1

The Internet as an Educational Innovation

Editor's Note: Collis. B. (1996). The Internet as an educational innovation: Lessons from experience with computer implementation. *Educational Technology*, *36*(6), 21-30.

Introduction: Will the Cycle Repeat Itself?

For over a decade, countries and regions around the world have pursued various initiatives to stimulate and support the use of computers in their educational systems. These initiatives have taken many different forms in different countries, some focusing on strategic support for hardware- and software-related programs, some on strategies more directly focused on curricular and instructional aspects of computers, some (fewer) on strategies for the school manager, and others (many) on different approaches to teacher education and support. Regardless of the focus or scope of the initiative, it appears that one type of result consistently occurs: a result that acknowledges the teacher as the key figure in the eventual success or lack of success of any computers-in-education initiative.

The wave of social and technological developments that stimulated interest in computers in schools in the late 1970s and early 1980s appears to now be paralleled by a similar surge of interest in educational aspects of the Internet. Throughout the world, the use of wide-area network capabilities for communication and access to new forms of information engagement is stimulating a wave of initiatives with respect to telecommunications in schools, particularly telecommunications via the Internet and applications such as e-mail and the World Wide Web (WWW). I will argue that this wave can be seen as an iteration of the "computers in education" wave of 10 to 15 years earlier.

What did we learn from the first wave? To what extent can we expect the patterns and results of the first wave to reappear in a second wave, this time focused on the computer network rather than just the computer? What might we do more efficiently and effectively the second time around in terms of responding to a computer-related innovation at the strategic and policy-related levels?

These are the questions addressed in this reflection. The conclusions that will be drawn are:

- In critical ways, the "Internet in education" is a second iteration of the "computers in education" phenomenon of the 1980s.
- In many critical ways, we can expect the same sorts of implementation results; however, the unique characteristics of the World Wide Web, coupled with differences in society compared to a decade earlier, suggest that certain breakthroughs in implementation success will occur in this second wave.
- The experiences of the field and of decision-makers with respect to computers in education in the 1980s present an interesting legacy with respect to the Internet in education, in some aspects positive and in others a burden. We will do well to learn from experience.

Sketching the Iteration: From Computers in Education to Computer Network Applications in Education

In the 1960s, research initiatives began relating to the use of computers for educational purposes, and the study of computer science (called by different names in different countries) became established as academic and professional domains. By the 1970s there was already considerable experience with the development of computer-based learning systems; for example, the PLATO environment was used in The Netherlands to create a complex mainframe-based system to support the learning of statistics at the university level that is still in use today (in an evolved version, of course).

With regard to teachers and schools, however, the breakthrough came via the impetus of a social and technological phenomenon: the personal computer. In 1979 and 1980 in particular, an explosive synergy occurred: The personal computer afforded personal control, allowing the individual to work independently of mainframe computers. Society saw this as a revolutionary, romantic, and powerful new opportunity; education was pushed by the same energies. Computers could revolutionize education, could even revolutionize the process of cognitive development of the child, and in more practical terms, could bring new competitive possibilities to schools.

Table 1. Comparing "Computers in Education" with "The Internet in Education."

Push Factors	Computers in Education 1979/1980	The Internet and Education, 1996/1997
Technological Breakthrough	–the microcomputer	–public access to the Internet and the WWW
Social Response	–we must have a computer, in our homes, in our schools…	–we must be able to get on the Internet, in our homes, in our schools…
Social Vision	–personal computers will revolutionize society and will create powerful new opportunities for those who can handle them	–the information highway will revolutionize society and will create powerful new opportunities for those who can handle it
Commercial Push	–a vast new market for goods and services	–a vast new market for goods and services
Social Expectation	–schools must not be left behind; all students must be computer-literate	–schools must not be left behind; all students must have "driving licenses for the information highway"
Vagueness	–metaphors and predictions are strong; results are anecdotal	–metaphors and predictions are strong; results are anecdotal
Push Factors	**Computers in Education 1979/1980**	**The Internet and Education, 1996/1997**
Pioneers show the promise	–both in theory and practice, there are impressive ideas and examples of how the computer can enrich and re-engineer education	–both in theory and practice, there are impressive ideas and examples of how the WWW and other network environments can enrich and re-engineer education
Educational decision-makers must and do respond	–every school must get computers; funding must be found; new initiatives are needed; policy and strategy are needed…	–every school must get **on the internet**; funding must be found; new initiatives are needed; policy and strategy are needed…

