classrooms. All are pervaded by ideologies which we must identify and unveil with our students.

The tutorial construct: computer-as-a-tutor.
A central concern of this construct is the issue of *instructional efficacy*. Early work related to programmed instruction focused on parameters of reinforcement and their effects on learning (Coulsen et al. 1962; Gilman, 1967). These were controlled laboratory studies, very close to the style of the behaviorist school. Educational uses of IT oriented by behaviorism (stimulus—response) consist of texts or exercises organized by increasing levels of difficulty (Computer Assisted Instruction or CAI) and drill-and practice. In this dependent relationship there is almost no possibility of original responses, the outcomes are under control, foreseeable, and usually standardized. Therefore it justifies the traditional pedagogy, based on training, copying, repeating, and automating.

The machine-as-a-human construct: computer as an intelligent machine.
Here the underlying proposal is to substitute the teacher with intelligent programs, capable of dialogue, able to intervene, ask questions, and give explanations according to the type of answer given by the student. The difference in this construct lies foremost in Artificial Intelligence research which is dedicated to the task of providing an account, in computational terms (algorithms and representational schemes), of various aspects of human cognition.

Both the **tutorial** and the **machine-as-human** constructs reflect prevailing notions of knowledge as given, and of teachers as the final authority. They both embrace a rather conventional view of teaching as delivery, the *banking education* mode (Freire, 1970). This construct is concerned with the way students reason and understand processes, but at the same time it sends a subliminal message that the machine is capable of replacing the social dimension of teaching.

The tool-kit construct: computer as an intellectual tool.
This approach is based on the principles of Constructivism. It brings the theoretical influence of Piaget on cognitive development and his notion of the learner as necessarily active (Piaget, 1985). This constructivist view proposes that learning occurs most propitiously under circumstances of personal inquiry and discovery. IT functions as a supporting tool of searching and exploring with the objective of provoking reflection and building concepts. Here students intervene by manipulating variables, raising hypotheses, and taking the opportunity to discover principles, properties or relations of several orders.

Papert was inspired by these ideas to propose "constructionism" and argued that the activity of programming computers (using LOGO) could play an important role in constructivist learning (Papert, 1980; 1993). He proposed reversing the relationship between computers and people; instead of computers in control of students, students would control the machines. Thus, his assumption was "that by engaging in the activities of programming—designing, building, and debugging programs—the learner acquires cognitive benefits that extend beyond simply learning to code in a particular language." (Koschmann, 1996, p. 9). There is no clear evidence, however, that using LOGO significantly enhances thinking and problem solving in different contexts (Dudley-Marling & Owston, 1988; Leron, 1985).

The tool kit constuct is based upon a reduced view of constructivism, where learning is seen as a cognitive, individual, and decontextualized act, thus disregarding historical and cultural realities of schooling (Noble, 1991).

The catalyst construct: the computer as a mediator.
This construct adds a social dimension and critical view missing in the previous ones. The social learning perspective of the Russian psychologists (Vygotsky, 1962;1978; Luria, 1976; Leontiev, 1978) offers a theoretical framework where social interaction in the classroom represents a fundamental condition for learning to take place. Vygotsky talks of interaction where activities happen in cooperative and conjunctional ways. The value of such interaction relies on the fact that students are challenged by different perspectives and internalize meanings as they ask and answer questions.

From this perspective, IT provides additional resources to support and enrich the interaction. Students working with IT can exchange ideas and in this way gain control of their own abilities as users, doers, and thinkers. Here teachers play an essential role, not only planning and embodying tasks in an integrated curricula approach, but also guiding students' reflection and understanding in a way that

actual learning can take place. When students and teachers see themselves as learners they can build a context for interactive learning, and IT can be used to foster this collaboration.

