*A Conversation
with Carol Twigg*

*TWO VOICES FROM THE
FIELD: Interviews by John
Strange*

*Guest Editor John Strange
interviews two individuals
at the forefront of develop-
ments in educational
technology.*

*In the first interview, Carol
Twigg, of EDUCOM,
describes the implementa-
tion of a "national infor-
mation infrastructure."*

Creating and Building a National Learning Infrastructure

In 1994, EDUCOM initiated efforts to implement a national learning infrastructure. The need for such an infrastructure, as well as the strategies for creating and building such a structure were published in final three bimonthly issues of *Educom Review* for 1994. This interview with the principal author of Educom's strategy, Carol Twigg, Vice President of Educom, provides a summary of the need for a national learning infrastructure. The interview also details the strategies that Educom has developed to help move higher education toward a greater emphasis on cost-effective, student-centered approaches to learning, and it highlights what has happened since Educom began its efforts and how other colleges and universities can partici-pate.

Strange: Why is there a need for a national learn-ing infrastructure.?

Twigg: Higher education is undergoing enormous changes. At the turn of the century only 232,000 students attended college. That was less than one percent of the population. Just before World War II the number of stu-dents in colleges had grown to 1.4 million. Today there are more than 13 million college students. More importantly, higher education is facing tremendous growth in demand for its services as we enter the twenty-first century. New educational structures have emerged to accommodate this growth, but still greater changes are necessary.

Strange: In addition to growth in numbers, what other changes have there been?

Twigg: First, the expectations of what students

should learn has changed. We prepare students to think and work. Emphasis on work has been increasing. But work in the future will require more thinking. We are going to have to put less emphasis on mastering a body of knowledge, on remembering facts. We need to make sure that students know how to access information when needed. Remembering information is different from using it. The capacity to learn is essential. We must emphasize the development of critical thinking skills. We have claimed this as our province in higher education, but we have not focused on it as clearly as we will be need to do in the future. And we have not taken into account the changing environment in which we work and study, an environment that greatly increases access to information by electronic means.

Another change is in the technologies we have which enable student learning. Classroom based, 50 minute lectures are not the most efficient, or the most effective way to deliver instruction. We know that. But we have not changed.

We also thought previously that college would prepare students for a lifetime career. Our majors, our curricula in general, reflect that assumption. But we now know that all of our students are likely to change careers frequently in their lifetimes. Are our present educational structures adequate to prepare our students for careers, not a career? I think not.

And you cannot forget that the students are different now than they used to be. We talk about traditional students and non-traditional students. Traditional students are high school graduates attending college full time immediately after graduation, in residential settings. How meaningful are these terms when traditional students make up less than 25% of the entire post-secondary student population in this country?

Strange: You have implied that students are now older when they attend college, that they often are working at the same time?

Twigg: Yes. That is correct. And I wonder how well prepared higher education is to deal with these students when our measures of quality, our aspirations as faculty, have as a referent the traditional institutions with ivy covered walls that many of us attended.

Because our students are different, they are creating new demands that relate to when we teach. Looked at another way, they are expressing desires to learn at times consistent with their varied schedules. And they are coming back to us, or to other institutions including proprietary schools and institutions throughout their careers. The American Society for Training and Development estimates that by the year 2000, 75 percent of the work force will need retraining. What role will higher education play in providing that training?

Strange: If ivy covered walls is not an appropriate image for understanding where people learn, what is?

Twigg: Everywhere. At the office. In the home. In the factory. Under the sea. In malls, hotels, on trains. The university is no longer a place. But we still think of it in that way.

Strange: You mentioned earlier that new technologies were available to assist the learning process. Can you elaborate?

Twigg: Of course. That is a central part of EDUCOM's vision of what must be done in higher education as we seek to build a national learning infrastructure. Steve Ehrmann of the Annenberg/CPB project likes to point out that we live in a world rich in information, and rich in tools with which to use that information. But we do not know how to use those tools. We do not use them in higher education. In addition to video based tools for learning — computers, electronic communication

tools, networks that like us together and that link us with information — are beginning to have widespread use. But few of our faculty actually use them in their instructional efforts. That will have to change.

