The Essence of Technology and the Education of Teachers

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The essence of technology is by no means anything technological. Thus we shall never experience our relationship to the essence of technology so long as we merely conceive and push forward the technological, put up with it, or evade it. Everywhere, we remain unfree and chained to technology, whether we passionately affirm or deny it. But we are delivered over to it in the worst possible way when we regard it as something neutral; for this conception of it, to which today we particularly like to do homage, makes us utterly blind to the essence of technology (Heidegger, 1977, p.4).

Technology is pervasive in American society and many hope it will become so in American schools as well. Numerous educators think that preparing teachers to use technology effectively should be a significant goal of teacher education programs, particularly in an "information age." In this view, one of the most effective ways individuals will be able to keep up with an expanding knowledge base is to develop efficient and effective ways to access and use information. But educators often fail to raise questions about the relationship between how prospective teachers are prepared and the view of education communicated through the methods used. Should we encourage a view of education that places technology at the center, that isolates the learner from other learners, that, through programming, pre-ordains what and how students will learn as well as the information to which they will have access? Or should we incorporate technology in a manner that suggests that learners and ideas are at the core of the educational process; that the

teacher, too, is a learner; that learning is a social process; and that, often, the richest learning occurs when all members of a learning community struggle together to not only find answers but to frame and reframe the questions as well? How we perceive technology influences how we incorporate it in our educational programs, but our failure to reflect on our use of technology may lead us to incorporate technology in ways we had not intended. Critical reflection is necessary to determine if our incorporation of technology enhances or undermines our intentions.

This paper is an outcome of my reflections on my own practice. One of my aims, as I educate teachers, is to help them begin to understand that knowledge is constructed, built on previous knowledge, coupled with experience, transformed, evolving, and consequential. I attempt to use methods to help me achieve that end. As I reflect on the ways I incorporate technology in my class I am reminded how difficult and complex a task it is to align means and ends. These reflections were supplemented with student input through analysis of the transcript of a computer conferencing activity they participated in, written assignments, informal interviews, and anonymous student evaluations of the course that served as the impetus for this paper.

Technology can be as basic as the paper and pencils students use or as complex as the television studios in some well-supported suburban school districts. Because it would be impossible to reflect on the full range of technologically-based activities in education, I will

focus on the use of computers in teacher education. I will discuss how different computer assisted activities may generate very different conceptions of education— different conceptions of teaching and learning, of how we know, and of possible educational futures.

Introduction

We teacher educators justify incorporating computer technology in our programs in a variety of ways. We cite our obligation to prepare prospective teachers for an increasingly technological society. We want our students to be able to prepare their future students to use computer technology effectively. If we are thoughtful, we caution our students about inequities in computer usage and availability, potential limitations in software, and the non-neutrality of computer technology. But we must also raise more fundamental questions with our students and our colleagues: What does the way we use computer technology convey, implicitly or tacitly if not explicitly, about how we view the teaching and learning process? What does our use of computers imply about how we "know"? How might all of this be related to an educational future we envision? Are we comfortable with the answers to these questions? If we are not, what should we do about it?

The teacher education program at the University of Michigan is using several computer-assisted activities. In this paper I focus on two of the activities that I have incorporated in my own class. It was my experience with these activities that generated the questions I address in this paper. The first activity, Learning Tool™, is an interactive educational software package. The second activity, computer conferencing, is a computer-assisted activity less often used in educational programs. First, I will describe each of the activities and how I used them in my course. Next, I will address the first three questions raised above — what did each of the applications, as used, convey about the teaching and learning process? what did they communicate about how we know? what kind of

educational future might their use imply? I leave the last two questions — are you comfortable with the answers to these questions? if not, what can be done about it? — for reader consideration.

The computer based activities I discuss are a major component of one section of the introductory teacher education course required of all elementary education majors. This course is part of a block of courses that students must take during the first semester they are enrolled in the school of education, usually the first semester of their junior year. The activities build on a practicum that includes nine hours of observation a week in a local elementary school. The specific aim of the course — Teaching in the Elementary School — is to provide students with the opportunity and skills to study the elementary school in relation to teaching, learning, curriculum, and the ethical and moral obligations of teachers.

Description of computer-based activities

Learning Tool. Faculty members from the University of Michigan designed Learning Tool, a software package for the Apple Macintosh. It is a program to help students "learn how to learn." Learning Tool incorporates principles of cognitive psychology and provides students with a model of how they learn as well as how to learn more effectively. Learning Tool operates at three levels: a work space, a map space, and a space where the learner can include extensive textual and graphic detail. In the work space students outline the information. They then move to the mapping level where key concepts are ordered through the creation of "note cards" generated from the outline.

