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explorations in education

Educating for the 21st Century

An Address to the Conference on The Internet and Politics Sponsored by The Academy for the Third Millenium, Munich, Germany, February 21, 1997

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Last Updated: Robbie McClintock

Educating for the 21st Century

¶1:XX Ladies and gentlemen, it is an honor to discuss the implications of the Internet for education with you. The previous speaker described the American effort to wire schools through Net Day. In response, several of you rightly queried how these developments in the school infrastructure would affect the educational content, the curriculum, that students might experience. I hope my remarks will prove responsive to these questions.

¶2:XX At this stage, Net Day sets a minimum goal of wiring together five classrooms and the library in participating schools. It thus initiates a local area network in the school, beginning to link classrooms together. Schools that can, should extend the local area network to more classrooms, putting as many computers as possible in each classroom on the network. Schools should in addition arrange for broadband connectivity between their school-wide LAN and the Internet. With new Federal Communications Commission regulations coming into effect in a few months, which will greatly lower the price of such connections for schools and libraries, many will connect up.

¶3:XX Through the Institute for Learning Technologies, Columbia University works with a growing number of New York City schools to help them established strong connectivity to the Internet and a well-developed infrastructure of internal networking to their classrooms. In comparison to Net Day, we reach fewer schools -- currently about 20 going up to about 100 by the year 2000. But we implant in the schools a much more fully developed infrastructure -- basically a broadband link to the Internet, currently a leased T1 line, and an internal LAN architecture that links workstations in classrooms at a ratio of five students per workstation.

¶4:XX ILT helps schools develop infrastructure because it is a necessary first step to doing the really important things, introducing educational innovations. We are not technologists seeking to use education to advance technology, but rather educators, seeking to use technology to improve education. Once an infrastructure is in place, everyone needs to work creatively on three large tasks -- developing new curricula and content for use with the digital technologies, providing effective professional development, and adapting practices of student assessment to the new structures of education. In my remarks this afternoon, I want to concentrate, not on the infrastructure issues, but on these three matters that become so important wherever the infrastructure is in place.

¶5:XX Now time is short, forcing us to speak merely *about* the Internet. In reality, we should not be talking about it, but talking with it, looking, exploring, and discussing together things we find on it and things we can do with it. Since there is not the time to do that while we are all gathered here together, I have put the text of my talk on our web server at the following location. Readers of print versions of this address can use it to explore as they wish the Web sites I will discuss.

http://www.ilt.columbia.edu/mcclintock/akademie3000/akademie.html

¶6:XX My formal remarks will follow a rather simple plan. I will

- Put *one question* pertinent to a discussion of education in a conference on the Internet and Politics;
- Introduce *two reflective observations* that help set the context for responding to the question;
- Discuss *four developments* that are, not the whole answer to the question, but a significant part of one; and
- Explain *one concluding imperative* that educators and the general public should follow in developing the educational uses of the Internet.

One Question

¶7:XX Through the conference speakers have differed a bit about types of democracy. We have heard from proponents of direct democracy, strong democracy, and representative democracy. Nevertheless we are all united by a basic commitment to democratic practices. To put my initial question, however, I am going risk a modicum of political incorrectness and ask you to consider a proposition voiced by an eminent practitioner of politics who we usually do not identify as a great democrat. One hundred thirty years ago, Otto von Bismarck observed that politics is the art of the possible. "Die Politik ist die Lehre von Möglichen." This aphorism indicates immediately why the Internet is important for politics. The Internet changes what is possible. Insofar as it changes possibilities, it challenges those who engage in politics to further develop their art, their capacities, their policies, to take these changed possibilities into account.

¶8:XX This conference thus uncovers possibilities created by the Internet with which our political processes should come to grips, particularly if we are to develop fully the potentialities of democratic polities. But my theme is a bit narrower, having to do with education, and to put the question that I want to ask here, I need to use a German term that we unfortunately do not have a good equivalent for in English -- *Bildungspolitik*. In English "politics of education" refers more to externals, whereas I want to discuss the political consequences flowing from educational practices and cultural policies. For this topic, *Bildungspolitik* is the correct word, and I will use it in putting the basic question: How does the Internet change the possibilities of *Bildungspolitik*? Is the Internet changing what is possible in educational practice, and do emerging educational practices condition political possibilities in new ways?

Two Contextualizing Observations

¶9:XX As a prelude to addressing this question, I want to reflect on two observations about the Internet. It has been surprising to me, now near the end of three full days, how little has been said or shown that concretizes what we mean by the Internet or that describes what sort of phenomenon it is. In talking as if we all share full, reflective experience of the Internet, we risk mystifying our subject. I believe that Robert Cailliau, an engineer key in inventing the World Wide Web, will soon discuss some of the systems characteristics of the Web and the Internet that give it such power. I want to make some observations about it from a different point of view, that of a

cultural historian who has been occupied with the educational uses of networks, particularly the Web and the Internet, since early in their development.