The overall movement is unstoppable	–computers are pervasive throughout society	–interconnectivity via computer networks is pervasive throughout society
The rich will get richer…	–an incentive, and a fear	–an incentive, and a fear

Concurrently, there were fears as well: computers would replace the teacher and would distort the social development of children at the same time as they would disenfranchise large groups (such as girls) from status and success.

It is interesting to compare the start of the computers-in-education wave of the early 1980s with the "information highway" wave of the mid-1990s. My argument is that we are now experiencing a second iteration of what we experienced before. Table 1 suggests some major points of similarity.

The computers-in-education wave did not occur in a vacuum, either technologically or in terms of educational experience. As noted earlier, computers had been studied and used in education in many ways prior to the "personal computer" breakthrough of the late 1970s. But the personal computer provided the "trigger event" to unleash the first wave of broadscale educational activity. Similarly, networks, including the Internet, had been in use in educational settings for many years before the trigger event of the World Wide Web (WWW) unleashed the second wave of broadscale social expectation. The trigger event idea is critical; a trigger event is rather like a break in a darn. Much water must be accumulated behind the dam wall before the pressure to erupt becomes inexorable, and then when the breakthrough occurs, the flood cannot be stopped.

What Has Happened in the First Wave?

We all know the story of the past 15-20 years with respect to computers in education and how these early hopes and fears have worked their way out in practice; however, each of us may see the results through a different optic and with different interpretations. The old adage of seeing a cup as half-filled or half-empty relates to our interpretation efforts. There are many different reports and analyses of what the results of the first wave of computers-in-education may be, and there have been a number of attempts to synthesize these results at the international level. In a recent book, Children and Computers in School (Collis, Knezek, Lai, Miyashita, Pelgrum, Plomp, & Sakamoto, 1996), three of the largest and most carefully controlled of these international comparative investigations are further synthesized. Conclusions such as the following 12 points seem to be justified when one looks at the international picture. To a certain extent, I offer the following as my own interpretation, although much research can be cited to support the interpretations, and of course my view of the cup may seem half-full or half-empty to others:

