

Is Computer-assisted Distance Learning Possible in Nematology?¹

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Abstract: In many institutions of higher education, introductory nematology is taught to small numbers of students. Nematology and other low-enrollment courses may be placed under scrutiny, reformatted, or dropped from the curriculum to cut costs and improve faculty efficiency. Computer-assisted distance education (CADE) offers a way to increase faculty productivity and job satisfaction, student learning and socialization, and cost-effectiveness. Participating institutions gain by sharing resources with other schools and may retain or even increase enrollments through broadened educational opportunities. CADE ranges from complete course offerings and video interaction to supplemental materials on a personal computer for independent learning. A modular approach to course development is the most successful model because of the flexibility it offers. While an entire nematology course through CADE is not possible without substantial institutional and faculty investment, supplemental materials can help remotely located students gain an appreciation for nematology. Nematological images, text, computer programs, and other resources can easily be placed on Internet web pages. Nematologists in all sectors need to continue to reach out to the next generation of leaders to tell them what nematologists do and why nematodes are important. The Society of Nematologists can be a leader in the systematic development of CADE in nematology.

Key words: computer, distance learning, education, nematode.

At North Dakota State University (NDSU), and in many other postsecondary institutions, introductory plant nematology is taught as a graduate-level course, usually to 5–10 students (Dickson and Meredith, 1987). A 1994 administrative decision to contain costs and direct faculty effort efficiently mandated that NDSU graduate courses could be taught only under special circumstances if fewer than five students are registered. As a result, Plant Nematology twice failed to be offered and its continued existence as a separate course in the Plant Pathology Department was threatened.

Several steps were taken to maintain Plant Nematology as a course in the NDSU curriculum. Intensified recruitment of graduate students into plant pathology has increased student numbers. The graduate curriculum was realigned to create half-semester bacteriology and nematology modules that students could take together in a single semester. In addition, faculty ad-

visors were reminded that the loss of plant nematology would diminish the graduate program by narrowing the broad-based training often expected of plant pathology graduates in the marketplace. Finally, the prospects and pitfalls of distance learning were researched and a computer-assisted distance education (CADE) open forum was developed as a world wide web site. Because many institutions in the United States and elsewhere share the experience of low enrollment in nematology courses, the question of what CADE can offer should be of interest to the *Journal of Nematology* readers.

Issues in Nematology Education

While some institutions offer a comprehensive education in nematology, many universities have only one course and low enrollment (Dickson and Meredith, 1987). Fewer students inevitably reduce peer interaction and socialization, which can impact learning. Furthermore, teaching a small class can negatively affect an instructor's job satisfaction. Low-enrollment classes are the first to come under scrutiny during cost-cutting periods. Program erosion may affect political support and cause the institution to suffer loss of prestige.

Graduate and advanced undergraduate students who enroll in nematology often be-

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come leaders in biological science or agriculture. For example, two students in the 1992 NDSU nematology class currently occupy important crop protection positions in the North Dakota Department of Agriculture. Thus, while a few elite schools will continue to train most future nematologists, all universities with a nematologist can help educate the next generation of professionals. These contacts help the nematology discipline maintain political support in higher education, government and agricultural business.

Advances in computer technology in the 1990s have had an enormous impact on how we work, live, and teach. Computer innovations have affected how higher education is delivered in many countries. Teaching applications include software programs, multimedia tutorials, asynchronous communication (one direction at a time), and synchronous communication (i.e., multidirectional, interactive video or audio conferences). Communication via the Internet has opened tremendous opportunities for enhancing nematology education. Indeed, CADE may increase faculty productivity, student learning, and cost effectiveness.

Pros and Cons of Computer-assisted Distance Education

Users of CADE may or may not benefit, depending on the individuals and how the curriculum is implemented. Emergent technologies impact CADE but are difficult to predict. Evaluations have shown some themes were important to success and recurred often as various disciplines integrated CADE into courses (Anonymous, 1996). These educational themes are discussed here.

Student outreach is a major advantage of CADE because diversity of the student population increases as geographic boundaries are overcome. While this benefit broadens the range of perspectives, it may also lead to cultural misunderstandings. Likewise, the range of educational opportunities is broadened because students gain access to special resources and expertise. Activities such as electronic mail, list servers, and live "chat

rooms" encourage a collaborative learning environment, but the lack of personal contact can inhibit interactivity. Profiles with a picture of the participant tend to humanize these distant relationships if video communication is unavailable.