Let me also add that it is not just a question of the tools we have available. We know more now about how people learn. They do not all learn the same way. Howard Gardner, in his book *Frames of Mind: The Theory of Multiple Intelligences* suggests that there are at least seven intelligences. Two of these, verbal/linguistic and logical/mathematical have dominated the traditional pedagogy of western societies. But what about the other five: spatial, musical, kinesthetic, interpersonal, and intrapersonal? These are overlooked by our institutions of higher education as they design and deliver courses and curricula.

It seems clear to me that we must address all of these intelligences in order to be more effective in what we do. We must provide opportunities for learning that address the individual learning styles and approaches of the learners. That will require considerable change in higher education! But information technology provides the tools to enable us to make these changes.

Strange: How do we go about addressing these issues?

Twigg: Information technologies can help us address most of these areas in which change is needed. Until recently these information technologies were too expensive to be widely used. That is changing, has changed in many cases. But information technology must be used in new contexts in order to be effective. We must re-engineer instructional processes to take full advantage of the potential that technology offers. The old technologies, the 50 minute lectures in classrooms, are no longer satisfactory. We need a better system of learning for our students. We also need to create a support system for faculty willing to meet the challenges of teaching in new and different ways, and in many different places. This is what we mean by a national learning infrastructure.

Strange: You speak of the need for a new learning infrastructure. How does the new infrastructure differ from the old infrastructure?

Twigg: First let's look at what is central to the old infrastructure. The old infrastructure is organized to support the teacher. That's why we have characterized it as a teaching infrastructure, We find the individual campus, the isolated classroom, and the autonomous teacher who waits for his or her students to arrive and then teaches for fifty minutes. The institution, the space, the teacher are the centers of attention. Faculty interests dominate the design of the curriculum. They teach what they want to teach, what they can teach. Those are the issues that dominate the design of our curricula. Who is asking What is it that students need to learn? The new learning infrastructure seeks to make this the central question in the design of a curriculum. The new infrastructure will be organized to support the student, wherever that student is.

Strange: If I understand you correctly, the new infrastructure will shift our focus from the faculty to the student, and in so doing will open new opportunities to students for learning.

Twigg: That's right. In the new infrastructure the student occupies the central place. If the students are central, why do they have to travel to a place to learn? Why do the students have to be limited to only what the faculty at their particular institution can teach? Aren't you teaching students how to author multimedia products, John? That opportunity is not available to most students in higher education. Why should they be so limited? Why couldn't they take your course from wherever they are, whatever institution they go to?

Strange: Well, that sounds good to me. What other changes are needed to the old infrastructure?

Twigg: I have already spoken of how limiting the 50 minutes on alternative days, large group lecture model appears to be. But the current infrastructure is also very expensive to maintain, and even more to expand. Physical plants and their maintenance are expensive. The labor intensive, highly repetitive model of instruction which we use is also very wasteful of resources. If we have to adhere to a fixed teacher/student ratio, what will happen to our budgets when as many as 700,000 more students want to take our courses as in the case in California? Even more importantly, why do we perpetuate a model which suffers from severe shortcomings in student access and quality? Even when we can afford to?

Strange: You seem to be rather strong in your condemnation of the old model. What suggestions do you have for getting beyond the past, for implementing a new infrastructure of learning?

Twigg: I do feel strongly that the old model cannot serve us well as we enter the twenty-first century. It is too expensive and it is inefficient in many cases. We need to expand our thinking about new ways of delivering higher education. It seems to me that some of the characteristics of the future forms of higher education, of a new infrastructure will be the following.

First, although institutions of higher education will continue, they will be very different. Fixed plants, fixed instructional settings will diminish in importance. An effort will be made to expand learning opportunities spatially and temporally. Learning sites can be everywhere and instruction can occur at all hours. Technology will make this possible, but changed attitudes and changed structures will be necessary to implement these changes. The student will assume a more central role, the faculty a less central position. Faculty will lecture less, facilitate more. Students will move among institutions more often, and institutions will have to alter their notions of what constitutes its own student body.