In this "Concept Map," the icons for each note card can be graphically organized and linked to display user defined relationships (temporal, causal, associative, etc.) among concepts. Thus, the user can graphically show the interdependency [among components of the map they create]. This allows the learner to

create spatial relationships among ideas. Note cards can also be stacked to create submaps. The ability to create multiple levels of submaps allows the user to develop complex, hierarchical relationships in a small map space (Kozma, in press). The third level of Learning Tool provides students with space to include detailed text and figures to support their understanding of the concepts they have mapped. All of this is intended to aid student learning.

I asked students to use Learning Tool to map a concept they would later teach to an elementary student. They also mapped an elementary student's understanding of the concept based on an interview with the student. They then developed a lesson plan using the two maps. I asked them to design a lesson that would extend the elementary student's understanding of the concept to more closely reflect their own, more sophisticated understanding. The purpose of the assignment was to help my students begin to see the relationship among their understanding of a concept, their students' understanding, and the implications of each for teaching. As I indicated in the syllabus for the course, "teaching should be more than teaching facts, it should result in students gaining a rich conceptual understanding of the 'content.' The ability to do that will be significantly influenced by one's understanding of the content, the students, the context, and the teaching and learning process."

Computer conferencing. Although interactive computer networking is fairly common, computer conferencing has infrequently been incorporated as a pedagogical component of educational programs (Bull, Harris, Lloyd, & Short, 1989; Merseth, 1991; Carey, Carey, Willis &Willis, 1991; Sproull and Kiesler, 1991). Computer conferencing is a computer-based version of voice conferencing with the added advantage that all participants do not have to be available at the same time. The computer conferencing activity discussed here used CONFER II™, a computer conferencing system that operates on the University's main frame computer.

Computer conferencing has several advantages. It allows students to carry on discussions outside of class for much longer periods than class time and at student convenience. Computer conferencing also provides a record of discussion; students can reread text, save it on a disk of their own, or print it at any time. Individuals can enter and exit discussions at any time.

Conferencing activities also have several potential disadvantages. Individuals unfamiliar with computers may find conferencing activities intimidating and may participate infrequently. Nonverbal feedback is missing from the discussion, a condition which might lead to misunderstandings. The discussions can become very complex leading to confusion for the participants. Access may be more convenient for some students. How the conferencing discourse is perceived, as written text or conversation, can influence how participants respond to it and value it.

The computer conferencing activity I included in Teaching in the Elementary School, the Dialogical Community Exercise (DCE), was an integral part of the course. The five major sections of the course — schools and society, teaching, learning, curriculum, ethics — provided the general focus for each part of the exercise. The specific focus for each part of the exercise was generated by a current policy or instructional issue related to each of the five major components of the course. Some were issues teachers have struggled with for a long time whereas others were relatively new to classroom teachers. For example, national goals was the policy issue discussed on the DCE during the part of the course devoted to the study of curriculum.

Computer conferencing provides an opportunity for what Strike (1991) describes as "undominated dialogue," a process that is one way to foster students' professional development

by weakening the power relationship among students and faculty. By participating in undominated dialogue, students may begin to identify information they need to make their own decisions rather than look to an external authority. Some studies of conferencing (Sproull and Kiesler, 1991) suggest that participants are more likely to attend to *what* is said during conferencing rather than *who* says it.

I used the DCE to help prospective teachers begin to recognize and acknowledge their professional responsibilities as teachers; to encourage them to develop the habits of mind and dispositions that would help them act as moral agents, and to engage in thoughtful reflection. Individuals also need to be held accountable for their choices. As Wolfe (1989) notes, *"the problem in modern liberal democracies is not that ordinary people do not have a say, but rather that it is so easy for them to say what they prefer without being forced to think through the consequences of their opinions for others"*(p.219). The conferencing activity was, therefore, intended to provide students with the opportunity to not only reflect on the different points of view that were presented in the discussions but also to be held accountable for the consequences of their opinions by others. The potential for conferencing activities to support these aims is discussed in more detail below, but first let us consider the view of teaching and learning that may have been conveyed to the students through my use of these activities.

