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Too Often, Educators' Online Links Lead to Nowhere

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It's one of those annoyances about the Web that make some teachers wonder why they bother.

After spending hours over the summer searching online for material to enhance their courses, then bookmarking the links on their computers or assembling them on class Web sites, teachers later find that many of the links no longer work.

"It's very frustrating—when you find a great activity, a Web quest, or research, and you go to the Web site and it's down," said Kelly L. Luton, who teaches Spanish at the 4,200-student Robinson Secondary School in Fairfax County, Va.

Often a site's unresponsiveness, moreover, isn't just temporary. Every day, educational Web pages pointed to by millions of hyperlinks are erased by their owners or moved to a different online address, leaving only confusing "Not Found 404" or "DNS error" messages—Internet-speak for "no one's home."

"Link rot," as the phenomenon is called, has turned the Web into the world's biggest piece of Swiss cheese: appetizing, but full of holes. Indeed, frustration with link rot led two University of Nebraska professors to publish one of the first-ever studies on its effects in the education world.

John Markwell, a professor of biochemistry, and David W. Brooks, an education professor, had collaborated to create a Web "textbook" out of links for three graduate-level chemistry courses for high school teachers, starting in August 2000.

"My original vision was that there are thousands of these sites put up by people who are teaching courses and putting their materials online, and if you could interact with all this material, it would be the equivalent of a textbook," Mr. Markwell said.

The professors carefully monitored the 515 original links they had collected pointing to scientific content or related pedagogical materials. To their disappointment, the collection eroded steadily, so that after 27 months, one-third of the links were extinct.

Overall, they calculated, the links had a half-life of 58 months—that is, half of them on average would be nonfunctioning by the end of that period.

'Lack of Certainty'

Mr. Markwell and Mr. Brooks found several reasons behind the failure of the science-education links.

To begin with, some of the Web pages they linked to were created by professors for use in courses, and as their course lineups changed the next semester, they would overhaul their pages and establish new Internet addresses. Or a page was produced by a graduate student who deleted it upon graduation.

Sometimes, education companies, scientific groups, or government agencies would reorganize their sites and rename file folders, perhaps after buying a new computer server, without putting up a redirect link to alert visitors.

Another fate—rare but worrisome for K-12 teachers—that can befall an educational link is that the Web address is purchased by a pornographer with no warning. The practice sometimes is called "porn-napping," for pornography kidnapping.

The two Nebraska professors experienced that phenomenon.

"We had a site on how to make yogurt with different bacteria; all of a sudden, they weren't making yogurt anymore," Mr. Markwell quipped.

Mr. Markwell said his research has dimmed his hopes for widespread use of Web textbooks—at least ones that teachers create themselves.

"If I were teaching in a K-12 setting," he said, "I'd be more likely to use a commercial site that provides stable material and material that has walls around it, rather than open, distributed resources."

On the positive side, Mr. Markwell has been able to replace the dead links with other good Web resources. He spends about three hours a month doing that for the three courses.

Still, in the paper on link rot that he and Mr. Brooks published on the Web and in similar form in the *Journal of Science Education and Technology*, they concluded that "although Internet resources may be freely available, there is a lack of certainty that they will be available for students next month, next semester, or next year."

Testing Teachers' Patience

In the precollegiate world, rotten links seem to be causing the most frustration among teachers who are inexperienced in applying the Web to instruction, say teachers who train other teachers in online skills.

Especially vulnerable are older teachers, said Ms. Luton, who has taught for five years. She uses the Web in her courses and has trained other teachers in the use of technology.

"They have a higher level of frustration than a new teacher coming into the profession," she said of classroom veterans. "Older teachers, they're so discouraged by it, chances are they won't go back to the Web."

Teachers who tend to be less flexible also are bound to suffer headaches from link rot, said Bernie Dodge, a professor of educational technology at San Diego State University. "It's the same kind of teacher who isn't able to go with the flow when their schedule changes at their school," he said. "They're the same ones who are angst-ridden when a link goes bad."

Mr. Dodge is one of the pioneers of the "Web quest," a popular instructional activity in which students go to Web sites selected by a teacher to search for information to answer questions or complete an activity, such as writing a letter to a member of Congress.

He hit upon the idea while teaching prospective teachers in 1997. The approach, he believed, was more targeted to the curriculum than broader Web "scavenger hunts" or Web surfing.

Web quests require considerable thought and planning—which is why many teachers swap them like lesson plans with other teachers via online discussion groups.

But the value of those swaps is diminished by the time and effort required to check Internet links.