Whereas most of the student population seems to like computer technology, a small percentage is uncomfortable. Viable alternatives to CADE may not exist in some situations, but accommodations should be made whenever possible to afford equal information access. For example, a course should be set up with a local computer expert on hand to assist students and maintain operations. The technology should be transparent, and students should become conversant with what they need to know as early in the course as possible. Students in an asynchronous CADE environment control their time, explore items in depth, and learn at their own pace, allowing for learning at any time and in any place; however, students who are prone to distraction may browse web sites aimlessly. Thus, exercises that focus attention and provide feedback to the instructor are generally sound educational tools.

The faculty obviously plays the largest role in CADE development. The quality of instruction often improves when faculty redesign courses to provide greater student self-actualization. In part, the faculty may be stimulated to improve a course because it is more public than before. Likewise, faculty may share ideas about teaching methods and may cooperatively instruct a course, which has the added benefit of reducing teaching load and justifying low-enrollment courses. On the other hand, demands on faculty time during the startup period may be extreme and development costs may be high. CADE also opens other outlets of communication, such as E-mail, which can create additional demands on faculty time unless limits are in place.

A modular approach to course development has been the most successful CADE model. Modular units are inherently less laborious, more flexible, and have fewer errors than more complex units (D'Halluin, 1997; Eastmond, 1997). Moreover, several

nematologists can cooperate to develop modular CADE units, with module assignments taking advantage of special expertise. Modular units usually are united through hypertext links, allowing transparent connectivity. However, links may break without notice due to internal programming errors or if an external location is amended or deleted. Fortunately, web page development software can systematically test links and alert the developer of errors, so periodic maintenance can eliminate broken links.

Nematology education can be well served by self-publication on the Internet. No hardcover introductory textbooks are in print at present, in part because nematology is a small market. Web page development is relatively uncomplicated to learn so it is easy to publish and update information. Unfortunately, the ease of publication allows spread of misinformation, a problem perhaps best overcome by a sanctioned peer review system.

Conflicting philosophies exist regarding fair use and copyright protection of CADE materials; often policies are absent or under development at higher-education institutions. Developers should be cautious about copying information or graphics found on the Internet or elsewhere because of copyright infringement. Faculty and host institutions have a right to be justly compensated for their investment in distance education, but public sector activity is inherently subsidized and should be equally accessible to all whenever possible. Course materials on the Internet can be protected with passwords; however, awarding academic credit could allow free access to the same effect. Indeed, today's curious Internet web browser could become the next Victor Dropkin.

Colleges and universities can educate more people at a lower cost by networked courses. Institutions that participate in CADE consortia share resources and may retain or even increase enrollments through broadened educational opportunities. CADE redefines the institutional role in society to serve not only resident students but also a state, national, and international clientele. In the United States, several land-grant institutions, including Penn State Uni-

versity and North Carolina State University, are among the leaders in postsecondary CADE.

Computer technology in support of distance education encompasses hardware and software elements. Reliable equipment and programs ensure a successful educational experience. Commercial software programs continually emerge, change, and disappear, so specific programs applicable to distance education will not be discussed here. Classroom management software for CADE, currently available from established vendors, provides a useful tool for nematology education. The trend in CADE is toward a transparent, seamless, distanceless, and multimedia environment.

Integration of CADE into Nematology Education

At present, software specifically applicable to nematology education includes programs and databases (Duncan and McSorley, 1987; Ferris et al., 1995; Francl, 1993), multimedia (Eisenback, 1997), and web pages on the Internet (Table 1). Several of the web pages have up-to-date links to other sites and documents. Also of potential educational value are the list servers and news groups, essentially bulk E-mail focused on a subject matter. Currently, discussion topics include general nematology (Listserve = nema-1), entomopathic nematodes (Listserve = entonema), and *Caenorhabditis elegans* (Usenet = bionet.celegans).

Future CADE development will depend entirely upon the talent of nematologists because the small market size inhibits commercial participation. Therefore, nematologists are strongly encouraged to place items of educational value on the Internet. Examples include digitized pictures and movies, retrospective articles, research synopses, biographies, extension publications, databases, and computer programs. Contributors should strive to use a leading edge, rather than trailing edge technology. For example, an attractive web page with fast-loading graphics and attractively formatted text is more suited to the web medium than is an unformatted set of lecture notes. Finally, even though hands-on nematology labora-

TABLE 1. Some currently available Internet web sites relevant to nematology postsecondary education.