¶10:XX First, we need to observe that people engage themselves with the Internet and the Web for a variety of motives. I think three are of substantial importance, both in general and in the discussions we are here having -- the commercial, the personal, and the intellectual. Let us reflect briefly on these three motives, in order to see why we should expect the intellectual drive to be the sustaining force for the further development of the Internet.

¶11:XX Take first the commercial. The Web is fast becoming a major locus of commerce, both as a marketplace and as a medium of entertainment. Major media companies are investing large sums of capital in developing ways to do business on the Web. Clearly the commercial dynamism of the Internet is one of the reasons for attending to it in a conference such as this one. I have no doubt that the Internet will thrive as a marketplace and numerous companies will profit handsomely by developing these commercial possibilities. There is a fear, however, that major media companies may take the Internet over and reconstruct it to suit their interests. Indeed, numerous speakers have alerted us to the potential distortion of cultural and political characteristics that may arise should the influence of the big media on the ethos of the Web become too great. The commercial motivations are powerful, but I have my doubts whether they will really dominate the future of the Internet. History endlessly provides opportunities for Hegelian ironies to take hold.

¶12:XX Commerce rests on the willingness to take risks; to deploy capital in the search of profit. The promise of profit is not the same as the attainment of it, and it is entirely possible that the Internet will be an arena of significant commercial failure, as well as success. Dominance by big media seems unlikely. That Disney, Time-Warner, and Bertlesmann invest substantial capital in it does not guarantee that they will earn a commensurate return or have an abiding influence over it. To reconstruct the Internet to suit their interests exclusively, big media companies will have to attack the status of the Internet as a common carrier and somehow provide their content with privileged dissemination opportunities. They can win big audiences by spending heavily to attain higher quality production values, but they are unlikely to be able to narrow the right of anyone to put whatever they like up for the world to interact with. Too many other large companies want, like endless other groups and individuals, to use the Web to support their content and to use the content of others. Thus, Boeing, Merck, Exxon, Hewlett Packard, and many other large corporations have substantial countervailing interests in an open Internet that serves their research and managerial needs. Even General Electric and Westinghouse, companies that combine media holdings with extensive manufacturing and service components, would be unlikely to align their interests with respect to the character of the Internet tightly with Disney or other pure media company. In view of this diversity of corporate interest, as much as I like to fear the ogre of fat cat capitalism, I think a restructuring of the Internet to close it off to only a few sources of content is most unlikely.

¶13:XX Another motivation, which itself attracts commerce to the Web, is the personal. Lots and lots of people are becoming hooked, finding the Web personally interesting and useful. Personal involvements are extremely diverse -- some like to advertise

themselves through personal home pages and others see it as a form of self-development, a tool for seeking out one or another community of common interest. When one looks at the interaction of the commercial interest and the personal interest, the former late (relative to now) and the latter, one of the spontaneous upwellings of activity in our culture, one can assert an intriguing parallel to the early history of radio. With radio, the first flourishing of the medium was driven by an incredible variety of amateur activity. That diversity was then quickly consolidated by well financed groups into networks that successfully limited the ability to disseminate programming to a few licensed broadcasters and provided through advertising the commercial wherewithal to sustain its economic development.

¶14:XX This comparison between the history of radio and that of the Internet seems persuasive as long as one leaves out of account the intellectual motivation behind the Internet and the Web. Radio was not a major medium of intellectual work. It did not change the practice of medicine, chemistry, astronomy, literary criticism, classical studies, or any other substantial domain of academic research. None of the great nineteenth or early twentieth century innovations in communications, excepting photography for certain specialized purposes, changed the character of intellectual work or shifted the boundaries of possible knowledge. Digital technologies, particularly the Internet, are different. They have had deep intellectual effects. This difference sets their historical trajectory radically apart from these earlier innovations. The Internet, first and foremost, is an intellectual medium. And the place of intellect in life at the dawn of the 21st century is sufficiently central to guarantee that the Internet will continue to develop continuously and indefinitely to realize its potential for the advancement of learning in our world.

¶15:XX What is the basic impetus of this intellectual motivation? We have heard the suggestion that it is tainted with a rejection of the world of concrete experience, driven by a neo-Pythagorean aversion to the body and the world of practical action. To see the Internet as a flight away from the world of action requires a monumental denial of major features of our intellectual traditions. Even the Pythagoreans were famed, not only for their obscure otherworldly religious tenets, but also as practical designers of effective constitutions and plans, useful in the Greek creation of new cities as they extended their commercial and cultural influence Eastward. Plato's great allegory of the human struggle -- out of the cave of appearance, into the clear world of abstraction -- culminated in the duty to return into the cave and to reconstruct it with the aid of rational thought. The historic power of Western rationalism has arisen, not from its occasional Manichean rejection of the body, but from its ability to combine abstract thought and embodied action, creating a world, not of accident, but of design. There is no better place to appreciate the power of that tradition than here in this hall in the European Patent Office where we have been meeting. It displays, in the wonderful geometric structure holding up the ceiling above us, the fundamental work of a patent office, bringing thought and action together, which writ large is the genius of both Western politics and technology. The intellectual motivation to the Internet pushes this effort to integrate thought and action in rational praxis a major step forward.