1. **Into the system:** Computers are present in educational institutions throughout the world, with computer rooms as standard as a school library or cafeteria. Every educational jurisdiction spends money in a regular way on some aspect of its computer provision. Computer-literacy courses or modules of some sort have become standard practice. Teacher education includes some acknowledgment of the need to prepare teachers for the use of computers. Many educational professionals have their identities and job definitions related to computers.
2. **First-level problems affect everyone:** So-called "first-level problems" confront every step of computer use in schools, by teachers, and by students. These problems are the same throughout the world. Individuals fight with them, at great cost of time and energy, until gradually an institutional response removes some of the personal burden. Computers do not work; software crashes, software is too difficult to install or understand, software is too expensive; there is no way a teacher can have a computer on his or her desk in the classroom (there may not even be an electrical outlet anywhere near the desk even if he or she had a computer and had a place to set it); there is no projection device so that students can see what the teacher might want to demonstrate; computers are fixed in the computer room and are not accessible when and where the teacher can manage their use by students; there are not enough computers, the computers are too old, too slow, too limited in memory; the teacher does not have time or a place to work personally with a computer, the teacher has no time…and on and on.
3. **Second-level problems are also persistent:** Gradually, first-level problems are reduced (never eliminated) through a combination of personal efforts on the part of committed teachers and institutional and system-wide responses. But a more challenging level of problems remains. These second-level problems are also familiar throughout the world: teachers do not see how to integrate computers into their instruction; teachers and decision-makers are not convinced of the payoff of computer use on the "real" markers of school achievement—student examination results; no matter what approach to teacher inservice training is attempted, it is not enough; no matter how hard we try, software is never good enough or appropriate enough.
4. **Good things are happening:** Throughout the world there are countless examples of good experiences with computers in individual lessons and with individual teachers and students. The results of these good experiences are elusive to measure with tests or to demonstrate in terms of any changes on broadscale educational output, but those involved know that quality instructional moments are occurring.
5. **Diffusion is difficult:** The good things that are happening are related to special people or situations and do not diffuse much into mainstream practice. Good teachers are associated with good examples of computer use. There is no evidence that the computer use made these teachers into good teachers. A good teacher sees possibilities in a powerful technology, sees a way to realize them in his or her own situation, and has the energy and persistence to implement them, usually at personal cost. In contrast to the more idiosyncratic success stories, substantial, long-term, expensive initiatives are needed to sustain computer use among the mainstream of teachers. Diffusion into practice has not yet much occurred.
6. **Different policy and strategies come to similar ends:** The above patterns seem to occur regardless of what policy or strategy has been employed. There are many different models for regional or national support of computers in education, ranging from indifference to highly integrated. Yet the results summarized here seem to repeatedly emerge. There are differences related to policy, to be sure, but at a broad level, the results seem to be similar. There are computers in schools; it is difficult to use them; it is even more difficult to see how to use them in instructional practice; some teachers do find a way and are associated with interesting and probably important learning experiences; diffusion into mainstream and meaningful practice is difficult and does not occur much. That so many different national policies and strategies at so many different levels of cost and activity generally lead to the same result, is in itself an important observation.
7. **Cost-effectiveness is not demonstrated:** There is no broadscale evidence, yet, to equate the amount of money (indirect and direct) which has been spent on computers in education with a corresponding payoff in terms of educational outputs. We do not seem to be able to say that a country's expenditures and efforts with computers in education have resulted in noticeable, sustainable, system-wide differences in student achievement.
8. **Not to fear:** We can be comforted that many of the fears expressed at the start of the first computer wave have not materialized. Computers have not replaced teachers; computers have not made the school obsolete; computers in schools have not turned children into anti-social problem cases; students generally have little "computer anxiety" and assimilate some level of computer-use skills, enough to function in their societies, through social osmosis,

regardless of our concerns with curriculum or instructional units for computer literacy. “Keyboarding” does not have to be taught. The life of the school goes on….

9. **Not to gain:** With the exception of a handful of large companies (I have heard that perhaps eight U.S. companies have nearly 50% of the world market in educational software), little or no money is being made from educational software. The software that is pervasive in schools is that which is pervasive in society as a whole, or is provided by the particular local initiative. Despite the success of the eight large companies, a market for educational software does not really exist unless propped up by external funding. Creating educational software that is portable among countries so that the market for its use is increased has rarely occurred. Once national or regional initiatives supporting the dissemination of locally-made software packages are finished, the locally made packages do not further disperse (although they may continue to be used in pockets of local settings).
10. **From subsidized exploration to…its withdrawal:** The computers-in-education wave was fueled by enthusiasm, by predictions and visions, and by the simple need to be involved in it. But throughout the world, the broadscale initiatives that were established as special national programs or special collaborations can no longer expect to receive the funding support that was available a decade earlier. There is a pendulum effect of a sort: in many countries, ministries and other educational decision makers are saying: “OK, good. We had a big project, the project succeeded in putting x computers in x schools, providing x hours of training for x teachers, supporting the production of x pieces of educational software with accompanying instructional materials, and funding x research and evaluation projects from our university partners. We learned much from this project, good, But now the special project must be over. Funding is scarce; other special projects demand our attention. if you want more money, show us the facts, the data, the results. We cannot afford to finance more exploratory and preparatory studies….” And teachers are saying: “OK, I tried it, but it didn’t really work for me, so don’t expect me to respond again to the next workshop or project. I really must get back to my real work…” And school administrators are saying: “Fine, we have a computer room, it is always filled, Teacher x does a good job in there, so let us now turn our attention to other things. We certainly don’t need days off for teacher workshops about computers in education; we did that….”
11. **The teacher is the critical variable in computer use in the school setting, but not the critical variable in the student’s computer use outside the school:** Whatever is done or not done by policy-makers, researchers, teacher-educators, and vendors, the teacher is the critical variable in the use and impact of computers with his students in his classroom. Conversely, what students do with computers outside of the classroom context, in their homes and in society more broadly, does not seem much related to what they do in school or to what their teachers do or not do.
12. **The computer has been a solution in search of a problem:** In general, countrywide or regionwide computer-implementation plans have not developed as a response to specific problems that teachers are experiencing, as expressed by teachers, but instead have been motivated by some combination of the “push factors” listed in Table 1. This may be why diffusion has been difficult; why cost-effectiveness on a broad and sustainable scale has been difficult to document; why second-level problems have been so hard to overcome (outside the stimulus of a special project or pioneer). Many voices have told teachers about the potential of the computer in their classrooms, about what they must know, about how they should proceed. But how often has the starting point been teachers’ own voices about their problems and needs (not with respect to computers, but with respect to the teaching and learning situation in their own classrooms)? How often has an analysis taken place based on these needs, with perhaps the result that money could have been better spent on some other intervention?