View of the teaching and learning process

The software programs we use to facilitate student learning reflect the mind of the programmer — and more. "There is always a bias in the program, and not necessarily an individual bias; most often it is a cultural one. A gender bias, a racial bias, a technological bias, for example, can be passed on in the guise of neutral presentation" (Soltis, 1988, p.viii). Educators are also becoming increasingly aware of the epistemological biases in our uses of

technology (Bowers, 1988; Ihde, 1990; Hlynka and Belland, 1991). Unless significant changes occur in educational programs that prepare educational technologists, we can be almost certain that most uses of technology will continue to be supported by a model of technical rationality.

A preliminary analysis of recent educational software (which retains many of the qualities of the print technology found in textbooks) reveals the view of rationality that underlies modern technology, particularly with its emphasis on facts (objective knowledge) that can be rationally manipulated in order to provide the authority for decision making. The current technology also strengthens the view of individualism as autonomous and self directing and reinforces the belief that change can be rationally planned (Bowers, 1988, p.6).

Computer applications like Learning Tool reflect this approach. An individual's understanding is abstracted from its context. The social dynamics of the learning process are, to a great extent, removed. Individuals rely on themselves for gaining understanding. The teacher is either a manager or organizer of instruction. The way I used Learning Tool reinforced this kind of understanding. Individual students were responsible for constructing their own understanding of a concept without an opportunity to reflect or dialogue with others. I structured the assignment with the intent of helping my students gain an understanding of how "knowledge" is socially constructed and how, in turn, the approach they take to teaching and learning will influence how their students construct their own knowledge. With the exception of one class session, when the students received feedback from their peers on their own concept maps, they completed all the work in isolation from other learners. Teaching and learning were conveyed as an individual endeavor occurring as students interact with software programs. I modeled for them the role of the teacher as a manager of instruction and conveyed teaching

and learning as something that is guided by the machine.

Interaction with a microcomputer involves a person-machine relationship, not an interpersonal one of sharing, nurturing, and caring. The person-machine relationship, at its best, involves the refining of ideas through the manipulation of data and abstract visual representations. At its worst, it is processing abstract information in order to establish the "truth" about an equally abstract aspect of social life perceived as requiring a technical response (Bowers, 1988, p.93).

Using Learning Tool as I did undermined my own intent. The use of applications grounded in cognitive psychology may be pedagogically incommensurable with fostering an understanding of the social nature of the teaching and learning process unless we take specific steps to help students see the tensions between these different ways of "seeing." Cognitive psychologists seem to suggest that, as teachers, we can rationally plan and facilitate student learning when we have a good understanding of such concepts and techniques as long and short-term memory, effective and efficient cognitive strategies, and how to help students organize, store, and retrieve information. We use applications like Learning Tool to help our students become autonomous and independent learners. What we lose in the process, if we are not critical about how we use them, is any chance for the development of learning communities.

By community I mean, "*a capacity for relatedness within individuals—relatedness not only to people but to events in history, to nature, to the world of ideas, and yes, to the spirit*" (Palmer, 1987, p.24). Although computer conferencing activities are communal they are not necessarily communities but their *thoughtful* use may foster the development of learning communities in several ways. Computer conferencing activities provide situations in which individuals can begin to speak to one another in their own voices and find out what they think by expressing themselves. "*The computer conference is one method by which we can bring the authority of the student's personal experience into the curriculum, integrating personal experience with received knowledge*" (Flores, p.106, 1990). A computer conference also provides "*a space where living persons can come together in speech and action, each one free to articulate a distinctive perspective, all of them granted equal worth . . . a space of dialogue, a space where a web of relationships can be woven, and where a common world can be brought into being and continually renewed*" (Greene, 1984, p.296). Students begin to develop a shared history and connect with each other as prospective educators. If we also use conferencing activities to help students begin to address the moral and ethical dilemmas they will encounter as teachers, we communicate the moral dimensions of the profession — an aspect of teaching that is recognized as absolutely essential by an increasing number of educators (Goodlad, Sirotnik, Soder, 1990; Harrington and Garrison, in press; Purpel, 1989; Strike, 1991; Wilshire, 1990). Conferencing activities can help prospective teachers develop a common world, one that provides ground for the development of norms of collegiality, joint problem solving, and relational ethics.

Analysis of the conferencing transcripts indicated that throughout the DCE students acknowledged the value in other individuals' perspectives. They frequently commented on the difficulty of determining how they felt about particular issues and how they valued their peers' comments. They also indicated that they changed their thinking by participating in dialogue with their peers. Students were confronted with a variety of perspectives on the same issue and were prompted by their peers to deliberate about those perspectives. Analysis of the transcripts also indicated students were aware of the potential consequences of particular choices, including the political, ethical, economic, and professional consequences. In the process of struggling with such issues as school choice, site-based management, and

grouping they were provided with explicit models of critical reflection and began to hold themselves and their peers accountable for their "actions." But what do these activities suggest about how we know?