¶16:XX People creating the Internet have made it through their intellectual enterprise. Even in its earliest origins, the American military did not design the Internet to manage the command and control of battlefield operations. Rather they developed it to support advanced military research. For better and for worse, that military research was in many ways contiguous with research in general. Hence, the broadening of the Internet to support academic work in general was quick natural, and ineluctable. This impetus has remained a driving force. Even now, as the possibility dawns on the well informed that the commercial hopes for the Internet as the market of all markets may not materialize, American universities are collaborating with the American government to implement Internet 2 and related projects. These projects will most likely initiate the real high-speed, widely available version of the Internet, not the many-channeled giant of video-on-demand that the entertainment providers like to depict as the latest utopian vision of commerce. From the educational point of view, the Internet of commerce and that of personal fulfillment are of merely accidental importance compared to the Internet of research and intellect. In what follows, I will be discussing the educational significance of the networking system created in response to these intellectual motives.

¶17:XX Second, we need to observe that the Internet is a complex social construction, coming into being in a present of long duration, one that began between 1970 and 1980 and one that will continue at least to 2030, if not a lot longer. Whenever we face the future we have a tendency to project familiar forms into it, assuming that change has run its course. I do not think that is the case at all with the Internet. What we see is a very early version still, in technical terms, and it is very hard to anticipate the social significance of further innovation. We can, however, suggest that as a social construction, the Internet may have a *telos* implicit in it, one that is very important for our theme of democracy. As the network of all networks, the Internet is making digital contents widely available independent of accidents of time and place. The Internet's inherent *telos* might therefore be stated as follows -- to make all cultural resources available to any person at any place at any time.

¶18:XX Now a culture in which all resources are available to any person at any place at any time might very well be a culture that can proudly call itself democratic in a full sense of the word. If we were to assert a democratic goal for Bildungspolitik, could there be one much better than making all cultural resources available to any person at any place at any time? I think it is important to keep this *telos* in mind, as we work as educators, for it clearly will not be the formal purpose guiding all the parties that work actively in the social construction of the Internet over coming decades. Yet if we have a clear sense of where the logic of the process is leading, we can proceed without too much worry about the intentions of different parties. All sorts of parties put all sorts of resources on the Internet for all sorts of reasons. The long-term effects of these activities will be to make everything accessible to anyone at any place at any time and the long-term task for educators will be to grasp the opportunities inherent in that condition and to make of them effective conditions for the thorough reform of education.

¶19:XX Having noted the primacy of the intellectual motivation driving the development of the Internet and the *telos* inherent in its long-term social construction, let us reflect

now on the new educational possibilities that it raises. The Internet challenges us to actualize these through and for our *Bildungspolitik*. These possibilities are extensive and we need a method for uncovering them. Over the past ten years, I have worked with may different resources on the net and I find my academic training as a cultural historian sometimes imposing itself on my practical work, making me look at websites rather as if they were cultural documents. We can bracket our practical ends in view with respect to them and reflect on them, interpreting them for the insight they give into the cultural developments that they may disclose. In the remarks that follow, I will point you towards a few websites. I ask you to look at them, not as you normally would as tools or resources for achieving some end in view. I ask you to look at them as documents that we can interpret in an effort to understand the possibilities emerging in the world around us. What do these and similar sites suggest about important possibilities unfolding for our *Bildungspolitik*.

Four Developments

¶20:XX It is important to note that technology in education is nothing new. Schools as we know them were invented in the sixteenth century as educators developed ways to make effective use of printed texts as supports for the educational process. The technology of schooling has not changed much from roughly 1500; it has simply spread from a few institutions for the children of leading elites in early modern European cities, to a worldwide, universal system of compulsory schooling. The technology of schools as we know them has been an extremely successful technology, but one that has significant limitations and problematic characteristics inherent in it. When Bismarck called politics the "art of the possible," he called in effect for a strategic sense with respect to possibilities. The politician should attend, not simply to any random possibility, but to those that provide significant alternatives to the structural weaknesses of the status quo. In doing that, it became the art, die Lehre, of the possible.