Must or Should We Re-invent the Wheel? Lessons from Past Experience and Their Application to the Internet in Education

Given these 12 conclusions about the first wave of computers in education, what are my predictions about the second wave, relating to the Internet in education? In Table 2, I repeat the 12 conclusions and follow each with a comment and a suggestion. These are my own views, presented for debate.

But is There Something New? Will the Second Wave Be Different?

I began this reflection by asking if we could learn from our computers-in-education experience with respect to our expectations for teachers' use of the Internet, particularly the WWW accessed via the Internet, and I have argued that there are many insights that can be applied. I do think, however, that the Second Wave does involve some things that will make a difference in terms of increasing the likelihood of implementation. Focusing particularly on teachers, I think that:

- The common and easy-to-use user interface of WWW browsers will be as helpful and attractive to teachers as it is in general in society, thus lowering some of the traditional barriers to teacher use of computer software.
- The ease with which the WWW with its search engines now allows us to access ideas and examples and images and materials through a single user interface is something which has never happened before. Such uniform front-end ease and international access to materials did not accompany the computers-in-education movement. We could read about an interesting software package, but had no way to see it or use it. We have finally made a breakthrough in the traditional dissemination bottleneck, and the breakthrough is at many levels. It is at a personal level: Teachers can look for and decide for themselves what they find interesting, not needing to wait for the filtering process through committees and resource offices. It is at an idea and energy level: There are many, many good and creative sets of materials being made available via the WWW by teachers and students that can now flow into the international community in a way that was never possible before. The cost of this freedom is loss of quality control, but teachers as professionals must be able themselves to judge if a resource is useful or not. This in turn implies a new priority for teacher education: wisdom, in making choices and in doing self-evaluation of possibilities. We have typically assumed the curriculum experts, the inservice professionals, and the textbook authors would be well-informed and trustworthy; now we must teach teachers (and students) to take the editor's task onto themselves.
- Another thing which is interesting is that the WWW supports teachers' access to discrete resources, to units of learning materials which can be integrated into one's own lesson and situation. We did not succeed with educational software, I think, because the teaching act is too personal to be handled by an instructional software package to a teacher's satisfaction. But finding and making use of good resources and units of information is something different. Teachers will, I think, be much more likely to see the use of good quality images and example materials that they can embed in their own lessons than they have been likely to see the use of a software package that tries to teach.
- The WWW is a flexible and universal medium; it is platform independent and capable of being used in many ways and with many different media forms. The surge of creative development of WWW technology is a breakthrough in society as a whole. For a while at least, ordinary people can do powerful things with the functionalities of the WWW, taking us back to the creative feeling that fueled the "computers in education" breakthrough of the late 1970s.

