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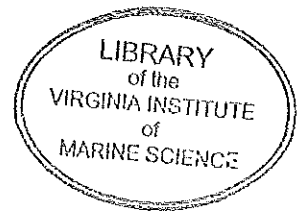Global Climate Change:

Sources of Information and Materials

by

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and

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GLOBAL CLIMATE CHANGE: SOURCES OF INFORMATION AND MATERIALS

Introduction

This project was undertaken at the request of the NOAA Office of Global Programs to analyze the current status of dissemination of information about global climate change to educators. Information users, information disseminators, and information producers were questioned as to their preferred means of receiving and distributing information and materials. Results of the information user study and results of the information disseminator study indicated that educators are not currently making use of telecommunications, clearinghouses, or national resource centers to any great extent as sources for global climate changes information and materials. However, telecommunications systems are rapidly becoming less expensive to access and easier to use, and educators are expressing interest in investigating these systems. There is presently no national, comprehensive, and standardized system of on-line information and material transfer to educators; there are a number of isolated systems which have been tailored to serve their unique and limited user groups. Efforts are underway to link and coordinate these systems to make them useful for the educational community at large; this will probably be accomplished within the next several years. Until that time, however, the most effective means of information and materials transfer to educators remains the national and regional professional education organizations.

Information Users

The sample group consisted primarily of formal and informal educators and information disseminators who are members of three organizations: the National Marine Educators Association, the Mid-Atlantic Marine Educators Association, and the Virginia Association of Environmental Educators. This structure offered three perspectives; national, regional and local. Concentrating efforts on these educators offered efficient access to individuals who were likely to have interest and expertise in the content area, as demonstrated by their membership and active participation in a professional organization. It is important to keep in mind that this group is composed of people who are already active marine and environmental educators, making efforts to locate up-to-date information and quality materials. These results are characteristic of this group.

Only 24% of the respondents report that they are not currently teaching about global climate change and related issues. Those respondents that are not currently teaching about global climate change cite "my school's curriculum doesn't include this" and " I don't know of any suitable materials for teaching about these issues"

most frequently as the reason.

69% of the respondents surveyed are teaching about the greenhouse effect and carbon dioxide emissions; 62% are teaching about ozone depletion; and 58% are teaching about sea level rise. 21% are teaching about other issues related to global climate change; topics listed by the respondents include deforestation, diversity, glaciation, acid rain, and water resources.

Educators and information disseminators are currently obtaining information and teaching materials from a wide variety of sources (Fig. 1). The relative importance of different sources of information and materials is appproximately the same for global climate change and for other current issues. The most frequently used sources of information and materials for both climate change and other issues are books and magazines, professional journals and newsletters, educators' meetings, and television. Moderately popular sources of information and materials are colleagues, Sea Grant or Extension services, courses and in-services, public libraries, and local or state resource centers. The least utilized sources of information and materials are national resource centers or clearinghouses, other (the two people who gave an example of "other" both listed newspapers), school system, computer networks, and the state Department of Education.

Figure 1. Sources of Information and Materials (listed in order from most frequently cited to least)

Global Climate Change	Other Current Issues
88% - books, magazines	82% - books, magazines
75% - professional journals and newsletters	73% - professional journals and newsletters
63% - television	67% - educators' meetings
59% - educators' meetings	56% - television
45% - colleagues	49% - colleagues
37% - courses, in-services	46% - Sea Grant, extension
36% - Sea Grant, extension	44% - courses, in-services
31% - public libraries	41% - public libraries
25% - national resource centers or clearinghouses	38% - local or state resource centers
21% - local or state resource centers	21% - national resource centers
20% - other	20% - other
11% - computer networks	15% - school system
5% - school system	13% - computer networks
4% - state Department of Education	11% - state Department of Education

Only 36% of the respondents report using national resource centers, clearinghouses or computer networks. Of the respondents that are not currently using these sources, 74% state "I don't know enough about them" as the reason. 48% state "I would need to know that [they] contain useful information and materials", 43% state "I would need the right hardware and/or software", and 37% state "I would need more free time." 30% state "I would need training to use them", 22% state "I would need financial assistance", 17% state "other sources meet my needs", and 11% list "I would need help from someone else to use them." Although it appears that the need for free time (to learn about and become proficient in using these sources) is only of moderate importance, many of the respondents who chose this reason were very emphatic about it.