Bryan T. Sweasy, an English teacher and "Web master" at the 600-student Lloyd High School in Erlanger, Ky., thought he'd hit on a great online quest that made better use of both his and his students' time. He built a weeklong activity around a series of Web pages hosted by cnet.com, a technology publisher. Starting from Mr. Sweasy's Web page, students would click on links to two or three pages each day, read them, and answer three questions about the topic.

"I put this together so I wouldn't have to lecture to them for weeks about the Internet," he said. "I felt [the information] was always going to be there."

But, he said, "the next year I went to teach that unit and found that those pages were gone."

Fleeting Links

Training and experience in using the World Wide Web go a long way toward making teachers appreciate its changeable nature and adopt appropriate ways of dealing with link rot, technology experts say.

"The more comfortable teachers are with technology, the more they expect links to be fleeting, and they have strategies for searching that are under their belts, so that they can replace those links," said Carol E. Edwards, the director of programs at the NEA Foundation for the Improvement of Education, a grantmaker funded by the Washington-based National Education Association that supports programs that prepare teachers to use technology.

Teachers can learn to recognize which Web resources are "likely to stay in existence more than others," Ms. Edwards said.

For instance, the University of Nebraska professors found that the attrition rate for Web pages in the dot-com and dot-edu domains were significantly higher than pages in the dot-org and dot-gov domains, which are from nonprofit and governmental hosts.

Ms. Luton recommends that teachers "be very judicious in the kinds of sites you point to—never point to somebody's personal-hobby site, a student site, or on a free Web provider like Geocities," because "they come and go very quickly."

Furthermore, teachers need to check their links as part of routine preparation for class—and for that, they need time. Ms. Luton spends an hour or two each week checking her links.

And she always has a "Plan B" in case a crucial Web link has disappeared, a strategy that also serves her well in case of other calamities, such as when the district computer server shuts down or filtering software mistakenly blocks out educational materials.

To back up her classes' online quests, Ms. Luton also keeps a stash of manila folders with hard copies of the Web pages students need.

Other tips come from Kathleen B. Schrock, who maintains "Kathy Schrock's Guide for Educators," a site she started in 1995 that has become world-famous among teachers, offering more than 2,500 links.

"I'm the queen of link rot," she joked.

Ms. Schrock, the technology administrator for the 750-student Nauset Regional Middle School in Orleans, Mass., said links must be checked thoroughly every semester. "Assume you can identify links for a term," she advised, "then you'll have to go back and check those links."

To check her 2,500-plus links, Ms. Schrock uses link-checking software, often called content-management software.

Also, experts said support from a school technology coordinator and a library media specialist can greatly ease the burden of link checking. Those professionals sometimes have the skill to help the teacher "whack" an important site—that is, make a copy of it so the teacher can use it off-line. For ethical and legal reasons, educators said teachers should first ask the Web site's owner for permission to make such copies.

Mr. Markham and Mr. Brooks, as well as other experts, call for government or education organizations or professional societies to start pooling resources in public digital libraries that are highly stable, so educators can depend on them.

One such effort by the Arlington, Va.-based National Science Teachers Association, for example, recruited 150 master science teachers over the past three years to spend parts of their summer collecting links for a special archive of science-related content for educators. The links selected by these so-called Web Watchers are organized in Web guides categorized by grade level and scientific topic.

The first eight Web guides will be posted online at nsta.org next month, and will be carefully maintained and gradually expanded, according to Tyson A. Brown, the manager of the program.

Educators will also benefit from a broader effort to archive the Web that is the brainchild of high-tech billionaire Brewster Kahle.

That effort, called the Internet Archive, is a vast and growing historical library of Internet sites and other cultural artifacts in digital form. It provides free access to researchers, historians, scholars, and the general public.

Teachers and others can use the historical search engine, the "Wayback Machine," at archive.org and retrieve Web resources back to 1996 that even their creators believe have been clicked into link rot oblivion.

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On the Web

"Broken Links: Just How Rapidly Do Science Education Hyperlinks Go Extinct?," summarizes John Markwell and David W. Brooks' project. Also, get further information on the research interests of Dr. John Markwell and David W. Brooks is available.

Read "Fighting Linkrot," from useit.com, the site of Web design guru Jakob Nielsen's. Thanks to link rot, writes Mr. Nielsen, "there is a looming danger that the Web will stop being an interconnected universal hypertext and turn into a set of isolated info-islands."

"Web-Users Beware: That Link May Be Rotten," an article posted by Newswise, examines the difficulties academic researchers face due to link rot.

There may be a way around link rot—in some cases. The Internet Archive, an online preservation project, allows Web users to resurrect dead links by accessing archived versions of old Web pages.

 Vol. 22, number 14, page 1,15