Predicting Diffusion: The "3P" Model

I and my colleagues have earlier argued that the likelihood that a teacher accepts a computer-related innovation into his or her practice is a function of three variables: expected payoff, level of problems that have to be overcome, and intrinsic pleasure in being involved with the innovation. We call this the "3P Model" (see, for example, Collis & De Vries, 1 993; Collis, 1996), and have seen it to have explanatory value in many different settings. The 3P Model says that the vector sum of Payoff, Problems, and Pleasure must be sufficiently positive in order for usage to occur. In general, "Problems" is a negatively-valued vector; pioneers and enthusiasts bring high value to the "Pleasure" vector (and also predict much higher values for the "Payoff" vector than do non-enthusiasts).

Table 2. Lessons from the First Wave applied to the Second Wave.

Results from the First Wave	Implications for the Second Wave
1. Into the system	We can expect access to the Internet (or whatever it evolves to) to be as common in schools as having a telephone number or a computer room. We can predict that students and teachers will be as familiar with the WWW (and its evolution) and with e-mail as they now are with faxes and word processing and automatic bank machines and pincodes. ***Lessons from the first wave?*** Economies of scale can help this process of system-wide presence, but the technology will change so quickly as will the social persuasiveness of the technology, that only the most strategic decisions relating to infrastructure access and cost reduction need be the focus of policy and strategy. We do not need to teach "Internet literacy" (although wisdom is a different matter).
2. First-level problems affect everyone	Schools will find it very difficult to offer useful amounts of Internet access to students or teachers. Classrooms will have no network connection, school networks will not easily adapt to Internet connectivity, server connections will crash, and having a teacher in the school technically able to solve Internet-related problems will be very difficult. Costs and security issues will increase compared to stand-alone computer use. ***Lessons from the first wave?*** Anyone advocating any form of Internet use should walk through each step of access problems with a classroom teacher in the actual classroom setting. A three-partner discussion, between the teacher, the school decision-maker, and a representative of the regional or national strategic team must occur so that "little problems" such as no printer access in the classroom and no projection device are given respect and attention.
3. Second-level problems are also persistent	Identifying educationally relevant uses of the WWW that teachers can see as applicable to their own needs and feasible in their own situations needs careful attention. A major possibility for such identification is the fact that the WWW provides access to resources not available in the school through a single user interface and a single sort of search tool. But the fact that "everything is available" will not necessarily mean the teacher sees or accepts the usefulness of "everything" in his or her practice, especially as "everything"implies junk as well as quality. ***Lessons from the first wave?*** Look for one convincing application of the Internet that is solidly useful in the particular school or teacher culture. Build on this, show it in practice, get evidence to convince teachers that this particular application is "worth it," and then do all possible

	to make it easy for them to make use of the application itself.
4. Good things are happening	Very good things are happening, particularly with respect to teachers applying in varied ways the functionalities of the WWW in learning settings. The fact that WWW functionalities can be used in an "intranet" context (that is, within the schools's own local area network) means that their value does not have to involve access to the Internet with the cost and quality control issues that this access entails. ***Lessons from the first wave?*** Look for examples of "good things" and support the teachers involved. Give them time and opportunity, and recognition. They are the pioneers; they may also be the only ones to really exploit the medium in the short-term, so use limited funds to support them rather than to try and engage everyone.
5. Diffusion is difficult	Some teachers will make good and powerful use of network opportunities, but we can expect that most will not, at least in the near future. ***Lessons from the first wave?*** Similar to Point 4 above, it does not seem to pay off to attempt to provide across-the-board inservice training in terms of results in practice. The "rigger event" strategy (Point #3), coupled with reduction of first-level access frustrations (Point #2), and support of one's creative pioneers (Point #4) will probably be more effective than national plans for "Internet skills for teachers" or expectations of system-wide implementation or expectations of vaguely understood goals such as "being a citizen of the global community."
6. Different policy and strategies come to similar ends	When a flood has begun, it will continue. Thus, social pushes for access to and use of the Internet, the WWW, and their follow-ups are occurring, regardless of what policy or strategy is chosen for the schools. ***Lessons from the first wave?*** Decision-makers need not invest substantial effort looking for a "best approach" or policy; a powerful idea will find its way. Be aggressive in supplying teachers and schools will affordable and convenient Internet access, look for the local-relevant "rigger event", reduce the most frustrating access problems, support your goo and creative teachers, this can be don in many ways. There is no "best" way.
7. Cost-effectiveness is not demonstrated	Just as it has been difficult with computers in education to show cost-effectiveness evidence, we can expect it will be even more difficult with networks in education. But we do need to try. ***Lessons from the first wave?*** We need to collectively take the issue of cost-effectiveness measurement very

