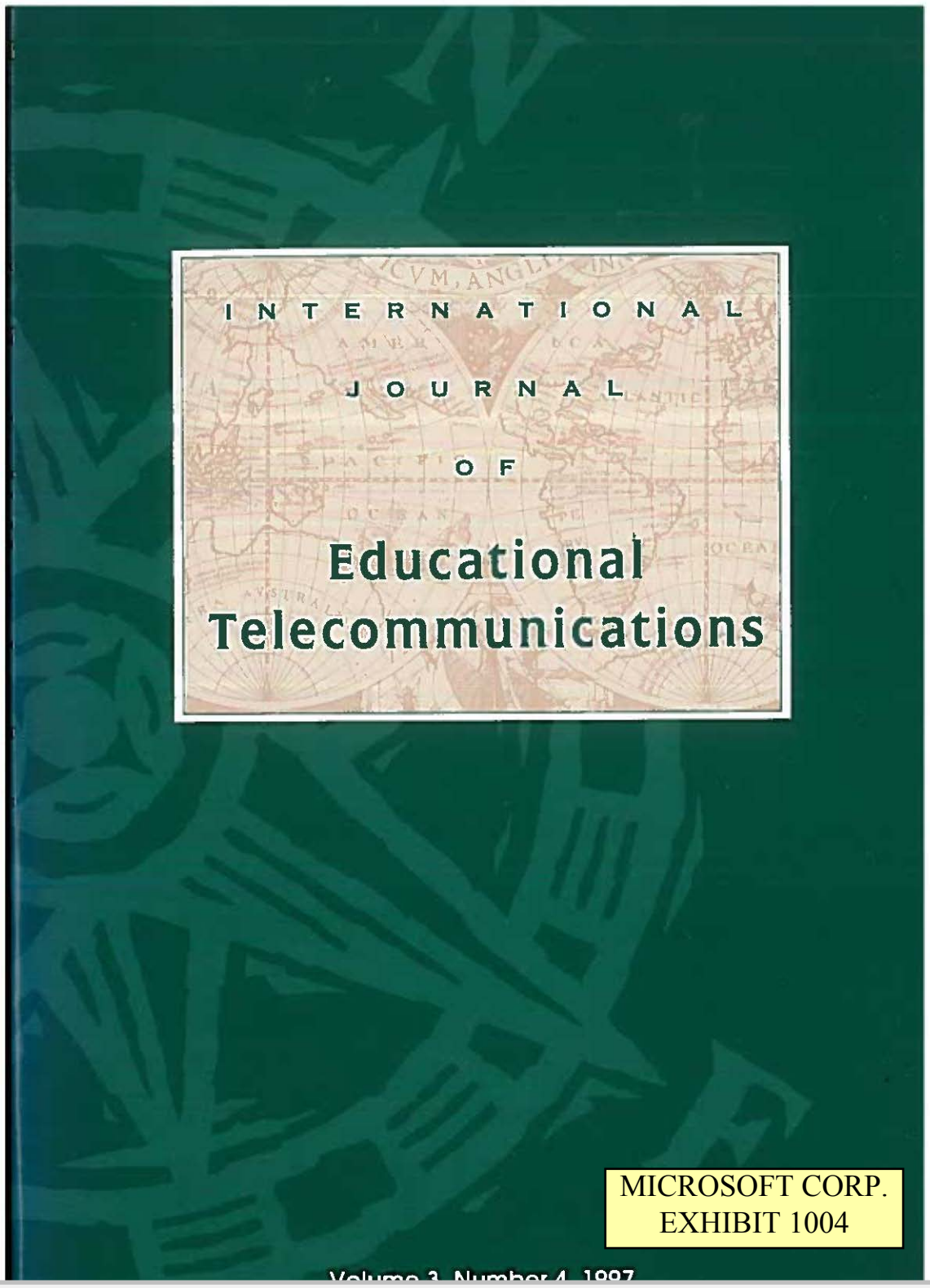

Volume 3, Number 4, 1997

International Journal of Educational Telecommunications

Volume 3, Number 4 1997

Articles

The *International Journal of Educational Telecommunications* (ISSN 1077-9124) is published quarterly by the Association for the Advancement of Computing in Education (AACE), an international, educational, nonprofit organization. Annual US membership/subscription rates: $75 individuals; $95 schools, libraries, and other institutions. Annual non-US membership/subscription rates, add: $10 per journal for postage. US funds, international money order, Visa, or MC. Single copy price $20 plus shipping fee per book of $2.50—US; $3.50—Canada/Mexico, and $4.50 elsewhere.
Publisher: AACE, PO Box 2966, Charlottesville, VA 22902, USA. (804) 973-3987
Fax: (804) 978-7449; Email: AACE@virginia.edu.
website: http://www.aace.org

International Jl. of Educational Telecommunications (1997) 3(4), 383-400

Using Networked Information to Create Educational Guided Paths *

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The extensive and encyclopedic materials found on the World Wide Web must be tailored and contextualized to support the instructional goals of education. We have explored the concept of "guided paths," ordered lists of pages independent of the existing Web structure, and have implemented a prototype, Walden's Paths. In addition to creating paths, a teacher may annotate the individual pages of a path to provide transition, emphasis, and missing explanation. In addition, some limited interactivity and control over the display of remote information is possible in our prototype. Walden's Paths works with standard Web browsers and servers so it can be integrated into an educational setting using existing hardware and software.