¶21:XX In the remarks that follow, I will concentrate on four such strategic possibilities arising with and through development of the Internet and related technologies in education. These are matters that pertain to long-standing systemic difficulties of existing educational structures. Our method will be to look at representative resources of the World Wide Web and to interpret their possible meaning relative to the difficulties of the status quo. We start with systemic difficulties of our educational environment and contemplate various examples of what the Internet makes possible and ask whether these might present opportunities for our *Bildungspolitik* that we may want to actively develop. The four areas I will address are equalizing educational opportunity, improving interaction between schools and universities, opening classrooms and schools up as centers of communication, and changing constraints on the politics of the curriculum. Let us reflect on each of these topics in turn.

Equalizing Education Opportunity

¶22:XX Cultural historians need to deal with two problems of understanding that other social scientists can often ignore – the need to compare the historic prospects of mature

developments with immature ones, and the need to account for periods of latency in the dynamics of historic change. Both of these are very pertinent to grasping the prospects for the Internet in education.

¶23:XX Schools as they stand are very mature institutions. Digital technologies confront us with a long-term, far-reaching transformation in our culture. Educational technologies as they will be conditioned by these new technologies are in a very nascent state. We have to compare the known with the indefinite. As a consequence, the wise interpreter looks for signs of changes under way, not for demonstrations of their fully developed actuality. That is the burden arising on having to compare the historic prospects of the mature system with those of the immature. To compound the difficulty, with significant changes, a prolonged period of latency can precede the emergence of palpable evidence of what is taking place.

¶24:XX In everyday physics, such latency phenomena are commonplace, for instance, whenever a variety of substances undergo a change of phase, as when ice melts or water boils. As the experimenter adds heat to cold water, its temperature increases, and its volume expands minutely but distinctly, increment by increment, until the water reaches the temperature of 100° centigrade. Then it continues at fixed temperature to absorb a significant quantity of further heat before boiling off as steam. With digital technologies in education, we are not simply adding inputs that will make incremental improvements in the performance of the existing system. We are adding inputs that will force a change of phase in that system – in due course. Unfortunately, we are now in the midst of that period of latency in which much added input will have at the systemic level no discernable effect.

¶25:XX History has many such latency phenomena and they make the evaluation of historical change very difficult. As a consequence, we need to exercise an element of imagination in thinking about possible transformations. The existing system of education has had chronic, general difficulties delivering on aspirations to equality of educational opportunity. This is not simply an American difficulty, but a general difficulty encountered by a worldwide system of schooling. The children of the well educated do better on average in school than do the children of the poorly educated. We cannot here plumb this phenomenon to its depths. Let us be content to be suggestive. Let us simply note three reasons why this differential pertains and contemplate representative sites on the Web that suggest ways in which the Internet may break existing checks limiting the equality of educational opportunity.

¶26:XX First, the children of the well educated have much better information about how the system works than do the children of the poorly educated. Schools have difficulty delivering a good sense of what the options for higher education might be for their students. Only relatively well-financed schools, ipso facto schools for the children of the well-educated, can afford extensive information on opportunities in higher education and counselors advising students on how to prepare for the transition. Imagine yourself now a student entering the seventh grade in the Frederick Douglass Academy, a public school in central Harlem dedicated to the idea that children from low-income families can succeed academically. Classrooms there are connected to the Internet via broadband linkages and the student there from the seventh grade on

has immediate access to all sorts of sites dedicated to the college-entrance process. Look, for instance, at the College and University list on Yahoo –

http://www.yahoo.com/Regional/Countries/United_States/Education/Colleges_and_Universities/all.html

¶27:XX It is a fast-growing, comprehensive list of pointers to American institutions of higher education. There are many more specialized listings that students will find useful for their individual purposes, but this one will make the point: full information about higher education is becoming ubiquitous in wired schools. To what degree will such resources open full understanding of options within the educational system to any student at any place at any time? Will such resources tend to perpetuate inequities in educational opportunity or diminish them?

¶28:XX Second, the children of the well educated have casual access to higher quality print resources than do the children of the poorly educated. Insofar as we fulfill the *telos* of the Internet, making all cultural resources available to any person at any place at any time, we overcome this differential. Take, for instance, the *Digital Dante* project that Jennifer Hogan, a Ph.D. candidate at Columbia, has been developing over the past four years.

http://www.ilt.columbia.edu/projects/dante/index.html

¶29:XX A wide variety of people contribute dynamically to this site – leading Dante scholars, translators, designers, and teachers. It has features that will engage people of diverse interests and sophistictions, from comparing translations and studying bilingual presentations to playing Dante, assigning contemporary figures, according to the player's judgment, relative to the moral psychology of the poem, to various rungs of hell, purgatory, or paradise. Hogan is pilot testing the site with a group of eleventh and twelfth graders in a Harlem school, beginning to test the hypothesis that a complex, many-leveled resource will prove intrinsically educational. Mass entertainments are usually pitched at single levels of sophistication, designed to amuse an audience but to leave sensibilities and capacities unchanged. Educational works invite entry at one level and provide internal opportunities for a student to transform his or her skills and tastes, engaging in self-development through the work. Will the Internet make sites that sustain educational engagement in this sense more widely available to any person at any place at any time than they have up to now been?

