NSF CISE Institutional Infrastructure (Education) Grant Overview

NSF award number, amount and period of support: CDA-9312611, $449,088+supp’ls,
8/15/1993 - 7/31/1998

Project title: Interactive Learning with a Digital Library in Computer Science

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Overview of Goals and Objectives: Key concepts of our project [89] were to improve CS education
by increasing interactivity and use of a DL. The main objectives/accomplishments were to:

• expand the content and software (especially user interfaces [178, 179, 210]) initially developed
  with NSF support of our “Envision” DL project, “A User-Centered Database from the Computer
  Science Literature” [130];

• develop/apply algorithm visualization tools that are easy for instructors to use in supplementing
  courses, and feasible for students to work with as an aid to program development and debugging
  [198, 199, 224];

• incorporate use of specialized DL systems like Netlib into related courses;

• add new courses related to human-computer interaction, multimedia, and a freshman level Intro-
  duction to Networked Information (later renamed Introduction to the Internet);

• significantly change courses like “Computer Professionalism,” to make use of interactivity (e.g.,
  asynchronous on-line debates) and DL support (e.g., adding to a large History collection);

• apply the key concepts to improve other courses.

Current Status and Accomplishments: In 1991 Virginia Tech began working with ACM through
support from NSF on a “User-Centered Database from the Computer Science Literature” [130]. In
1993, Virginia Tech expanded its work on DLs to launch the NSF EI (Education Infrastructure / In-
novation) project, partnering with Norfolk State University, which has developed extensive sets of
labaratory manuals. Over 40 courses are available through our WWW server, with the number of ac-
cesses exceeding 10 million. The original courseware server was upgraded in 1997, and an IBM do-
nation has provided a mirror machine in the Computing Center to ensure reliability. Ongoing collab o-
ration with IBM and their DL systems has helped Virginia Tech coordinate development of the Net-
worked Digital Library of Theses and Dissertations (http://www.theses.org/).

Several courses have all the on-line materials required for self-study available, and new pro-
grams are under development for distance learning and continuing education. In the new multimedia
course, there was a dramatic increase in megabytes transferred because of more images, digital audio,
and digital video: from 847 in 1995 to 1052 in 1996 to 2373 in 1997. Due to the development by
Prof. John A. N. Lee (then Editor-in-Chief of IEEE Annals of the History of Computing) of one of the
largest repositories on computer history, with a unique image collection of the founders and early
systems in our field, there is extensive additional traffic from throughout the nation. Starting in 1996—with the help of NSF-funded digital video capture and editing facilities—audio annotations,
digital video movies, and animations to show interactive applications have been added. One of the
courses developed under this effort, and extended through support from SUCCEED, is CS1604, In-
roduction to the Internet. A self-study version of this course was finalized in 1997, designed to be
widely used throughout the Southeast and beyond by those interested in a freshman or beginner-level
orientation to Internet, DLs, collaboration technologies, etc. This version has numerous audio and
movie files to help learners, an automated real-time feedback facility (using our SGML-based
QUIZIT tool [205, 206]), and a variety of illustrations and demonstrations.

In one old and two new courses, we have adapted Keller’s Personalized System of Instruc-
tion [141] to our networked environment. Students proceed at their own pace, study on their own, get
help through asynchronous communication with peers and instructors, and in general have much
greater flexibility in learning. Many students prefer this type of course, and in the case of CS1604 we
simply could not accommodate the demand any other way, in this time of scarce resources. Students
requested that we add interim deadlines, since they tend to procrastinate and require help with time
management — doing so seems to have solved the major problem faced earlier. Pilot tests with courses like CS1604 are demonstrating how these subjects can be mastered through independent study courses.

In June 1997, a workshop to disseminate results was conducted in Blacksburg, VA with attendees from all over the nation. Deborah Knox, from the College of New Jersey, attended, and is now collaborating with Co-PI Fox on the Computer Science Teaching Center, CSTC, http://ei.cs.vt.edu/~cstc/, recently funded by NSF.

**Materials that Have Been Developed:** One result of our effort is the prototype Envision system. Its user interface was designed for access to bibliographic collections, as well as richer DLs. Its search engine, MARIAN, is likely to be ported to Java by 1999, thanks to a grant from NLM. A second result is the content converted from ACM, made available to ACM to help with their DL efforts. A third result is the software created to increase interactivity of learning: SWAN (algorithm visualization), an on-line debate system for managed dialog, and QUIZIT. A fourth result is the set of pages about EI projects, at http://ei.cs.vt.edu/~csei/. Finally, there are well over 10,000 WWW pages of CS courseware.

**Publications Summary**

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**Presentations by Project Investigators**

Many presentations have been given over the course of the project, including 9 keynote/ distinguished lecture talks: Puebla Mexico (6/10/98), Univ. Utah (3/7/96), UNC Chapel Hill (2/1/96), NORD-INFO (Helsinki, 11/94), Multimedia Systems (Ottawa, 10/94), ISMIS’94 (Charlotte, 10/94), EG-MM’94 (Graz, Austria, 6/94), CAIA’94 (San Antonio, 3/94), IR’93 (Regensburg, Germany, 9/93). Eight tutorials, 3 demonstrations, and more than 20 other presentations also were given.
RELATED REFERENCES


72. Fox, E. A., “Digital Libraries: The Networked Digital Library of Theses and Dissertations (NDLTD) and the Computer Science Teaching Center (CSTC),” Keynote for *Computer Science Workshop*,
sponsored by CONACyT and NSF, Puebla, Mexico, June 10-12, 1998.
(http://www.ndltd.org/talks/CONACyTNSF.pdf)