III. Pedagogy of Informatics

Using IT in schools demands deep reflections which focus more on educational issues than Information Technology itself. We should begin with two fundamental questions: (1) *What kind of* society *do we want?* and (2) *What kind of individuals do we want to prepare?* This requires a determination of *why* we use computers in education, and *how* we should do it. In response we will be weaving a pedagogy of informatics (Jurema et al. 1995) which "takes into consideration learning and teaching processes, organization of curriculum, and reflection on people/machine relationships in learning and in the wider community, as well as developing children's ability to use computers competently" (p. 187). It also involves the presence of enriching contexts and amplified, didactic situations in a way that goes beyond the space of the classroom.

To put this Pedagogy into practice it is necessary to engage in a process of "capacitation" which opens spaces involving reflection, dialogue, and reinvention of actions leading to better educational practices (Weber, 1992). Capacitation is more than building capacity. It refers to an ongoing, active process where teachers work together and become empowered and energized through deep collaboration. Capacitation comes from within through the process of dialogue, exchange, reflection upon personal practice, and action. This is in contrast to traditional professional development and training where knowledge is brought to teachers from the outside. Capacitation enables teachers to go deeper and move forward by making links between their practice and theoretical foundations. It becomes possible to take action and provoke changes, thus enabling teachers to shape their own future.

By joining capacitation with the development of technological literacy, we are beginning a dialogue and pinpointing some landmarks that educators and students can use to find their way through the technological jungle. In this sense, teachers' capacitation process is essential to assure the use of Information Technology as a pedagogical tool integrated into curriculum.

1. Foundational Premises

Foundational premises for developing a program based on a Pedagogy of Informatics (Jurema et al., 1995) include:

- The interdisciplinary nature of IT knowledge involves a range of subject areas and processes, including but not limited to mathematical, historical, linguistic, logical, conceptual, and graphic. IT needs to be an integrated element of the school curriculum.

- Learners are active participants who in the course of their learning structure their experience and knowledge. Teachers are partners who support and stretch children's understandings and skills in using the tools of culture (Rogoff, 1990).

- The cooperative work of students and teachers creates a new cultural resource which is greater than the knowledge and understanding that any of the individuals possessed before (Vygotsky).

- IT is a *means* not an *end*. In the educative process it does not replace people but assists them in reorganizing interactions, thus reorganizing the teaching and learning process (and the play).

- The content of knowledge and its daily application are intrinsically related.

- The *capacitation* of teachers is essential.

An approach based on the pedagogy of informatics requires teachers to develop their own knowledge and understanding of informatics in our society, to rethink their roles and practices, and base their teaching on their students' curiosity and active involvement in their learning .

IV. Practical Applications

Our framework couples an understanding of both theoretical and practical levels of technological literacy with dialogue about whether, when, and how IT can be best used to accomplish tasks or purposes at hand. From this combined basis we have developed a series of different practical applications that attempt to translate such pedagogical issues into practice. Our challenge has been to communicate in language that *is simple but not simplistic* (Freire, 1985) and to structure activities which model our beliefs about learning and capacitation. The following examples are offered to illustrate ways we have expressed in practice our theories related to IT:

Citizens of Cyberspace has been developed as a resource to support teachers to guide K-6 students to become critical and effective users of the Internet. One aspect of being a citizen in cyberspace involves understanding "Netiquette" or online etiquette. The

following activity encourages students to connect this concept to their everyday lives. They construct their own version through collaboration and discussion with each other and by conducting research on the Internet.

Netiquette Activity:

Individually write down some customs or rules that help your family get along together. In small groups identify and discuss some of the customs or rules that help this class/school get along together.

As a class, develop a list of customs or rules that you think would make the cyber community a safe, productive , and pleasant group to belong to.

Organize for several pairs to conduct a search on the Internet to find out some further suggestions for online etiquette.

Develop a class guide to Netiquette. Keep adding to and refining it as you learn more about getting along with others in cyberspace.

(O'Rourke, 1997).

