REMARKS BY DR. G. WAYNE CLOUGH
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It is an honor to address the Association of Library and Information Science Educators and to provide the perspective of a university president following Dr. Norris's predictions.

Predicting the future is always a little risky. In the late 1940s, IBM's Tom Watson predicted that the world would need about six computers total. In 1977 Ken Olsen of Digital Equipment Corporation said that "there is no reason for any individual to have a computer in their home." Even Bill Gates of Microsoft was heard to say in 1981 that "640K ought to be enough for anybody."

Just last month, Dr. Larry Smarr, who helped create the Web browser and is one of the world's most respected computer technologists, suggested that the Internet is evolving into a single, vast computer fashioned out of billions of interconnected processors. He sees a future in which billions of Internet-connected computers and sensors overlay the real world and enhance every human activity. And he says the real question is whether this vast, planetary supercomputer will become self-aware and emerge spontaneously as a thinking machine. My own observations about education will probably sound tame by comparison.

What Dr. Norris calls the "Knowledge Age" presents both challenges and opportunities for universities and libraries. We are both traditional institutions who now face major adjustments not only in our technology but also in our thinking. As institutions for whom change has traditionally been slow, we are now faced with the need to respond to a world where change is resolute and unwavering. We have to find the means to deal with these circumstances, while not losing sight of the fundamental traditions that have sustained us over two thousand years.

But if we can do that, there are great opportunities for us. To function well in the Knowledge Age, you have to have both the "I" and the "T" of IT. It is not enough just to have whiz-bang technology; you also have to have the information or content. As universities and libraries, we specialize in educating students in the difference between information and knowledge, and that skill is becoming increasingly important. To quote *New York Times* writer David Bouchier, "The world wide web is no substitute for a library, because it has no librarians in it." Even as information goes online and technology takes over many tasks of the traditional librarian, the increasing need for people who can manage information and make sense of it will open tremendous new opportunities.

More than a year ago John Chambers, CEO of the high-tech superstar Cisco Systems, predicted in the *New York Times* that "education over the Internet is going to be so big it is going to make e-mail look like rounding error." And that is one prediction by a technology CEO that is likely to prove true.

The U.S. Department of Education says that nationwide 1.6 million students are enrolled in online courses. Michael Zastrocky, vice president for academic strategies at Gartner Inc., a technology consulting company, projects that by 2004, 75 percent of college students will have

taken a course online. Gartner predicts that 60 percent of universities worldwide will offer online courses by 2002 and 80 percent by 2004.

Those numbers include library and information science education. For example, it is now more than a year since the University of South Connecticut began New England's first online master's of library science, integrating library science, information science, and instructional technology.

Online learning undermines the monopoly of geography, which is both a threat and an opportunity for universities and libraries. It erodes the traditional constituencies who were bound to us by geography, but at the same time it opens up vast new constituencies who were once impossible to reach.

As Dr. Norris noted, the advent of online learning also means we face new competition. Cenquest, for example, provides accredited web-based graduate business courses and degrees, and works with corporations to provide their employees with education opportunities that are easier and cheaper than traditional brick-and-mortar college programs. This company is only one of many emerging providers that compete with universities. Some have become partners with universities in placing their courses online.

Information has become a commodity, and we universities and libraries who deal in it have to learn to think more like a commodity business. In other words, we have to make our traditional offerings more competitive, and at the same time develop new offerings based on value that will increase both our margins and our markets.

Much online education deals in master's degrees and professional specialty programs. And Georgia Tech is no exception. We introduced the nation's first online master's degree in mechanical engineering more than a year ago, and have put several other engineering masters online since then. These programs are not simply the same old curriculum dumped into digital format, but have been developed specifically for Internet delivery.

Our goal is to follow our graduates and others who need our services through their careers, continually designing and redesigning online education programs so that no matter where they are or what they need, they can always come back to us for education. And within three years we will build a high-tech global learning center and an undergraduate learning center that are designed to allow us to deliver education creatively to every class of student in the future.