¶30:XX Third, the children of the well educated have a better chance of attending schools that use powerful pedagogies purposefully. It is difficult to tell whether this differential will significantly change with the use of digital technologies in education. Currently, drill and practice programs are more heavily used in schools for children of low economic status. I believe that this tendency results from historical inertia carrying prior practices into the digital environment. As schools become well networked, teachers will find it increasingly easy to share their ideas about teaching and to post their favorite resources. The effect should be to spread good practice throughout all parts of the system. A good example can be found at the website for the Dalton school astronomy course, developed by Malcolm Thompson, a most gifted teacher in a school for highly advantaged children.

http://www.nltl.columbia.edu/Groups1/Astro/home.html

¶31:XX Without the Internet, teachers and students in less privileged settings would have no way to gain access to Thompson's pedagogical innovations. With the Internet, the exchange of good practice becomes more feasible and more routine. Another excellent example of a teacher sharing an innovative web-based course is the CyberEnglish course developed at the Murry Bergtraum High School in downtown New York by Ted Nellen.

http://mbhs.bergtraum.k12.ny.us/cybereng/

¶32:XX Will norms of good practice become more flexible as teachers everywhere realize that they can present their innovations and achievements to their peers? Will teaching gain stature as a profession as it becomes a domain of work that is increasingly open to the public?

¶33:XX Developments such as these suggest that the Web can possibly have a significant effect promoting the equality of educational opportunity. To make this assertion, however qualified, is not to assert that the spread of digital technologies into the culture will follow egalitarian lines. Those with wealth and power enjoy the fruits of innovation much earlier than those without. We can predict that the processes by which technology enters schools will for a time reinforce existing distinctions. When fully introduced, however, the sorts of sites we have been considering suggest that the net effect will possibly be very egalitarian.

¶34:XX There are some serious risks that the net effect of the innovations can possibly exacerbate educational inequalities as well. Until recently the popular culture and the school culture have been diverging and the combination of well-networked computers in both schools and homes may bring those two cultures back into a self-reinforcing relationship. Where this reconnection of home and school were to happen, it would greatly strengthen educational performance. Unfortunately, the children of financially secure families are much more likely to have access to good computers in both school and home than are others. If the convergence of the school culture and the home culture is what makes the significant educational difference, then the net effect could seriously aggravate class differences. Some hold that market forces will drive the cost of home technology to levels at which networked computers will be as widely distributed as televisions and telephones. Perhaps. But very possibly, advanced societies will need to make special policy efforts to ensure that a persistent class differential in home access to technology does not substantially exacerbate educational differences over the next few decades. But insofar as the technology reaches both homes and schools, networked digital media will empower students far more effectively than current arrangement do, and this added empowerment will have the greatest relative benefit for those who currently are least advantaged.

Interactions between Schools and Universities

¶35:XX Throughout the modern era, the distance between high intellect and the education of the ordinary person has grown steadily greater. This gap causes significant problems for democratic decision-making with respect to issues that demand great expertise. Consistently, the frontiers of professional practice, interpretative scholarship, and

research science become more and more esoteric. At the same time, the Baconian recognition that knowledge is power becomes more and more imperious and the ordinary person seems reduced to an intellectual minority. In the face of these developments, one has difficulty believing in the possibility of disengaging from rule by paternal experts. It seems so inescapably wise, prudent, and necessary.

¶36:XX I do not want to propound a populism that discards high intellect. The sense of possibility about relations between expertise and the populace has become so constrained, however, that it is nearly impossible to consider the opposite -- that we can restructure access to realms of expertise in ways that enable the populace to participate effectively in them. Let us contemplate nevertheless the possibility of a populism that universalizes high intellect. Perhaps it will turn out to be one of those surprising possibilities that history sometimes springs on humanity.

¶37:XX We take so completely for granted the gap between the highly cultivated and the ordinary person that we rarely try to explain it in a substantial way. Instead, we incant one or another circular explanation -- the gap comes about as a result of "increasing specialization," which is simply another name for the gap itself. Dare we ask why specialization has increased? Why do ordinary people find it so difficult to grasp domains of expertise? To say that they are not smart enough does not really suffice, for most experts, who have shown themselves to be smart enough to be experts in something, are ordinary people with respect to most other domains of expertise. To say that there is just too much to know to be expert in everything begins to move towards an answer. It leads to the simple question, Why is there "too much?"