Figure 1

Conquering Cyberspace: this is a three day workshop we offer classroom teachers (Dalmau et al. 1997). We structure the workshop to involve the strands of conception, collaboration, connectivity and capacitation. Throughout the workshop we create space for different types of activities that support learning together. These include: exploring/searching; making connections; reflecting/reviewing learning; dialogue/ discussion; real work; skills and tools. We prompt questions that lead to deeper reflection about the sociohistorical and political-ideological aspects of Internet use. We teach technical skills related to use of hardware and software in the context of projects that groups of teachers develop in the course of the workshop. We also offer post communication dialogue via a mailing list which maintains a space for reflection . This process is supported by the ICC web site (International Connectivity & Capacitation, 1997).

Our most recent workshop was conducted in Australia in collaboration with the Australian Centre for Computer Enhanced Learning at Victoria University of Technology. Participants commented on several occasions that they appreciated the regular opportunities to break away from the machines and engage in discussion and reflection about their own learning: "Tonight's session made me think and become more aware of the implications of the Internet, especially the sessions where we could share our thoughts and discuss our ideas with groups." "It has been good to have an opportunity to stand back and think critically about the value of the use of the Internet because there is a tendency to always look forward and see developments as positive."

We observed communication on different levels during the workshop. For example, we often heard "look at this" or "how did you get to that site?", resulting in simple cooperation and exchange. A deeper level of interaction was achieved during a round robin activity where participants shared their ideas for a classroom based project and formed teams with those who had similar interests.

Moments of real collaboration were sometimes not fully apparent to the collaborators. Our attention was caught by discussion and planning between two teachers who were working together at one computer, and we commented on the advantage of working in teams. We received an immediate response from the person holding the mouse, "But no, I'm doing all the work!" Control of the machine was equated with the actual work being achieved and offline collaborative work (discussion and planning) was ignored in this context.

One of our goals for this workshop was to encourage reflection about literacy and the implications for IT literacy as applied to integrating use of the Internet into the classroom. Interest in this appears to be sparked by the following comment in one participant's learning log: "What interests me the most is linking literacy and purpose and the usefulness of the Internet as a resource in our lives." It is important to keep this bigger picture in mind as we conceive IT use in the classroom.

Introducing Computers in K-8. Jurema and CostaLima (1993) conceived and developed a methodology which takes into consideration the learning and teaching processes and the organization of curriculum. We work with concepts of how computers function in specific curriculum contexts such as mathematics, language, and history. The activities aim to stimulate reflection and concept building by students, in pleasant and playful ways. We also lead discussions to further reflection about human/machine relationships in learning and the wider community, while developing children's ability to use computers competently.

The following example opens room for students' and teachers' creation as they work with concepts of retrieving and processing information, and reflect upon the differences between human and machines.

Information Technology (IT) can be used as a means to deepen and enhance learning by focusing on developing IT literacy. This promotes critical consciousness which enables students and teachers to make informed choices about the way they use and respond to such technologies. We must prepare students and educators to think and act in a high tech society through practical applications which are embedded with sound theoretical foundations such as those outlined in this paper.

Quadrilha

John loved Teresa who loved Raymond, who loved Mary who loved Joachim who loved Lily who didn't love anybody. John went to the United States, Teresa joined a convent, Raymond died in an accident, Mary remained single, Joachim vanished, and Lily married J. Pinto Fernandez who had no part in this history.
(By Carlos Drummond de Andrade)
After reading, ask students the following questions: What is the 17th word of the poem? How many times does the word "loved" appear? Then, lead your students to reflect on how they got their answer and what information was necessary to answer these questions.
Possible responses: Record, retrieve, take notes, counting, calculating, and so on. Highlight the concepts of memory and data processing, comparing how humans and computers work.
Don't forget to emphasize that people create, machines perform, repeating what people "tell" them to do. For example, people can create a different outcome of the poem. Although machines can be programmed to generate random and different outcomes, these outcomes must still be defined by the people who conceived the program. It is important that we remind our students that this is not magic.
(Jurema & Costa Lima, 1993)

Figure 2

Our practical applications remain in progress and will continue to develop. We share an international perspective, construction of experience, and reflection and analysis of different situations which assist us to further develop concepts as we work with teachers and students in Australia, Brazil, and USA. The use of technology to enhance learning can be viewed from multiple perspectives through such international collaborations.