Second, curricula will be outcome driven, not input centered. Curriculum development will begin by asking what students need to learn. Through a process of individualized assessment, we will find out what students already know and how they learn best. Technology will make vast quantities of information readily available. Learning materials will be modularized and will be delivered in a variety of formats which take advantage of all of the new electronic technologies. Evaluation will be an important component of these learning materials.

Third, the new learning infrastructure will support an information age pedagogical model where learning can occur anytime, anyplace, anywhere. Institutions will operate year-round. There will be no distinctions between regular classes, evening courses, and weekend offerings. Semesters and fixed class meetings will be a distant memory. Students will take as much or as little time as they need to complete the learning required. Just-in-time learning will become the norm. Students will access only those learning modules they find necessary, whenever and wherever they need them.

Fourth, a national learning infrastructure will empower students to be self-paced, independent scholars. They will be actively engaged in learning, not passive listeners to lectures. They will make use, through technology, of the rich information resources that are available, and they will often work collaboratively and we won't think they are cheating when they do.

Fifth, they will collaborate electronically. Physical contact will be less important for students. Video-based electronic contact across networks will increase.

Strange: Technology appears to be a critical part of your vision. I am not surprised since EDUCOM has always had technology as its central focus. Do you think the technology currently available is adequate to realize this vision?

Twigg: Not presently. One of the first tasks is to create a robust national information infrastructure. This will be the base upon which a learning infrastructure will be developed. Without that information infrastructure we cannot develop and distribute the interactive learning materials we need to improve the quality of education. The social and economic forces at work today are accelerating the development of the national information structure.

Strange: I am not sure what makes up that infrastructure. Would you explain it in more detail?

Twigg: We must begin to move toward an advanced broadband network such as that proposed by the Clinton-Gore administration. The network is essential to overcome the enormous costs associated with getting information to stand alone learners at many sites. They must be connected to all information, and to each other. The Internet is a forerunner of the new information infrastructure that is needed. By using Internet, e-mail, gopher, and mosaic we get a glimpse of what the future holds, but only a glimpse. It is only when the limited-bandwidth Internet expands to a widely accessible broadband network that we will have the necessary information infrastructure in place.

Strange: Let me interrupt you a moment. Am I correct that a broadband network would make transmission of multimedia data, that is audio, video, pictures, animations, fast and efficient? More data, in more complex forms, could travel farther faster?

Twigg: That's right John. Today's Internet is primarily text based. We need all those other data as well. But having the network is not enough. We also need entirely new instructional materials. Peter Drucker has said that in order for a new technology to be successful, it must do the old job ten times better. Currently there is no software at the collegiate level that even comes close to Drucker's requirement. We must also create, and make available on a national basis, high quality, self-paced, multimedia, technology based learning materials.

Strange: Can you cite any examples of instructional materials that have been developed, or that are under development.

Twigg: The best example of how a national body of learning materials might be created can be found in the CUPLE project in Physics, a project begun by the American Association of Physics Teachers. Participating physicists create instructional modules according to an agreed-upon standard. These materials are then reviewed by national peers before they become part of the instructional modules. Thus, both creators and users are assured of consistency and quality, and the result is a growing body of instructional materials that can be used in diverse settings.

I can't give you — yet — a good example of effective instruction materials that integrates evaluation in a meaningful way. But we must have built in assessment. Built in assessment facilitates individualization of learning, thereby improving quality. It also reduces faculty intervention, thereby reducing costs. But assessment can't be just of what students have learned. We must assess what they already know so that the proper learning modules can be selected. When learning is truly modularized, and assessment is regular, we will have made great strides in improving education. No teacher based learning environment is able to individualize learning in this way. That may be the greatest benefit of all from technology — the ability to truly individualize learning. We have yet to see college level products that fulfill

this promise. That is why we are so eager for the efforts we have begun in building a national learning infrastructure to move forward.

Strange: You keep talking about reducing faculty intervention in the learning process. Why is that?

Twigg: First, the cost. Approximately 80% of all costs of colleges and universities are personnel costs. Controlling costs means reducing the direct, personal intervention of faculty where that can be done without lowering quality, or when we can improve the learning process by doing so. The availability of a vast quantity of learning materials easily accessible via the network will make possible the creation of new kinds of learning environments. Students will do more on their own, more effectively. Faculty intervention will be directed to those areas where it is most useful. In this way quality can be improved and costs contained.