	seriously. We must move beyond theoretical predictions of great benefit to some sort of objective evidence that increased access to wide-area networks is paying off. Thus, we must start now, gathering some types of useful baseline indicator data, so that perhaps in five years we can say, "Yes, but before we used all aspects of the WWW services extensively, students only reached the x level of some kind of attainment but now we can demonstrate that students are reaching a better level." Will we be able to say this in five years? Perhaps we should start by asking teachers: What are your problems and what are some indicators of those problems?
8. Not to fear	Newspapers around the world featured articles in 1995 and 1996 about the dangers to children of the pornography on the Internet. Governments have even taken initiatives to "protect" children from this danger, through technologies such as "chip cards" and special agents, and through "urgent" legislation. ***Lessons from the first wave?*** Given the increasing access to the "big world" and its evils that bombard children in every part of their lives, it does not seem to be a cause for concern that school use of the WWW is going to corrupt the morals of our students. Nor does it seem that we need to anticipate sociological or psychological damage from network use, any more than it occurred from personal computer use. More seriously, we do not need to fear that schools will soon disappear and teachers will be replaced by some virtual equivalents.
9. Not to gain	While the Internet will open up new channels to the international dissemination of electronic learning materials, there is not likely to be a corresponding rush of purchase orders via the many types of forms from within WWW pages. Teachers and schools will want **free** materials or services subsidized by their local jurisdictions; a commercial market for educational network services is not likely to develop. ***Lessons from the first wave?*** It is unlikely that commercial groups will make large profits from school access to the Internet. In contrast, more use will be made of teacher-made and student-made materials, because these will be available for free. This means that decision-makers cannot expect commercial interests to support schools' Internet access. Funding will have to come from the educational jurisdictions, and increasingly from the individual parents and teachers in a school. Of course, this will lead to inequities in educational opportunity reflecting the inequities in society; networking will not reduce them

10. From subsidized exploration to—its withdrawal	Here we will suffer from being the second wave. Society, and teachers, are rather tired of computer-based innovations, and will be less tolerant of spending energy and money on them. ***Lessons from the first wave?*** Make sure the Internet enthusiasts have good awareness of the computers-in-education history of a school or district or country. This history will flavor all new computer-related initiatives in a way that the newcomer, filled with passion for the WWW, is likely to underestimate. And, also, there will be less tolerance for experimentation among teachers who already have experiences with computers. A justifiable skepticism about "fads" in education must be anticipated and respected.
11. The teacher is the critical variable	In the classroom, the teacher is the gatekeeper and the filter; the teacher, not the visionary, not the vendor, not the service providers, not the national decision-maker. A good teacher may do very good things with networking opportunities; a weak teacher will not, no matter how we try with strategies and inservice training. ***Lessons from the first wave?*** We have learned that teachers are very much influenced by and helped by each other. Stimulating and supporting teacher networking with respect to ideas about classroom applications of the Internet seems to be a good strategy decision.
12. A solution in search of a problem	Because the Internet lets teachers talk to the world and access an unlimited amount of information, we must not assume that this is going to be seen by many teachers as a response to their most real classroom problems, or even as something they want. ***Lessons from the first wave?*** Start with a careful discussion with teachers of what they perceive as their major instructional and professional problems. Do not mention the Internet in this discussion unless ou can do so as a convincing and realistic response to some of those problems.