Delivering courses for master's degrees and other post-baccalaureate professional online is a particularly good fit both for universities and for students. For the student's part, online learning requires a high level of motivation, self-discipline, and personal responsibility, which lends itself to older students who are taking courses to bump up their careers.

From a university perspective, online learning is a good fit for master's and other post-baccalaureate professional courses, because in many cases it can be tailored to fit individual circumstances. While science and technology fields often require hands-on labwork, this aspect often can be taken care of in master's courses by short campus visits or work related experiments.

Challenging as online learning may be, universities face the additional test of bringing on-campus programs into the Knowledge Age. A couple of years ago, the well-known business consultant and author Peter Drucker predicted in *Forbes* magazine that "30 years from now, the big university campuses will be relics. Universities won't survive. It's as large a change as when we first got the printed book." And true to his word, Drucker recently joined the "faculty" of an e-learning company.

Another guru of online learning, president emeritus of the University of Michigan James Duderstadt, came to Georgia Tech last year and told us that traditional residential campus like ours simply may not be adaptable to the 21st century.

Other online educators point out that students in the traditional classroom can be looking at the professor, but who knows where their minds are. In contrast, online students can't progress through the course without engaging with the subject matter. They don't get to the end of the lesson unless they do the work.

Of course, there are always two sides to every coin, and on the other side of this coin are people like David Noble of York University, who complains that universities are in danger of becoming "digital diploma mills." He says, "It is a sign of our current confusion about education that we must be reminded of this obvious fact: that the relationship between people is central to the educational experience."

Stephen Talbott, a former software programmer who publishes his *NetFuture* newsletter on the Internet, nevertheless says, "Digital technologies encourage us to abandon whatever vestiges of community are left to us. This is a disastrous loss, since our encounters with others and with the world are the primary matrix for all human growth and development."

Actually, campus-based higher education needs to be somewhere in the middle between these two sides, blending the best of both worlds. Higher education does have a higher calling, which is what distinguishes it from mere vocational training. Even James Duderstadt had to admit, when he came to our campus, that educating the "whole person" has become more crucial than ever in this age of technology, and that it can be done best on residential university campuses.

For their part, the technology skeptics have had to admit that the attention spans of students have become so short that even bright students are failing exams based on hour-long lectures. A National Science Foundation study calls today's students the "MTV generation" that has grown up with IT, and points out that even though their attention spans are shorter, they have an uncanny knack for multi-tasking.

Our goal at Georgia Tech is to conserve the traditional rootstock that gives value to higher education while at the same time grafting on leading-edge educational technology to serve today's students. It's kind of like the wineries in the Finger Lakes region of New York. They did not uproot their traditional rootstock in order to plant the more exotic grapes that consumers wanted. Instead, they grafted the newer exotic vines onto the old rootstock, which had proven its

enduring value and vitality over the years. It was important to keep the sturdy older stock viable so that when, and if, the time for a new approach was needed, it was still there to build on.

The Internet is an incredibly powerful and capable tool, but it is still a tool. And it becomes useful when you use it as a tool within a larger structural context. Our goal at Georgia Tech is to preserve the rootstock of the enduring core values of higher education, while at the same time changing our expression of those core values to fit the demands of the Knowledge Age.

Georgia Tech is a traditional university in the sense that we are 115 years old and have 15,000 students – 11,000 undergraduates and 4,000 graduate students – in a residential campus setting. Two thirds of our students live on campus, and we continue to experience strong growth in applications from students who see tremendous value in getting their educational experience up-close and personal rather than in a strictly virtual environment.

At the same time, we are a highly technological university with 1,700 miles of fiber-optic cable on campus, and data ports everywhere. In addition, an arrangement with BellSouth gives us comprehensive wireless environment.

We require every student to have a computer that meets certain specifications, and we have revised the entire on-campus curriculum to incorporate web-based enhancements. We have courses, such as English composition, in which students work on group projects in online chat-rooms, which not only gives students documentation of who said what, but also allows professors to see quickly whether the students understand the material and how much work each student contributes to the project.

