LETTERS

Internet as Teacher: Is it a Virtual Improvement?

The ever-growing labyrinth known as the Internet is being touted by many quarters. Politicians and educators alike claim the necessity of universal Internet access and warn of the problem that too many are denied access. Grade-school children are taught how to surf the Web while university professors draw students into the Internet like politicians gather votes, making grand promises and assurances of better education. Virtual classrooms and even virtual universities are proliferating. Yet a significant number of people are denied access, due to financial limitations or simply to being in the "wrong" school district. To underscore that the problem is real, it has been given a name: "Digital Divide."

New funding initiatives appear continually for "technology in the classroom." However, these initiatives make little or no mention of research, improved teaching, or better learning. Technology should enhance teaching, not obscure learning. But with many students held in the glare of the monitor like moths in the porch light, comparisons are now being made between drug addiction and Web addiction.

Consider the university that extols the virtues of the exciting new shopping mall, and even forces students to go there by placing its bookstore inside. The university then boasts publicly that every graduate visits the mall. I hope this university exists only in my imagination, but the proliferation of Internet vendors puts the brick and mortar in this parable.

Should a class studying low pressure and vacuum be sent to the local Hoover vacuum supplier? Should a lecture on gas mileage and economy be accompanied by a visit to the used car dealership? With vendors buzzing across Web pages like mosquitoes on a summer night, this exact scenario is played out daily in the classroom.

Virtually anything can—and does—appear on the Internet. Creation of a Web page, with links to any other page, requires only a computer with a modem, a phone line, and an Internet service subscription, which can cost less than twenty dollars per month, or is even "free" if one is willing to endure the increased advertising. Beyond a hypothetical disapprobation from the Internet provider, content is not censored or controlled in any way. Compare this to a textbook sold by a major publisher. The authors are chosen with care, and must be authorities; the book undergoes expert review; and additional revisions are often made in subsequent editions.

Although there is no denying the usefulness, even the necessity, of the Los Alamos National Laboratory's e-print server (http://xxx.lanl.gov) and similar scientific servers, these are the exceptions, not the norm.

With legislation looming to force more and more people onto the Internet, the question is, Is the Web a valuable source of knowledge or a glitzy new form of yellow pages? My daughter recently asked me about europium. Knowing almost nothing about it, I went to a search engine and typed in the word, found five vendors that sell it, but retrieved little other information. I reported to my daughter that it costs about $100 per ounce. She was not impressed, and the next day asked me again what physicists do.

Huge sums of federal and state dollars are being spent to incorporate Web use in the classroom. I suggest putting these funds toward creating more teaching positions, buying laboratory or demonstration equipment, modernizing classrooms, or subsidizing tuition; or for scholarships, book allowances, or even new blackboards.

As professor and department chair I am forced to provide, by action or inaction, guidance in Web-based education to students. Due to the rapid commercialization of the Internet, its value to education is being compromised. I hope we can channel our finances and our creative energy toward a real improvement in education, and not a virtual one.

Richard Hammond
(rich_hammond@ndsu.nodak.edu)
North Dakota State University
Fargo

Letters submitted for publication should be sent to Letters, PHYSICS TODAY, American Center for Physics, One Physics Ellipse, College Park, MD 20740-3842 or by email to ptletter@aip.org (using your surname as "Subject"). Please include your affiliation, mailing address, and daytime phone number. We reserve the right to edit letters.

Causal Discussion of Superluminal Pulses

Recent observations of "superluminal" light pulses were widely reported in the news media. Some reports noted that the observations do not contradict Einstein causality, but others were misleading. For example, one began by announcing that "scientists have apparently broken the universe's speed limit." Another unfortunate circumstance has been a cavalier derision of the work by other physicists.

In his "What's New" column on the American Physical Society's Web site, Robert Park[1] asked, "Whoa, is this the old phase-velocity stuff that has confused generations of physics students?" No, it is not. It is the group velocity that is found to be greater than c (the speed of light in a vacuum). A month and a half later, Park said,[1] "Charles Bennett at IBM Watson points out that this is little more than a confused rehash of an old story, where the peak of the wavepacket leaving the 'superluminal' medium is causally related to just the leading edge of the wave packet entering the medium." I would like to offer a different perspective.

Generations of physics students have been assured that, when the group velocity is either greater than c or negative, a pulse will be so distorted that group velocity is no longer a meaningful concept. (The implication that there would otherwise be a conflict with special relativity is incorrect, because the group velocity is not a signal velocity.) But

continued on page 81

© 2001 American Institute of Physics, S-0031-9228-0102-220-7

1972 to accept a half-time teaching position. He became a full-time professor in 1985. Over the years, the laboratories with which he was associated produced an astonishing variety of experiments that included electron resonance studies of gas-phase atoms, paramagnetic resonance spectroscopy of disordered materials, Mössbauer spectroscopy of solids, atomic beam studies of gas kinetics, and laser magnetic resonance studies of simple atoms that extended into the far infrared. Simultaneously, Virgilio and his students and collaborators were actively engaged in the related theory, particularly in the use of self-consistent field theory to calculate atomic magnetic moments and in the use of analytic and Monte Carlo modeling to analyze spin resonance spectra of disordered materials. Many researchers worldwide sought his expertise.