A wide variety of organizations, agencies, and programs were listed as resource centers and clearinghouses: federal agencies, such as NOAA, NASA, USFWS, and DOE; national non-profit organizations, such as the Center for Marine Conservation and the Environmental Defense Fund; state agencies, such as Departments of Education and Natural Resources; universities; and professional organizations, such as the National Science Teachers Association and the National

Marine Educators Association. Many of the sources mentioned were considered resource centers by some respondents and clearinghouses by others. Many sources were listed which the investigators of this study would not have described as either resource centers or clearinghouses. Most of the sources given were mentioned only one or two times; however, ERIC (Educational Research and Information Center) was mentioned several times.

Several examples were given of computer networks. Non-commercial networks (Internet, Bitnet, and various state Department-of-Education-sponsored networks) and commercial dial-up systems (CompuServe, Prodigy) were mentioned, as well as non-profit networks such as EcoNet and GREEN (Global Rivers Environmental Education Network). No respondents reported using OMNET. All but one of the respondents using resource centers, clearinghouses, and computer networks reported having located useful information and materials from these sources. 30% of the resondents reported that their state has a special computer network for teachers. 14% reported that their state does not have such a network and 56% of the respondents do not know of any special educational networks in their state. A disconcertingly high number of the "no" or "don't know" responses were from educators from states which do in fact have such networks.

The respondents who are using computer networks, clearinghouses, or resource centers to locate information and materials found out about them most frequently from educators' meetings (87%) and professional journals and newsletters (68%), and less frequently from colleagues (45%) and courses or in-services (45%). 26% of respondents found out about these sources from Sea Grant or extension services, 23% from local or state resource centers, 23% fron their school system, 19% from their state Department of Education, 13% from books or magazines, 10% from television, and no one reported finding out about networks, clearinghouses, or resource centers from the public library. 10% of the respondents chose "other"; the only person who gave an example of "other" reported finding out about these sources "by accident."

Very few (5%) of the respondents reported no computers at all at their facility. 62% reported computers in administrative offices; 56% reported computers in labs and classrooms; and 35% reported computers in teachers' work areas. 21% of the respondents reported computers located in other areas; for example, the library or media center.

41% of the respondents rarely use computers to obtain information and materials for use in their educational programs and 35% never use the computers for that purpose. 11% use the computers weekly to locate information and materials and 13% use them daily for that purpose.

44% of the respondents use an IBM-PC or compatible most often and 48% use an Apple or MacIntosh most often (no distinction was made between school and home computers). 5% use both IBM compatibles and Apples and 3% use something

other than IBM compatibles or Apples. 40% have access to a CD-ROM disk drive, 37% do not, and 23% don't know whether or not they do.

Summary of Educators' Recommendations for Dissemination of Global Climate Change Information and Materials

Educators' recommendations for the types of information and materials that they would find most useful for teaching about global climate change are quite varied. The type of information most requested is data, either on CD-ROM or on-line. Several would like simulations or models (including computer software) that they could use to illustrate "what if" scenarios. They are also interested in receiving general background information on global climate change as well as evidence that climate change is in fact occurring. They are interested in recommendations for actions they and their students can take to lessen human factors contributing to global climate change. Several respondents listed topics in which they are particularly interested; for example, sea level rise, acid rain, the ozone hole, the greenhouse effect, lifestyles, deforestation, carbon dioxide, particulate emissions, marine systems, and overpopulation.

The educators questioned have specific recommendations for the format of materials they would find most useful. They want curriculum materials (hands-on activities, lesson plans, and labs) that they can use with their classes, rather than purely informative material. They also want visuals that they can use with their classes, most particularly videos and posters. Recommendations for posters include photographs, satellite images, graphs, charts, and maps.

It is very important to these educators that any information or materials they use be as current as possible. It is also important that materials be appropriate for the grade level of their students. Additionally, these educators want materials that are easy to understand, reproducible, inexpensive or free, and specific to their region.