We also use the Internet for on-campus classes that meet in a certain classroom at a certain hour of a certain day. For example, our College of Architecture offers a joint design studio course with Stanford University in which the students meet simultaneously in classrooms on both campuses and are engaged with each other and their professor in a live, interactive, online setting.

This blend of online and classroom education also enables Georgia Tech to offer degree programs at remote sites around the world. We have physical operations and faculty onsite in southeast Georgia; Metz, France; and Singapore, and we offer bachelor's and master's degrees at these places. Internet technology allows students at these locations to take courses taught on the GT campus, as well as students on our main campus in Atlanta to take real-time online courses taught at these "remote" sites.

We are constantly seeking the right mix of educational delivery. To this end, a few years ago we surveyed our students on campus and discovered that they felt like stenographers in class – frantically trying to write down every thing the professor said or wrote on the board. They didn't have time to think along the way, let alone ask a question, and when they reviewed their notes later, they sometimes realized they didn't actually comprehend what the professor was talking about. So we developed the e-classroom, which we have since installed at several other universities at their request. It uses multimedia technology to capture the lecture itself plus any

information the professor projects or writes on a board, and makes it available online to students after the fact.

Most of our professors no longer hand out paper in class other than tests. Each class has a website where students can find all hand-outs, assignments, power point presentations, class notes, and after-the-fact solutions to homework and test problems. Some of our academic units, like the School of Electrical and Computer Engineering are engaged in a coordinated effort to digitize all the materials for their undergraduate curriculum for use by students on campus and off. These, and other new approaches we have introduced to our curriculum, were recognized in the presentation of the 1999 Theodore Hesburgh Award to Georgia Tech, the nation's top award for support of undergraduate teaching and curriculum innovation.

Many of our new initiatives may sound an awful lot like distance learning, and you may wonder whether students bother to show up for class if they can get all the information online from their dorm rooms. The answer is yes, they still come to class, and the digitized online video version of the lecture is used as a reference or study tool. They come because they value the opportunity to interact face-to-face with some of the world's leading scholars in the fields they are studying.

And our distance-learning students feel the loss of the first-hand personal interaction of the classroom and teaching lab. We have a master's degree student in mechanical engineering, for example, who goes to class on campus, then reverts to the online iteration of the course whenever her job sends her out of town. The reason she doesn't just do the whole course online is the value of the direct personal interaction. E-mail interaction with the professor and Internet delivery is slow and superficial by comparison.

At Georgia Tech, we regard our campus as a community of learners, all engaged in the discovery of knowledge at some place on the continuum. And our goal is to involve all levels of students and faculty together in education, in research, and in reaching out beyond our campus. As a result, many of our senior-level faculty who are engaged in break-through research also teach undergraduates and even freshmen in the classroom.

It works in the other direction as well. We believe that if we are to create a campus where human interactions underlie our teaching and learning, then all of our students, even our undergraduates, should be engaged in our research enterprise. And we are expanding our efforts with a major new initiative to support undergraduate research for the coming year. In fact, the opportunity to learn by working in the research lab of a professor who is at the forefront of creating knowledge is a powerful magnet that attracts outstanding students to residential education on our campus. It also is the means by which we create value above and beyond that which can be obtained from a virtual educational experience.

This cross-fertilization between the classroom and the research lab is one of Georgia Tech's rootstock values that deserves preservation in the face of the turmoil of our rapidly changing world. We are presently in the process of creating an endowment, which we hope to fund at the $10 million level, to sustain our commitment to undergraduate involvement in research.

This is one of the most important reasons I believe research universities like Georgia Tech that offer the larger university experience are in no danger of going the way of dinosaur in the next few decades. Indeed, if the United States is to remain pre-eminent in transforming knowledge into economic value, then American research universities must remain world leaders in generating new knowledge and making basic scientific breakthroughs, and that requires hands-on work in research labs between faculty and students.