Considering his level of engagement in advanced research, Virgilio was remarkably active in teaching at all levels; he held his last class just a few weeks before his death. His four one-semester introductory courses for physics majors at UNAM were notable for their use of experiments that related specifically to the needs and resources of Mexico. Many of his former students are now in academic and research positions throughout Mexico. Moreover, he was also the leading author of numerous textbooks written for Mexican students in the secondary schools and in the early years of college. In those books, he stressed the importance of observation, using, for example, many experiments of his own design that could be conducted using local resources. He also made important contributions to the public understanding of science through his popular articles and his book *To Catch a Photon* (Fondo de Cultera Economica, 1992).

In 1991, the Sociedad Mexicana de Física awarded him the Academic Medal for his contributions to the development of physics in Mexico.

A warm and humane man who cultivated the friendship of his colleagues, Virgilio fought to establish an attitude of tolerance everywhere in Mexico, especially in his beloved UNAM. He will be missed by all who knew him.

Jose Jiménez-Mier
Eugenio Ley-Koo
National Autonomous University of Mexico
Mexico City
Jens Zorn
University of Michigan, Ann Arbor ■

Letters

continued from page 14

in 1982, experiments were reported[2] in which pulses passed through an absorbing medium with little distortion and with a group velocity that "exceeds 3×10^{10} cm/s, equals $\pm\infty$, or becomes negative." During the 1990s, Raymond Chiao, Paul Kwiat, and Aephraim Steinberg studied faster-than-*c* effects in the tunneling of single-photon wavepackets.[3] Their experiments answered longstanding, subtle questions about how long it takes for a particle to tunnel across a barrier.

The experiments by L. J. Wang and colleagues,[4] which attracted much of the recent publicity, demonstrate that the peak of the exit pulse can emerge from an amplifying medium before the original peak enters it, and this can occur with essentially no amplification, absorption, or pulse distortion.

Rolf Landauer, Thierry Martin, and others discussed related phenomena in the early 1990s for particular types of wavepackets, and Gerhard Diener[5] in 1996 presented an especially clear analysis and proof that causality is preserved. While the possibility of reconstructing the complete pulse from an infinitesimally small tail might be regarded as an old story, it is certainly worthy of further study, especially in connection with quantum noise. I suspect that many physicists would agree with Landauer's comments[6] that "the easy explanation [that the whole transmitted wave comes from the front end of the much larger incident wave] is unsatisfying," and that "our understanding of this is not what it deserves to be."

References

1. http://www.aps.org/WN/WN00/wn060900.html and http://www.aps.org/WN/WN00/wn072100.html.
2. S. Chu, S. Wong, *Phys. Rev. Lett.* **48**, 738 (1982).
3. See, for instance, R. Y. Chiao, A. M. Steinberg, in *Progress in Optics,* E. Wolf, ed., vol. 37, Elsevier, Amsterdam (1997), and references therein.
4. L. J. Wang, A. Kuzmich, A. Dogariu, *Nature* **406**, 277 (2000).
5. G. Diener, *Phys. Lett. A* **223**, 327 (1996).
6. R. Landauer, *Nature* **365**, 692 (1993).

Peter W. Milonni
(pwm@t4.lanl.gov)
Los Alamos National Laboratory
Los Alamos, New Mexico

Origin of 21-Micron Emission Feature Is a Mystery

The proposed identification of the mysterious emission feature at 21 microns with titanium carbide nanoclusters (Physics Today, June 2000, page 21) is certainly a major news item in astrochemistry. However, no mention was made of the feature's initial discovery or of the 10 years of intensive research into this problem by astronomers and laboratory spectroscopists. Since 1989, when the 21-micron emission feature was discovered in four protoplanetary nebulae observed with the Infrared Astronomical Satellite,[1] many carriers, including large polycyclic aromatic hydrocarbon clusters, hydrogenated amorphous carbon grains, hydrogenated fullerenes, and nanodiamonds, have been proposed. These earlier suggestions were based in part on the great abundance of carbon observed in all of the nebulae that exhibited this emission feature.

The recent precise measurements of the feature's central wavelength (20.1 microns) and line profile based on observations by the Infrared Space Observatory[2] preceded the laboratory identification and made a definite identification possible.

Contrary to the impression given by the article that there are only two such objects, we have found 12 objects showing this emission feature, all belonging to a new class of celestial objects called proto-planetary nebulae. Why the 21-micron emission feature would be limited to such a short phase (a few thousand years) of stellar evolution is not understood.

Although the laboratory spectroscopy of titanium carbide clusters is a significant piece of work, it may not represent the final solution to the 21-micron feature mystery. A recent study has suggested that the feature can originate from out-of-plane bending modes of carbon rings with one carbon atom replaced by oxygen.[3] Since the stretching and bending modes of aromatic hydrocarbons are commonly observed in proto-planetary nebulae, this suggestion is not unreasonable. Whatever the carrier of the 21-micron feature turns out to be, large-scale molecular synthesis leading to the formation of large organic molecules certainly can take place efficiently even in the low-density circumstel-