The educators surveyed strongly recommend that information and materials be publicized and disseminated through existing organizations and the publications and conferences of these organizations. Other successful modes of information and currculum dissemination to educators are the national workshops and publications associated with programs such as Project WILD, Aquatic WILD, and Project Learning Tree. These programs provide a standardized user-friendly package of materials and training in the use of the materials. Many respondents requested that a mailing list of interested educators be developed and maintained and that information and materials be mailed directly to the teachers. A large number of the respondents stated specifically that any materials distributed by mail not be sent to the principal or district central office. A few educators expessed interest in accessing information and materials via on-line systems. Although most educators questioned do not know enough about such systems to make effective use of them, almost all indicated a desire to learn more about them.

85 people responded to the information user questionnaire. 70 (85%) describe themselves as primarily educators (classroom teachers, school administrators, aquarium or museum staff) and 12 describe themselves as primarily information disseminators (resource center, network, advisory program, or library staff). Two people consider themselves both educators and information disseminators and one person chose neither option.

42 people were interviewed in person at the National Marine Educators Association in Portland-Newport, Oregon, August 9, 1992. 536 copies of the questionnaire were enclosed with the fall issues of the newsletters of the Mid-Atlantic Marine Educators Association and the Virginia Association of Environmental Educators; 51 were returned (9.5% return rate). 85 copies were distributed to participants in the Global Issues Workshop sponsored by New Hampshire Sea Grant in October 1992; however, none were returned.

Information Disseminators

Until recently, there has been no plan for the development of a national telecommunications network. Regional and local systems have evolved, grown, and coalesced. In most cases, these systems were designed to meet the specific needs of a limited user group. Additional services were added to the systems haphazardly as the needs of the user groups warranted. As a result, there is a wide variety in services offered, user groups served, and means of access of these regional and local systems. However, it appears that these differences are gradually decreasing as network administrators plan for the future.

Responses from Part I (system users) of this study yielded a list of clearinghouses, resource centers, and computer networks that educators reported as useful sources of information. Managers and frequent users of these systems received a questionnaire about the purpose, services, means of access, and future plans of the systems. 13 system administrators returned the completed questionnaire. Figure 2 lists services and information available from each system. Appendix A contains descrptions of each system, including system objectives and means of access. Seven of the responses were from administrators of state Department-of-Education-sponsored computer networks (Pennsylvania, Virginia, West Virginia, Nevada, North Dakota, Florida, and Alaska); three of the responses were from regional nodes of the national LinkNet consortium (Hampton Roads, Virginia; Wisconsin; and New Jersey); one response was from a nationally accessible bulletin board service (operated by the Department of Energy); and two responses were from resource centers (one national and one state) with more traditional means of access. A number of disseminators contacted failed to respond, which suggests either a lack of interest in the dissemination of global climate change materials or a questionable level of responsiveness to queries from the science education community.
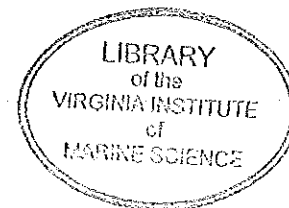
Figure 2. Services Offered by Systems

research based information on global climate change	5
environmental education materials	1, 2, 5, 6, 7, 9, 11, 12, 13
access to scientific databases	1, 2, 4, 5
curriculum materials	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
information	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
bibliographies	1, 2, 5, 6, 9
abstracts/summaries	1, 4, 5, 6, 7, 9
full text entries	1, 4, 5, 6
key word searches	1, 2, 4, 5, 6, 8, 9, 11, 13
custom searches of files and databases	5, 6, 8, 9
bulletin board, e-mail, or other on-line communication among users	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13
information about current and upcoming events	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
training and personal assistance for users	1, 3, 4, 5, 6, 9, 10, 11, 12, 13
dissemination via hard copy	4, 13
dissemination via disc	3, 4, 6, 13
dissemination via CD-ROM	3
dissemination via on-line access	1, 2, 3, 4, 5, 6, 8, 10, 11, 13

1. Penn*link
2. Virginia's PEN
3. West Virginia Microcomputer Educational Network
4. IKELink
5. SEND-IT
6. Florida Information and Resource Network
7. AKNet/University of Alaska Computer Network
8. Learning Link Wisconsin
9. Learning Link Hampton Roads
10. NJLink
11. Newton
12. National Distance Learning Center
13. Instructional Resources and Technology Services

A few of the systems charge an hourly rate for use in addition to the long distance telephone call required to access the system; several do not charge for use but can only be accessed by making a long distance call. However, many systems

are free to use and accessible via a toll-free phone line. As a rule, larger systems are more likely able to provide a toll-free phone line. Some of the systems are accessed only from the Internet, and some may be reached via both the Internet and a phone call.