We have found in our research, however, that for teachers who do not feel pleasure in a computer-related innovation (and in particular, in the use of telecommunications in education), not only is the Problem vector perceived as considerably more negative, but the Payoff vector is also not perceived as very strong. In other words, the 3P-Profile of the enthusiast is different from that of the non-enthusiast.

The breakthrough in network usage that is now occurring via WWW developments appears to be contributing to a reduction in the negative value of "Problems," an increase in the number of persons experiencing a "Pleasure" feeling with network use, and thus in both real and perceived ways is suggesting a positive "Payoff" vector. The personal computer breakthrough in the late 1 970s changed the "3P" relationship about computer use for the teacher and stimulated much hope in Payoff. It may be that the breakthrough of WWW functionalities and the World Wide Web itself will support a positive enough "3P" vector sum so that the teacher will implement the innovation into practice to a greater extent than has been the case with computers in the mainstream.

Conclusion

Based on this reflection, I feel more optimistic about the Internet in education, because of the WWW, than I have for many years about non-networked computer aided instruction and educational software in the classroom. However, I have learned enough from experience to know that push factors do not automatically translate into instructional integration. I would summarize the following as my major lessons learned from experience with more than 15 years of computers in education:

- Begin with teachers' own classroom problems and concerns; do not begin with the technology or its promise. Because you begin with a clear problem, you can also begin by collecting baseline data, and hopefully you will be able to show improvement against these data if the Internet application that responds to them is sensibly chosen.
- Anticipate the need to demonstrate some sort of meaningful effectiveness, fairly quickly. Thus, choose a problem that is particularly important to teachers, and if a WWW application is a realistic help to that problem, build carefully and slowly on this. Treat this as a "trigger event" and collect examples of this effectiveness in local practice. Stimulate teacher networking as a way for exchange of personal experiences about the trigger event.
- Make it as easy as possible for teachers to use the Internet in the trigger-event context; walk through each step of the process with a teacher for him or her to make use of the WWW in the classroom. An intranet approach, with a connection to the Internet, for example, may remove many practical problems for the teacher, in that he or she can download WWW materials, prepare and adapt them in advance, and use them with better control and without time sensitivity in the classroom.
- Consider not putting the school computers only in a computer room, but instead look to the ideas of a "portable" computer room: a trolley of laptops that can be rolled into the classroom; a laptop with built-in modem that the teacher (and students) can take home for preparation; a convenient way (such as infrared) to connect to a network, or at least an Internet connection handy to the teacher's desk; and, most importantly, a transviewer device on top of the classroom overhead projector and as common as the overhead projector so that the teacher can use the computer with network connection for demonstration purposes as he or she teaches as well as for student access during project and individual work. This model (Moonen, 1996) would move us much ahead of the first-level problems that have confronted teachers' attempts to integrate computers in their lessons during the last decade. It may be that the computer-room model, with its heavy and bolted-down computers, will frustrate creative and targeted Internet use even more than it has frustrated computer integration.
- Support the enthusiasts; it is their energy which will stimulate creative applications and overlook frustrations. For the rest, the majority of the teachers, work soberly on the convincing trigger event application.

References

Collis, B. (1996). *Tele-learning in a digital world: The future of distance learning.* London: International Thomson Computer Press.

Collis, B., Knezek, G., Lai, W., Miyashita, K. T., Pelgrum, H., Ti., & Sakamoto, T. (1996). *Children and computers in school. Mahwah*, NJ: Lawrence Erlbaum Associates.

Collis, B., & De Vries, P. (1993). The emerging trans-European network for education and training: Guidelines for decision makers. Report prepared under assignment from the Task Force Human Resources, Education, Training and Youth (now DG XXII), Commision of the European Community, Brussels.

Moonen, J. (1996, July). *Many questions, and a few answers.* Closing presentation to the UNESCO Second International Congress on Education and Informatics: Educational Policies and New Technologies, Moscow.

Betty Collis is with the Faculty of Educational Science and Technology at the University of Twente, The Netherlands.