Institutional host	Description	Uniform Resource Location (http://)
University of Nebraska	Parasitic nematodes home page	ianrwww.unl.edu/ianr/plntpath/nematode/wormhome.htm
University of California-Davis	Departmental home page	ucdnema.ucdavis.edu
USDA Nematology Laboratory	National laboratory home page	www.ars-grin.gov/ars/deltsville/barc/psi/nem
University of Southampton, UK	Description of the nematode nervous system	www.soton.ac.uk/~djab
Univ. of California-Riverside	Departmental home page	nemweb.ucr.edu/nemhp.html
University of Texas Southwestern Medical Center	<i>Caenorhabditis elegans</i> home page	eatworms.swmed.edu
University of Edinburgh, UK	Nematode phylogeny	http://helios.bto.ed.ac.uk/mbx/fgn/worm/wormhome.html
Wageningen, NL	Departmental home page	www.spg.wau.nl/nema
University of Florida	Departmental home page	gmv.ifas.ufl.edu/~gcs/nemadoc.htm
University of Florida	Taxonomy of entomopathogenic nematodes	gmv.ifas.ufl.edu/~kbn/kbnstein.htm

tory experience is not possible for students located away from campus, virtual experiences can be conveyed. For example, a microscope image can be shared by video transmission. Although this aspect is limited, CADE students can gain an appreciation for nematology that may be otherwise unavailable.

Nematology education beyond auto-tutorials and asynchronous communication requires centralized coordination and funding. A complete course offering using CADE, as opposed to supplemental materials, must meet with administrative approval at the host institution as well as a commitment at each remote site. Synchronous video communication, other than the basic one-to-one conference video systems, requires relatively expensive equipment, high bandwidth, and telecommunications staff. An on-site coordinator skilled in the technology is needed at each location to provide technical assistance.

Summary

Although a complete introductory nematology course using CADE may be unlikely in the near future, computer applications on personal computers and supplemental materials on the Internet are a reality today. Likewise, student use of E-mail, list servers, web-based discussions, etc., are currently available. Thus, CADE is already integrated

into nematology courses at many institutions, but further development is possible and desirable. The list server "nema-l" provides a logical platform for further development of a computer-assisted nematology course.

Nematologists in all sectors need to utilize these new technological avenues to reach out to the next generation of leaders in agriculture and the natural sciences and tell them what nematologists do and why nematodes are important. The Society of Nematologists and its members can play a leadership role by: (i) sanctioning and stabilizing decentralized educational resources, (ii) working with universities on outreach efforts, and (iii) providing political support for CADE. To do less puts nematology as a distinct discipline at risk.

LITERATURE CITED

- Anonymous. 1996. Workshop summary: "Breaking the barriers: distance delivery models and methods," International Council for Distance Education. Pennsylvania State University, 23 October, 1996.
- D'Halluin, C. 1997. Some issues about implementation of a distance learning system of the third generation. 18th International Council for Distance Education World Conference. Pennsylvania State University, 2-6 June, 1997.
- Dickson, D. W., and J. A. Meredith. 1987. Perspectives on nematology teaching. Pp. 22-27 in J. A. Veech and D. W. Dickson, eds. *Vistas on nematology*. Hyattsville, MD: Society of Nematologists.
- Duncan, L. W., and R. McSorley. 1987. Modeling

nematode populations. Pp. 377–389 *in* J. A. Veech and D. W. Dickson, eds. *Vistas on nematology*. Hyattsville, MD: Society of Nematologists.

Eastmond, D. V. 1997. Instructing faculty to develop and deliver distance courses with computer network technology. 18th International Council for Distance Education World Conference. Pennsylvania State University, 2–6 June, 1997.

Eisenback, J. D. 1997. Root-knot nematode taxo-

nomic database on CD-ROM. Wallingford, UK: CAB International.

Ferris, H., E. P. Caswell-Chen, and R. L. Sloan. 1995. Synopsis of a developing database of host status of plants to nematodes. *Journal of Nematology* 27:499 (Abstr.).

Francl, L. J. 1993. A hypertext glossary of nematology. *Journal of Natural Resources and Life Science Education* 22:153–155.