While a case can be made that geographic location is not important to online learning, it is of great significance to the cutting-edge technology companies that are driving America's economy forward. High-tech economic development is remarkably concentrated and strongly focused on particular locations, and inevitably these locations are around a major research university.

During the course of my career I had the opportunity to live and work in Silicon Valley, the Research Triangle Park, and Seattle, before returning to Atlanta as president of my alma mater. All of these locations have vibrant high-tech economies, and while there are some differences in why they are successful, the common factor in each case is the presence of strong research universities. You will find Atlanta on every list of up and coming high-tech centers, and the presence of Georgia Tech, together with partner institutions Emory University, Georgia State University, and Clark-Atlanta University, is the driving force.

Research universities spin off new start-up companies based on discoveries from their labs. Georgia Tech's Advanced Technology Development Center is the nation's first university-based business incubator, and it is widely recognized as the nation's best incubator. Many of the dozens of start-up companies nurtured by the ATDC were begun by our faculty and employ our students. Location remains important for this to occur.

Research universities are also magnets that attract existing high-tech companies from other locations to take advantage of their expertise and the skilled workforce they produce. E-mail is not enough for these companies. They want to be able to walk across the street and engage professors and graduate students on-site in their research labs.

So, even though a lot of learning in this Age of Knowledge is taking place in a virtual environment, the creation of new knowledge and the driving forces of the Knowledge-Age economy are very literal activities. And they take place at research universities where faculty and students are engaged together in hands-on processes.

I would like to conclude with one more example of the need to preserve the valuable rootstock of higher education even as we graft on exotic new strains of technological expression. Dr. Norris mentioned the growing role of corporate sector and professional associations in education, and we are experiencing that at Georgia Tech as well, but it has a curious twist to it in this age of online learning.

Our largest college is engineering – Georgia Tech graduates more engineers than any other college or university in the nation. And what engineering firms and professional associations are emphasizing to us is the importance of instilling in our graduates not just engineering knowledge, but an understanding of what it means to practice engineering.

The teaching of the practice of engineering occurs at the cusp between theory and practice, between the classroom and the real world. It is not easily done in person let alone over the Internet. It is generally best done by faculty who have had hands-on experience in engineering practice, teaching well-designed capstone courses that draw together the threads of a student's education and apply them to practical projects that challenge the student in as many aspects of engineering practice as possible. And they work best in a face-to-face, hands-on setting that enables a rich discourse to occur between student and professor as solutions are considered and worked out.

The teaching of engineering practice also provides an opportunity to develop the ability of students to work in teams, which is a critical skill in the workplace, but is very difficult to cultivate in an asynchronous online learning environment. The book on *The Social Life of Information* by John Seely Brown and Paul Duguid, which Dr. Norris has referenced, contains a chapter on the importance of practice that makes the distinction between "knowing that" and "knowing how." "Knowing that" comes from accumulating information which can easily be done online; "knowing how" comes from hands-on practice.

Practice involves the ability to put your knowledge to work in a bigger picture. It develops an ability to define the problem rather than just have it handed to you, an ability to work in teams across disciplines and differences, an ability to compromise within time constraints, to deal with political pressures, to appreciate ethical considerations, and to have an understanding of one's civic obligations. These are some of the rootstock values of higher education that define our higher calling and distinguish higher education from vocational training.

Educational technology has had, and is having, a remarkable effect on the way we do business in universities. It is opening up new educational markets, offering ease of access to information, enriching traditional educational processes, speeding the influence of research findings, enhancing communications between faculty and students, and enabling students who cannot return to campus to take courses and degree programs. We at Georgia Tech are working to take advantage of the positive aspects of this technological revolution.

But after all is said, the fundamentals of the educational process have yet to change. More and more students continue to seek out the traditional educational experience, research continues to require on-site effort to be effective, and leading-edge economic development thrives best in proximity to a university. If we seek to build the future of the university based on recognition of what technology does well and does not do well, we will continue to see a vibrant future.