Perception of how we know

With applications like Learning Tool, as I had my students use it, knowing is portrayed as the assimilation of knowledge and an objective achievement under the control of the individual learner. "Knowing" was presented as a segmented, hierarchical process that builds over time. My use of Learning Tool conveyed a way of knowing that incorporates a *"view of objective knowledge and its transmission [that] misrepresents how knowledge is humanly constructed over time in culturally specific ways and continually reconstructed as it is communicated to others"* (Bowers, 1988, p.43). Although I wanted to provide my students with an opportunity to begin to reflect on how knowing is socially constructed; on what their role would be as teachers in helping their students develop a more comprehensive understanding of what and how they know; on how their students' backgrounds of experience might influence the understandings they would bring to, as well as develop within, the learning environment, I conveyed something very different. I asked my students to identify the parts of a particular concept so that they would, supposedly, have a clearer understanding of the whole. In doing so, I asked them to take a color from the tapestry of their knowing and break it into its component shades and hues. In the process, how could they possibly sense the whole, let alone begin to appreciate its intricacy? With assignments like this one, is it any wonder that our students often think of education as the accumulation and transmission of facts?

Applications like computer conferencing may help us change that perception. Incorporating activities that build on the communal nature of learning helps our students understand that how we know is a reflection of what we

know, who we are, the experiences we have had, and the "others" who have been and are a part of all of that. Through conferencing activities we can assist our students to begin understanding the value and importance of narrative ways of knowing. Conferencing activities can be structured to give students opportunities to reflect on how what they know is influenced by what they hear, as well as what they see or read. In addition, conferencing activities can be incorporated in ways that help students begin to address the complex authorship of their way of viewing the world and appreciate and acknowledge the validity in perspectives different from their own. This is a very different way of knowing than is typically presented in educational programs. This way of knowing validates oral language as well as written language. This is not something typically found in higher education programs (Bowers, 1984; Ong, 1982). But, as Belenky, Clinchy, Goldberger,and Tarule (1986) suggest, in order for reflection to occur, the oral and written forms of language must pass back and forth between persons who both speak and listen or read and write—sharing, expanding, and reflecting on each other's experiences. Such interchanges lead to ways of knowing that enable individuals to enter into the social and intellectual life of the community. Without them, individuals remain isolated from others; and without tools for representing their experiences, people also remain isolated from the self (p.26).

Computer conferencing activities may allow us to do precisely this. In fundamental ways they merge the oral and written forms of language. My students perceived conferencing as conversation. Analysis of the transcript of the exercise indicated this. As one student wrote, *"I've **heard** a lot of people saying they don't think there is a need for improving education. What do you mean by this?"* Another responded, *"you **said** that children in poor communities are stuck, they were born into the system. But don't forget who designed the system."* Another student expressed some frustration when writing, *"there was so*

much I wanted to say and now I've forgotten it!" Although conferencing discourse seemed to be perceived as oral language students had a written text to which they could refer. One thing that became apparent in the course of the activity was that some students devalued the "conversations" precisely because they saw them as such. In using a conferencing activity in my class it became apparent to me that these activities may provide us with an opportunity to help our students understand that although the oral tradition often utilizes formulaic knowledge –conceptual formulas, fixed sayings–the spoken word is more adaptable to communicating knowledge that is vital to the lives of the community. Knowledge communicated through the spoken word is continually updated to fit the changing circumstances of community life. The dynamic nature of the spoken word, which is sustained through remembering rather than memorizing, leads many in literate society to view the spoken word as less trustworthy than the written word. But the great irony is that the written word takes on even more authority as context and authorship are lost sight of (Bowers, 1988, p.82).

One of my primary goals as a teacher educator is to help prospective teachers begin to understand the human authorship in what and how they know. It is only in acknowledging the human authorship in our way of being in the world that we are able to move outside of the possible limitations that may be a consequence of this authorship. In doing so, we will be more able to make choices that support more open, inclusive, and integrated ways of being (Belenky et al, 1986; Gilligan et al., 1990; Kitchner and King, 1990; Perry, 1970). How we use technology, the kinds of teaching and learning environments those uses support, and the ways of knowing conveyed in each use may lead to very different conceptions of education. One's way of knowing, influences in fundamental ways, one's way of being in the world as Palmer (1987) cogently points out:

My *thesis is a very simple one: I do not believe that epistemology is a bloodless abstraction; the way we know has powerful implications for the way we live. I argue that every epistemology tends to become an ethic, and that every way of knowing tends to become a way of living. I argue that the relation established between the knower and the known, between the student and the subject, tends to become the relation of the living person to the world itself. I argue that every mode of knowing contains its own moral trajectory, its own ethical direction and outcomes* (p.22).