Students acquire knowledge-building skills and strategies through exposure to an expanded discourse community and broad base of information resources (Scardamalia & Bereiter, 1993). The Internet shows promise of providing such exposure: a wealth of new material and a spectrum of new voices are becoming available to students and educators alike through networked electronic information resources like the Internet's World Wide Web. The breadth of this material promises to increase as digital library efforts continue and research organizations recognize the importance of

contributing to globally accessible multimedia databases.

As extensive and encyclopedic as these materials are and promise to become, they still must be tailored for classroom use. The bulk of the material available today is not aimed at the needs of K-12 students, although many elements—image collections, simulations, digital video segments, audio, electronic versions of well-known works of fiction and reference materials, library indices, databases, and hypertextual documents—have the potential to play a strong supporting role in the curriculum of tomorrow.

Access to extensive resources and a broader discourse community will be instrumental in supporting learning through exploration (a natural complement to what Pea and Gomez refer to as learning-in-doing [Pea & Gomez, 1992; Pea, 1993]). Exploration is a valuable mode of learning, but it is even more valuable when it is constrained by a curriculum developer's well-conceived ideas of which materials should be included, supplemental text aimed at the particular level of student, and additional structure and ordering to help the student comprehend what he or she is discovering.

Scardamalia and Bereiter distinguish between knowledge reproduction strategies and knowledge building strategies: knowledge building strategies focus on the development of understanding, while knowledge reproduction strategies focus, very literally, on students' abilities to absorb passively, then recreate, what they have been told (Scardamalia & Bereiter, 1993). Our focus is on using guided exploration of large scale information resources to engage students in comprehending, interpreting, and evaluating materials—the substance of knowledge building and critical thinking.

The World Wide Web (the "Web") and its hypertextual paradigm are well-suited to form a basis for exploratory learning. A central theme of hypertext and the Web is traversal: a reader moves from one segment of material (a node or page) to another by following a link to related material. A reader's need for detail, explanation, alternative discussion, or related topics is guided by his or her own desire to explore, to construct knowledge, to find information. Of course, without a particular aim in mind, or any sort of guiding purpose or instruction, link following easily can become a random walk. It is necessary to add meta-structure that reflects an instructor's curricular goals to the underlying hypertextual network to make it suitable for exploratory learning and knowledge construction.

We can envision the future to some extent by looking at materials, media, and genres available on the Internet today. If we look, for example, at NASA's Web site[1], we can find information for the public about NASA programs (including existing educational materials). Or we can find movies of insects on Iowa State's entomology information server[2]. Or we can

view the Library of Congress's Soviet Archives Exhibit[3]. Some of the information provides methods for interaction; for example, Xerox PARC's map viewer[4] allows readers to zoom on map regions or search for place names as one would in a gazetteer. Simulations and visualizations are also available through the Web to help readers grasp more difficult materials and concepts. Authors have created a number of indices to effect additional structure on top of these diverse sites, but most of them are just lists of Web pages or Web server sites or hierarchies of such lists; few of them provide the additional rhetorical structure that one would encounter in materials for classroom use.

PROBLEMS OF GENERAL WEB ACCESS

What are the specific kinds of problems that we anticipate (and have observed) when students are given general access to the kind of large, heterogeneous collections of information that we find on the Internet?

A significant amount of material is not organized for comprehension by a K-12 student. Much of the information on the Web assumes access by an information-seeking adult or possibly an adult who is casually browsing or "reading around." This material, if left as is, will bore or frustrate most students, since they require a more structured presentation of background material before they can explore and understand the less organized information.

Given a relevant territory (which we will refer to as an information space) and a general organization for material, a problem still remains: the material—the content and links—still needs to be tailored to address the needs of school-age learners. Because the Web's hypertextual structure is represented by content mark-up (Berners-Lee, 1994) (i.e., links are denoted within the pages themselves), this sort of tailoring requires methods for changing material at a within-page (intra-node) level. Since many Web document genres (such as home pages) are new, many authors who contribute valuable material are inexperienced in constructing readable hypertexts. A given Web page may include too many (duplicate) links, or too few links (requiring additional structure to be understandable to the student), or may include links to "irrelevant" material outside the information space. Within-page tailoring may also be necessary to adapt material that is presented at the wrong level for a K-12 student. A second grader who is interested in the space program will not be able to understand a mathematical description of vehicle trajectory, but may be able to understand diagrams or a simple verbal account of the same material.

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