References

1. Andrade, C. D. (1976). Reunião: 10 Livros de Poesia, Rio de Janeiro: José Olympio.
2. Bowers, C. A. (1988). The cultural dimensions of educational computing. Understanding the non-neutrality of technology. (Vol. 1). New York: Teachers College Press.
3. Coulsen, J., Estavan, D.P., Melaragno, R., & Silberman, H.F. (1962). Effects of branching in a computer controlled auto-instructional device. Journal of Applied Psychology, 46, 389-392.
4. Dalmau, M. D., Jurema, A.C., Ketterer, K., O'Rourke, M. (1997, July 24-Aug2). Conquering Cyberspace, ICC (Australia)/ACCEL, Victoria University of Technology, Melbourne, Australia.
5. Dudley-Marling, C. & Owston, R.D. (1988). Using microcomputers to teach problem solving: a critical review, Educational Technology 28(7), 27-33.
6. Gilman, D. (1967). Feedback, prompting, and overt correction procedures in non-branching computer-assisted instruction programs. Journal of Educational Research, 60, 423-426.
7. Freire, P. (1970). Pedagogy of the oppressed (Myra Bergman Ramos, Trans.). (20th anniversary edition ed.). New York: Continuum.
8. Freire, P. (1985). The Politics of Education: Culture, power and liberation. New York: Bergin & Garvey Publishers, Inc.
9. International Connectivity & Capacitation (ICC Australia, Brazil, USA). (1997). *ICC's Conquering Cyberspace*. [Online] Available: http://www.iteci.com.br/~icc [1997, June].
10. Jurema, A.C., and Costa-Lima, M.E. (1993). Informática para crianças e adolescentes. Recife, PE: ITECIedições.
11. Jurema, A. C., Costa-Lima, M.E., Dalmau, M.C., Jurema, M. (1995, October 17-20, 1995). Towards a pedagogy of Informatics. Paper presented at the CSCL'95. The First International Conference on Computer Support for Collaborative Learning, Indiana University. Bloomington, Indiana, USA.
12. Koschmann, T. (Ed.). (1996). CSCL: Theory and practice of an emerging paradigm. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.
13. Kreuger, L. W., Karger, H., & Barwick, K. (1989). A critical look at children and microcomputers: Some phenomenological observations. In J. Pardeck. and J. W. Murphy

(Ed.), Microcomputers in early childhood education. New York: Gordon & Breach.
14. Leontiev, A. (1978). O desenvolvimento do psiquismo. Lisboa: Horizonte Universitario
15. Leron, U. (1985). Logo Today: Vision and reality, The Computing Teacher (February), 26-32.
16. Luria, A. R. (1976). Cognitive development. Its cultural and social foundations. Cambridge, MA: Harvard University Press.
17. Noble, D. D. (1991). The classroom arsenal: Military research, information technology, and public policy. London: The Falmer Press.
18. O'Rourke, M. E. (1997). Citizens of Cyberspace: Guiding K-6 students to become effective users of the Internet. Unpublished Master's Report.
19. Papert, S. (1980). Mindstorms. New York: Basic Books.
20. Papert, S. (1993) The children's machine: Rethinking school in the age of the computer. New York: Basic Books.
21. Piaget, J. (1985). The equilibration of cognitive structures. The central problem of intellectual development. Chicago: University of Chicago Press.
22. Rogoff, B. (1990). Apprenticeship in Thinking. New York: Oxford University Press.
23. Scribner, S. (1985). Knowledge at Work. *Anthropology and Education Quarterly*, 16(3), 199-206.
24. Vygotsky, L. S. (1962). Thought and language (Eugenina Hafmann and Gertrude Vakar, Trans.). Cambridge, MA: The M.I.T. Press.
25. Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.
26. Weber, S. (1992). A universidade e a qualidade da educaçao publica. Em Aberto, 11(53), 64-72.

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