¶38:XX To answer this question, observe through modern history how the tools requisite for advancing knowledge and the state-of-the-art in field after field have become more and more elaborate, costly, and fragile in use. The research library, the archive, the observatory, the operating room, the well-instrumented laboratory, the diving bell, the space shuttle -- all these are expensive places where only a few, highly-trained people can work without disrupting and degrading the effort. The expertise of the expert lies largely in his or her having mastered the tools of the domain, tools that will work only by restricting them to carefully selected and well-trained practitioners. In short, places of high intellect are profoundly elitist, not by choice, but by the inherent necessity of their operation.

¶39:XX Or is the necessity an historical necessity, one contingent on long-standing historical conditions? It is with reference to this question that we should contemplate, again as cultural historians reflecting on the human meanings of certain developments, various domains of expertise upon the Internet. Network digital multimedia changes the terms of access to once restricted provinces. To be sure, thresholds still exist and the new access is virtual rather than material, but it can often be substantial, allowing people at a distance to control a complex apparatus and to receive the results of work they thus produce with it.

¶40:XX Consider, for instance, the Project Perseus site and its effect on access to classical studies. Modern academic disciplines go back historically to the way F. A. Wolf defined the Homeric question in the mid 18th century, and the classics have remained

a point of tension between drives to specialization and ideas about general education ever since. Classic studies are an interesting measure of the problem because the range of resources relevant to the field is limited and thus not too estranged from the reach of the lay person. The sources are expensive enough, however, that only some schools could acquire them, and there was the obvious threshold difficulty of language competence. Thus at the point of their widest dissemination, classical studies defined at most a fairly broad elite. The limited number of ancient texts and works of art has made the field a good candidate for digitization of its resources and hence tools for classical studies are becoming available on line. What are the possibilities for engagement as a result? The Perseus site is worth contemplating in this context.

http://www.perseus.tufts.edu/art&arch.html

¶41:XX It provides anyone connected to the Internet very substantial access to the full range of resources available for study of the ancient Greeks. Clearly, by itself, such access will not make a classicist of everyman. But it opens up the issue of how educators can use such resources effectively in the course of the average person's education. What hitherto was a material impossibility may henceforth become a function of pedagogical preference and choice.

¶42:XX Much the same holds for many areas of scientific research. The great paradox with empirical science has been the way that education in it has been dogmatic. The empirical groundings of scientific thinking have been largely beyond the reach of the educational process. With instrumentation increasingly shifting from analogue to digital readings, the empirical base of much scientific work becomes available routinely on-line. Given the ease and accuracy with which digital systems can reproduce and transmit that data, it all comes within the *telos* of the Internet, becoming accessible to any person at any place at any time. Again, as with Perseus, the problem then becomes one of finding pedagogies whereby ordinary persons can fruitfully study what hitherto had been off bounds and out of reach. And here we encounter a most unusual feature of the emerging conditions for working with advanced knowledge: tools have become so powerful and data sets so complicated that simplifying strategies providing powerful, intuitive means of visualization and simulation have become necessary to researchers. These tools work so well that relationships that once required great mathematical sophistication to grasp are now apparent to immediate visual observation, not only by researchers, but also by nearly anyone who looks.

¶43:XX One can find diverse examples of these developments on the Internet. I offer two from the Lamont Doherty Earth Observatory, a component of Columbia University that is set apart from our main campus and is supported entirely by external research funds at a level of over $100 million annually. Education has been outside of LDEO's mission. Until recently, that is -- to everyone's surprise, it is becoming a natural extension of pure research efforts there to extend the visualization tools and the like that they are developing so that students in elementary and secondary classrooms can work with massive scientific databases.

http://www.ldeo.columbia.edu/EV/EarthViewHome.html

http://ingrid.ldgo.columbia.edu/

¶44:XX Groups that develop the most advanced scientific databases are increasingly also simultaneously developing powerful means by which students in schools can work directly with the materials. Time alone will reveal what effect these developments will have on the accessibility of expert domains. They are likely much more quickly to change the patterns of interaction between higher education and elementary and secondary schools. Historically, the intellectual apparatus of higher education has been too costly and fragile for use in schools. As that apparatus becomes digitized, students and teachers the world around can make routine use of it. The pedagogical challenge that educators face is to develop educational strategies to activate these resources effectively in educational experience. One of the major tools in doing that will be a third area where new possibilities are developing, the role of classrooms as active centers of communication.

Opening Classrooms as Communications Centers

¶45:XX Traditional classrooms are closed societies. The bell rings, the door shuts, and the class comes to order. The resources in that closed society are relatively sparse -- the textbook, a few supplementary materials and possibly an encyclopedia, and the teacher's stock of knowledge. It is hard, on-demand, to amplify a given day's discourse. The school library is limited. Access to it during class time is inconvenient. These communications constraints have conditioned the educational possibilities within classrooms for centuries. Consider whether the Internet may change them.