Different ways of knowing and being in the world will lead to different choices in how we use and value technology. These choices may lead, in turn, to very different educational futures.

Different choices — different possibilities

What kind of an educational future might various uses of technology lead to? What might they imply for our children's future and for the future of their children? May particular uses of technology lead us in directions we might not choose to go? Might they have done so already? (Bowers, 1988; Ihde, 1990; Mander, 1991; Winograd and Flores, 1986). Is this what both Heidegger and Palmer are warning us about?

Using computer-assisted activities in the ways discussed above may lead to very different educational futures. In one, the teaching and learning process is relatively impersonal, learning is viewed as a technical response with the machine "driving" the curriculum, students work in relative isolation. Although they may engage with others that engagement has little to do with community. It has to do with competition. There is not only a self imposed isolation but a system imposed isolation as well. How can students possibly work together when they are in competition with one another? What might this future imply not only for the kind of educational environments we would be fostering but

for the kind of society educators would be nurturing in the schools?

Much of our culture teaches us not the skills of community building but rather of individual competition. We know that democratic communities do not simply happen and that their growth is certainly not inevitable. Democratic communities need constant nurturance and attention to remain dynamic and responsive. This means more than learning *about*; it also means learning *to do*; it involves not just an understanding of the structure and how it works but how it works in *particular and concrete* situations. This also involves the skills of communication, of understanding one's social self in addition to one's personal self, of learning how to work with others and how to increase the probability that political and bureaucratic process and machinery be responsive to our highest aspirations (Purpel, 1989, p.127).

Applications like Learning Tool, as I used it, will not help us to achieve the educational communities envisioned by Purpel. What they leave out, among other things, is communication. They focus on what the individual can learn in isolation as opposed to what can be learned in concert with others. In contrast, with educational activities supported by computer conferencing, students work together to address educational concerns. In doing so, they may begin to see that multiple views on the same issue often lead to a richer understanding; that an awareness of diverse perspectives provides the potential for generating better solutions to educational concerns; that solutions attending to more voices, considerate of the complexity of intentions and means, reflecting on the consequences for all students are important steps for generating the best solutions to today's educational dilemmas. In doing so, they also begin to understand that knowing and learning are communal acts. They require many eyes and ears, many observations and experiences. They require a continual cycle of discussion, disagreement, and consensus over what has been seen

and what it all means. This is the essence of the 'community of scholars,' and it should be the essence of the classroom as well (Palmer, 1987, p.25).

We have multiple obligations as educators of prospective teachers. Not only must we prepare them as educators, we must provide an environment wherein they can thrive as learners. We must model for them the kinds of teachers we want them to be. We must foster their development as learners in the same ways we want them to nurture the development of all of the students in their care. We have a professional responsibility, if not a moral obligation, to attempt to determine what kind of environment we are creating through each of the choices we make as educators. In light of this, as an educator, I find the essence of technology extremely troubling.

More questions than answers

I have barely begun to address the questions raised above. As limited as those answers are, there are other important questions that have not even been considered. In addition to the two questions I leave for the reader to answer — are we comfortable with the answers to the questions raised about the teaching and learning process, the perception of knowing that our uses of technology communicate, and the educational futures our particular uses may forecast? and, what can we do it if we are not comfortable with the answers the these questions? — there are other questions that must be considered as well. In this paper, I attempted to address, in part, one of those additional questions — what are the possible first and second level effects of technology?— as it relates to the applications of educational technology that served as the exemplars for this discussion.

Sproull and Kiesler's (1991) definition of the first and second-level effects of communication technology may be instructive here. They define first-level effects as "*the anticipated technical ones—the planned efficiency gains or productivity gains that justify an investment in a*

new technology"(p.4). Should educators be concerned with the efficiency of technological applications or does this question, in itself, limit our thinking about how technology is used in education — does the reflection of a technicist orientation to education blind us to the essence of technology?