Strange: Are others in higher education making challenges similar to those you are making?

Twigg: Yes, a number of educators such as Alan H. Leader, Dean of the School of Business at Southern Connecticut State College, are speaking out on this issue. Leader recently reminded us that "The purpose and outcome of our educational enterprise is learning, not teaching." Others are saying similar things, insisting that we identify the value we add to a student's knowledge and abilities rather than describing where he or she sat and for how long. You have been urging colleges and universities to address the issues of technology and education in your talks and lectures. Joseph Burke, the Provost of the State University of New York recently predicted that catastrophe is certain, if education — both higher and lower — becomes obsolete as it clings to a talking technology for teaching that its own researchers describe as inefficient and ineffective. Some things are beginning to happen.

Strange: But will that be enough?

Twigg: Of course not, but at least there is some movement. The real challenge is to move rapidly ahead in building the advanced technological infrastructure. We at EDUCOM are trying to move that effort along as rapidly as possible. We believe that higher education cannot create the new learning infrastructure alone. There must be partners in the process. We see four partners as necessary: leaders of higher education, public policy makers, publishers, and digital companies.

Strange: Explain how these groups will participate. For example, do you think higher education's leaders have a vision for change?

Twigg: In his book, *Future Edge*, Joel Arthur Barker makes a relevant distinction between management and leadership: you manage within a paradigm, but you lead between paradigms. Most of higher education's leadership is managing in a paradigm. What we need are leaders to move us toward tomorrow's paradigm. Administrators sometimes blame faculty for their inability to bring about changes. But the changes which are necessary to bring about a national learning infrastructure are at the institutional level. Individual faculty, even where there are several faculty members at work trying to implement change, cannot do it. The National Science Foundation has spent literally millions of dollars on awards to individual faculty members to improve individual courses at individual institutions. And in the 1980s IBM spent additional millions funding more than 3,000 individual faculty projects in its Advanced Education Projects. Both NSF and IBM meant well, but both programs failed to achieve systemic results that went beyond those individual classrooms.

By comparison, the NSF's advanced networking program began with a vi-

sion of a national high-speed communications network, and leveraged federal dollars to stimulate public/private partnerships to build it. This strategic approach has led to the creation of the Internet as we know it today.

Higher education needs to begin with a clear vision of what it is trying to accomplish in the field of technology-mediated learning. Too often discussions about the integration of technology and instruction begin with the question "Why hasn't it worked?" This is usually followed by "How can we get them to use it?" Technology is an enabling mechanism. It is not an end in itself. Until institutional leaders can clearly state why we want them to use it, or what we want them to use it for, we will fail to make significant progress.

Strange: Where do the publishers' digital companies fit in, assuming higher education can change?

Twigg: Without the systematic involvement of the publishing and digital industries, the ad hoc application of technology to learning by individual faculty members will remain the norm. The difficulties of sustaining ongoing product development and consistent quality control under these circumstances are insurmountable. The involvement of those whose business it is to develop, produce, distribute and market educational products is critical to the development of a national learning infrastructure.

But at the same time we have to help those companies understand how to create a market for their products. One thing is clear, the products have to be based on open standards, easily transferred across hardware platforms, operating systems, networks, and institutions. Proprietary is out in the new world. And this must apply to institutions of higher education as well as to the hardware and software producers!

Strange: And what about public policy makers?

Twigg: Public policy makers play a major role in creating a climate for change. One of the largest inhibitors to a learning infrastructure lies in our current definition of academic quality. Quality in higher education is defined primarily by measuring institutional inputs — the number of full time faculty, the number of books in the library, the number of students in a class, the amount of contact between students and faculty. In the public policy arena, we find regulations and funding formulas based on this paradigm of quality, in the form of FTE counts, contact hour definitions, and financial aid requirements. We need to develop new strategies at the public policy level for stimulating new approaches to instruction and for measuring institutional effectiveness.

Strange: I can tell that you are excited by the movement toward a national learning infrastructure in just the first few months after EDUCOM launched its initiative. I gather it is well underway.