¶46:XX The Internet changes the location of intellectual resources fundamentally. In physical form, collections have a whereabouts and users must go to those locations. With fully developed digital networks, the movement is reversed: users are at one or another place and collections come to their locations. Formerly, the classroom and the library were in different places; now the library enters the classroom and not only the library that happens to be in the school, but full, aggregate digital library of the World Wide Web. The challenge is to make full use of it there in each and any classroom. The task is immense; the change fundamental; and it does not end with this movement of resources to the student.

¶47:XX Consider the Ralph Bunche School, which has students in grades 4 through 6 and is located in West Harlem.

http://ralphbunche.rbs.edu/

¶48:XX Here, under the dedicated leadership of Paul Reese, one of the pioneers introducing the Internet in schools, students regularly use the Internet as a communications medium in a number of distinct ways. First, they publish a monthly newspaper on the Web that presents events in the school and s significant sampling of student work. Second, they create stories, artwork, and commentaries for presentation of the Web. And third they solicit extensive input from people outside the school, using the Web as a medium for gathering data from the external world -- for instance input relevant to an inductive study of probability. Too often students experience their education as something done to them, something that they must passively endure. Children who

use the Internet to communicate their work and to solicit participation from others in it will be less likely to be estranged from their own education in this way. The opportunity to situate educational work in far-flung communicative experiences is rapidly growing and potentially it can have a significant influence on the meaning students attach to their educational experience.

¶49:XX Students at the Ralph Bunche School demonstrate that advanced communications capacities can help transform the educational experience even in the elementary grades. Later in the educational experience, such communications capacities are even more significant. Desktop video conferencing will soon open the classroom even wider. Already inexpensive programs such as CUSeeMe are helping students share common interests and reach out to peers and experts in diverse locations. Two trends will greatly expand these capacities in the next ten years. Bandwidth is increasingly rapidly while video and audio compression technologies are improving substantially. To be sure, traffic on the Internet is likely to remain susceptible to congestion, but given the underlying trends, that congestion will simply be evidence that use of video conferencing is spreading throughout the system.

Changing the Politics of the Curriculum

¶50:XX Finally, consider the character of the political tensions that accompany decisions about school curricula. For the past 500 years, the curriculum has consisted of compressed surveys of selected subjects scaled to fit within usable textbooks. The scale of the curriculum has not been a function of what is worthwhile in the culture, but rather what a limited set of books can encompass. Children could not carry a great encyclopedia around with them in their backpacks. Consequently, the politics of the curriculum involved a competition to exclude materials judged pernicious and to include those deemed essential. This competition is at the heart of the conflict between multiculturalists and defenders of the cannon. This competition is rapidly becoming meaningless and unnecessary.

¶51:XX In truth, for every literary tradition there is a broad, living cannon, one far more inclusive and challenging than any of the pale representations of it in official curricula. And each of these has an integral worth to it. Is the person who reads Cervantes instead of Shakespeare significantly disadvantaged? We have the opportunity to build a curriculum that does not rest on a host of exclusions. This new curriculum will put a tremendous premium on inclusion and diversity. Visit some of the major digital library sites -- I'll point to a few parts of Columbia's digital library, as I know it best. You can find similar doorways into the aggregate library of the Web through most research and public libraries. All of these bring new kinds of collections into schools.

http://www.cc.columbia.edu/cu/libraries/digital/texts/

http://www.columbia.edu/cu/libraries/indiv/ets/offsite.language.html

http://www.columbia.edu/cu/libraries/indiv/ets/offsite.subject.html

¶52:XX An astounding curricular variety is increasingly possible. Educators will need to decide whether or not to embrace it.

¶53:XX What is likely to be the issue troubling the public as it engages this variety? What are the wellsprings of cultural vitality and depth? Is it important that everyone within a community should have mastered a least common denominator identical, or nearly so, for all? I must say that personally, the least common denominator is of little use. I find myself able to function at a higher level of intelligence in interacting with people who have had an education of some depth and rigor, regardless of whether or not it included a single set of common cultural resources. I suggest that we at least entertain the possibility that a curriculum that maximizes quality and diversity will have human consequences far more preferable than those that result from a curriculum that achieves commonality at the cost of quality. In this context, it is worth visiting one school that we have helped link to the Internet. It is a small Muslim school associated with the Mosque that Malcolm X founded on 116th Street between Lenox and St. Nicholas Avenues, the Clara Mohammed School.

http://pindar.ilt.columbia.edu/heap/schools/scm/

¶54:XX This school is deeply distinctive and ambitious in its educational program, despite the fact that it has few financial resources with which to work. The school seeks to develop a tri-lingual curriculum, using English, French, and Arabic. Routine access to the Internet has made a big difference in its ability to achieve these goals. If it does so well, will it serve its students better, children of poor minority families, than if it had a more typical curriculum?