In addition to the first level effects, and more importantly perhaps, we must acknowledge and question the potential second-level effects of any technological applications we choose to incorporate in our programs. Drawing again from Sproull and Kiesler (1991), second-level effects are those which come about primarily because new technology leads people to pay attention to different things, have contact with different people, and depend on one another differently. Change in attention means change in how people spend their time and in what they think is important. Change in social contact patterns means change in who people know and how they feel about them. Change in interdependence means change in what people do with and for each other and how these coupled functions are organized in norms, roles, procedures, jobs, and departments. Social roles, which codify patterns of attention and social interaction, change (p. 4-5).

I have attempted to address some of the possible second-level effects in this discussion. I also acknowledge that it is impossible to predict all of the consequences of the incorporation of specific technological applications. We are becoming increasingly aware of this as we note the consequences of our desire to control the natural world through increasingly sophisticated technologies. What we can be fairly certain of is that the second-level effects will probably have little to do with the intended effects and that they will *"often emerge somewhat slowly as people renegotiate changed patterns of behavior and thinking"* (Sproull and Kiesler, 1991, p.8). But, perhaps most importantly, we need to remember that it is the human-technology interaction that

will be the most important factor in the shaping of second-level effects (Ihde, 1990). How we respond to and use technology will direct, in large measure, the second-level effects.

Perhaps an easier question is to ask ourselves about technology is if our technological applications allow us to do something better or something we could not otherwise do. Answers to this question should be guided, at a minimum, by a clear understanding of what our aims are. I can not say with any certainty, based on the educational framework I choose to work in, that Learning Tool helps me to do something better or that I could not otherwise do. In fact, its use may result in something just the opposite. But, as discussed above, computer conferencing activities help me achieve something I might not otherwise be able to do. Conferencing activities provide opportunities for undominated dialogue, time for reflection, and the presentation of multiple perspectives in a non-threatening environment that cannot be achieved in typical classroom discussions (Harrington, in press).

Other questions that should be considered include what is amplified or reduced through the use of particular applications of technology? (Bowers, 1988; Ihde, 1977). What was amplified and reduced as I used Learning Tool? — computer conferencing? To effectively answer these questions the uses of technology must be considered within the full context of not just one course, but the entire program. The computer conferencing activity I used is followed by others at various points in the program. Concept mapping is also addressed at other times. Are there cumulative effects of our uses of technology? If so, what are they? Do the multiple uses of technology undermine each other? Although I have no answers to these questions yet, what I will no longer do is assume that the essence of technology is something technological.

Conclusions

Another thing I will do for my students and myself, as I continue to struggle with the problems inherent in incorporating technology in the courses I am responsible for, is to take seriously Mander's (1991) recommended attitudes about technology, especially the following:

Since most of what we are told about new technology comes from its proponents, be deeply skeptical of all claims.

Assume all technology "guilty until proven innocent."

Eschew the idea that technology is neutral or "value free." Every technology has inherent and identifiable social, political, and environmental consequences.

In thinking about technology within the present climate of technological worship, emphasize the negative. This brings balance. Negative is positive (p. 49-50).

But, as we help our students take seriously our relationship to technology we must also help them understand that we probably will never live free of technology, even if we would choose to. As we define technology our uses of technology define us—we have important choices to make. Langdon Winner (1986), in his book *The Whale and the Reactor*, reminds us of the consequences of particular choices that have been made in the past — intentional, unintentional, and unknown. For example, when Robert Moses decided to keep the overpasses on the Long Island Expressway low so that it would be difficult for buses, and the poor and blacks who used public transportation, to travel on them, he limited their access to Jones Beach, Moses' widely acclaimed public park. Moses made doubly sure of this result by vetoing a proposed extension of the Long Island Railroad to Jones Beach(p. 23). Winner also addresses choices that resulted in consequences that were unintended: the fluoroscope machine that X-rayed children's feet to see the fit of a shoe and in the process exposed children to hazardous amounts of radiation; the consequences of the hexachlorophene added as an ingredient to soap and powders, the consequences of DDT, PCB's, and asbestos. Although none of the consequences were ever intended, we live with them nevertheless. But I think the most critical point Winner raises is that we can never be sure of all of the consequences of the choices we make regarding technology. He cautions that we may not know what we have lost until it is too late. This is poignantly expressed in his story of a visit to the Diablo Canyon nuclear reactor site and catching site of a California grey whale swimming off shore. The juxtaposition of the two clearly illustrates the significance of the choices to be made as we consider the multiple forms of technology that enter our lives. What are we willing to give up? Will it be worth it? Although the choices we make in education may not be as outwardly dramatic, they are, nonetheless, as significant.

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