Twigg: Absolutely. We have over eighty partners already involved in the initiative's work. But let me make clear, John, that the initiatives we have undertaken are part of a process. We are not creating an institution, a program, a thing. We hope to stimulate new partnerships which will look at things differently, which will generate the synergism that will bring about the fundamental changes and lead us to a world in which learning truly becomes learner centered, and in the process becomes more efficient, more effective, and less costly. That has already begun to happen. Publishers with unpublished products because they could not see a market have begun to talk with potential users who can constitute that market. Colleges with specific publishing and software needs have sparked interest in those providers in designing materials that will meet the needs of a cross section of higher education.

These events are happening. As they expand, the infrastructure will move forward. The partnerships are what are important. No single player can bring about the new learning infrastructure alone!

Strange: What are you doing first?

Twigg: First, we are identifying the areas in which change can have the greatest impact. We are not trying to change everything. For example, the Maricopa Community College District with ten campuses and over 100,000 students in the Phoenix metropolitan area found that it offered some 2,000 courses. But forty-five percent of all student enrollments are in just twenty-five of the courses! If Maricopa can make instruction more effective and more efficient in these twenty-five courses, they will have a major impact on that institution. We want others to examine their enrollments, to see whether a similar situation exists on their campuses. Undoubtedly, much of the early work will be centered around large introductory courses, courses which constitute much of the enrollment in our institutions.

Strange: You have emphasized the importance of partnerships. How does that work.

Twigg: Participants in the National Learning Infrastructure Initiative publish RFPs. In our terminology that stands for Requests For Partners. Let me cite just three examples so you will see what I mean.

The University of Michigan is seeking partners to work on developing object-oriented procedures that will result in the creation of instructional and support modules that are compatible with each other, and are designed to knit seamlessly with one another. Michigan wants to provide the programming support. It wants help in the development of the curricular and support modules. The outcome will be modules that fit in all learning environments, and make the instructional environment more robust.

Rensselaer Polytechnic Institute is seeking partners to develop its notion of studio courses, an outgrowth of the CUPLE project of which I spoke earlier and now extended to other disciplines beyond Physics.

California State University is also seeking partners to develop and publish a common set of definitions for the infrastructure required to support new learning environments which will be learner centered, and consequently dispersed, but at the same time institutionally based to a large extent.

These are just examples. What we want to help make happen is to facilitate the development of partnerships that will produce learning outcomes equivalent to or better than what can be achieved by traditional methods; be modularized to allow for flexible use on the part of diverse institutions; incorporate examples appropriate for student audiences ranging from teenagers to mature working adults; be available in a variety of formats corresponding to different learning styles; be constructed so that learners weak in only a portion of the topic have to complete only the material that addresses their particular deficiency; include a pre-assessment component to ascertain learning style and point of entry and post-assessment to certify that learning has occurred; be network accessible; and be based on non-proprietary, system independent technological standards.

Strange: That is an enormous undertaking!

Twigg: Absolutely. That is why partnerships among higher education leaders, the print and digital publishers, and the public policy makers are so important. By getting them together, taking, stimulating new ideas, we feel confident that we can move forward to the new learning infrastructure we believe is so important.

Strange: How does an institution, or a business, become a partner?

Twigg: I would suggest that anyone interested in membership first review our page on the World Wide Web on Internet. It can be found under educom.edu. Or call the Washington, D.C. office of EDUCOM (202-872-4200; Fax 202-872-4318). Institutional membership is $5,000 annually. Meetings are held twice a year. The partnerships that emerge hold their own meetings and pursue their efforts where and when it is appropriate to do so.

Strange: You have excited me about the prospects for the development of new partnerships that will create the technology based learning materials so necessary to take advantage of the powerful new technologies that surround us. Thank you for sharing your ideas and insights with us.

Twigg: Thank you, John. EDUCOM looks forward to even more partners in this effort. We will all be surprised, I think, by the serendipitous results of these activities.

Is your institution a metropolitan university?

If your university serves an urban/metropolitan region and subscribes to the principles outlined in the Declaration of Metropolitan Universities printed elsewhere in this issue, your administration should seriously consider joining the Coalition of Urban and Metropolitan Universities.

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