A Concluding Imperative

¶55:XX In closing, I want to reflect on one imperative that seems to me important if we are to bring possibilities for educational improvement to historical fruition. During the twentieth century in the United States, and I suspect elsewhere as well, people have been paying more and more attention to teaching, and the official didactic program of the school, as the one, significant causal factor determining the outcome of educational activity. According to the conventional wisdom, education is what happens when teachers teach something effectively and students learn it well, absorbing precisely what has been taught. Continued acceptance of this habit of thought will lead us to ignore the most significant opportunities of change presented by the Internet and related technologies.

¶56:XX For every teacher in the system there are twenty to thirty students. We should introduce advanced technologies as investments in our students. We have the opportunity to use capital to enhance the capacity of students to do their work, to study, which is a much more complex activity than simply learning what their teachers teach. Students learn, but they also criticize, think, probe, scrutinize, judge, question, hypothesize, and disagree. Students inquire, observe, theorize, map, reason, assume, examine, inventory, seek, challenge, dispute, hope, quote, speculate, infer, conjecture, suppose, list, investigate, notice, recognize, contest, and tinker. They converse, create, wonder, reflect, travel, doubt, solve, understand, and write. Students also predict, perceive, inspect, comment, read, conform, honor, refute, debate, compose, oppose, discuss, invent, copy, search, picture, measure, compare, record, estimate, and consult. And finally they analyze, deduce, guess, memorize, listen, evaluate, formulate, simulate, meditate, admire, muse, emulate, aspire, waver,

synthesize, weigh, contrast, associate, catalog, compute, assert, and so on through all the verbs that describe the human capacities for cultural activity. Advanced technologies are tools to make study, the work of students, more efficient and effective. They enable students to do all these activities with greater power and self-direction. Tools of study can vastly amplify the range of educational possibility.

¶57:XX Look at the tools with which school children work. They are essentially the same as they became in the sixteenth century. Textbooks, notepads, pens and pencils, book bags, desks, slates and chalk, various visual aids -- all these were invented centuries ago. They condition what pedagogies will be successful. They require, after the elementary matters have been introduced, that the day be divided into periods devoted to distinct subjects. Across diverse subjects and ages, groups recite in unison lessons duly learned. Over and over, innovations in pedagogy have been tried, and over and over practice has gravitated back to long standing norms, for those norms accord with what most students can accomplish given their traditional tools. By providing students with new, powerful information tools, we change what students can accomplish, and as we change what students can accomplish, we change what pedagogies can usefully prevail.

¶58:XX What are the implications of this potential for investment in the ability of students to carry out their work? From my experience with the effect of the Internet in classrooms, it will conduce towards an intellectually rigorous progressive education accessible to all. To make this renewal of progressivism work, it is important to accomplish four things in the classroom:

- Pose powerful generative questions in cooperative settings;
- End limitations on the intellectual resources available to students;
- Enable teachers and students to communicate beyond the classroom; and
- Provide advanced tools of analysis, synthesis, and simulation.

Where these prevail, all students learn; they learn with depth and rigor; and they take possession of their learning as their own.

¶59:XX By investing in the power of students to conduct study well, we have the opportunity to renegotiate the ecology of educational effectiveness. During the first half of the 20th century, progressive educational ideas were widely tried and they generally failed in practice. We should, at this point it the discussion, understand why -- the intellectual resources available to students and teachers in closed classrooms were insufficient to sustain productive projects and inquiry. Given the limits that even a highly learned teacher would bring to the classroom, given the paucity of books and other materials, twenty-five curious students following an open-ended line of inquiry will quickly exhaust the teacher's ability to respond with point and authority. Progressive education could not, and did not, work in closed classrooms -- the appropriate setting did not exist.

¶60:XX By investing in the power of students to work with effect, we open the classroom and make it an appropriate setting for an intellectually rigorous progressive education accessible to all. Technological innovations do not originate the aspirations of progressive education -- those go back to Jean-Jacques Rousseau, to Goethe,

Pestalozzi, and Froebel. They lead through the great educational thinkers of this century -- Dewey, Montessori, Freire. Technological innovations do not create ideas, or hopes and aspirations, but they do change the ecology of feasibility. Consider how in the sixteenth century, the spread of printing helped turn medieval heresies, which had a century earlier been easily suppressed, into major reforms of Christendom. The ideas of the Reform and the Counter Reform were not new, but owing to print, in the sixteenth century their feasibility was markedly greater than in the fourteenth. In the same way, the Internet changes what is possible in education. The Internet challenges educators to make the best of those possibilities actual by providing students the most powerful tools of telecommunications in our culture -- that is the imperative we face. Let us grasp it.