Most of the systems require users to obtain an account. Some require that users apply for and receive an account on the system before logging in for the first time; some allow users to establish the account as part of the first session. Some systems do not require individual accounts; the system is open to anyone who can reach it and knows how to use it. An "account" does not necessarily imply a financial arrangement. While commercial networks do charge for use, most of the systems appropriate for educators are state sponsored and funded (and therefore free to users). An account is an arrangement whereby users are assigned unique identification names and passwords. It is advantageous to a user to have a unique identity on a system because that opens the door to individual communications - i.e., they can send and receive messages to and from other system users. The advantage to system operators of maintaining unique accounts is that it makes it possible to accurately gauge the amount and type of system use. System means of access varies widely; this often makes it hard to define user groups accurately.

Student access to educational networks is a sensitive issue. Some systems permit unlimited student access, some have controlled student access, and some do not permit any kind of student access. Student use of computer networks can be a powerful learning tool. In Virginia, for example, student groups across the state are participating in an acid rain study. Individual classes measure acidity of their local ponds and streams and post their findings on Virginia's PEN. Students in western Virginia are using VA-PEN to search university library catalogs from their classrooms, enabling them to do extensive library research with out making a lengthy trip. Obviously, there is substantial scope for students to make constructive use of telecommunications networks. However, some system operators, particularly of more extensive networks, are concerned about inappropriate material that might be accessible to students via the networks.

Some of the systems were established for educators (the original mission of the system was to promote communication between educators and to provide support in the form of information and materials). However, some of the networks were established primarily as administrative systems for communications between individual schools, district central offices, and state Departments of Education. Although some of these systems have become primarily used by teachers, their administrative origin is reflected in current operating rules and means.

Some systems are operated through the state university system (for example, FIRN in Florida) and are only accessible to K - 12 teachers and students who travel to a university or community college and use the FIRN workstation.

Almost all of the systems contacted have plans to expand their services. They

plan to lower costs for their current services and provide increased Internet access to their users.

Not surprisingly, network operators say networks are the best way to disseminate information and materials. They also advise that having a continuous flow of new, useful, and interesting information is an essential component of a successful system.

Information Producers

Most scientific information about global climate change is published through traditional channels, and is easily accessible to researchers who consult the peer-reviewed literature. However, current practices for organization and management of this information rely heavily on electronic systems, and electronic sharing of both pre- and post-publication material and data has become routine within the scientific community. A rapidly increasing amount of this material is accessible to individuals other than scientists, often through various Internet connections, but it is seldom in a form useful to educators.

Considerable activity is currently in progress attempting to identify scientific materials of potential value to educators, and arrange for its distribution in a useful format into the educational community. NOAA and EPA, as well as many other national programs, are actively investigating educational applications of their data and information. There seems to be a general consensus among both representatives of major national programs and formal and informal educators that it is important to carefully select and package current data and information to make them easily available to educators, pertinent to the needs and interests of learners, and simple for instructors to incorporate into individual instructional programs.

Efforts range from plans for major national projects like the Eisenhower or EPA Clearinghouses to the smaller local and regional programs which this study indicates many teachers already depend upon.

Conclusions

When this study was initiated, very few of the educators contacted were involved in any kind of computer networking on any subject, but almost everyone expressed interest in finding out more about computers and networking. Most of the people interviewed in August 1992 knew so little about the field that, although they wanted to learn more, they had no idea where to go for help, who to ask, and what to ask. When educators were asked if they used the Internet, most replied that they had never heard of it. By March 1993, almost everyone contacted knew about it and either already had access or were trying to get it. Preliminary findings of this study were presented at the October 1992 meeting of the Mid-Atlantic Marine Educators

Association; three people attended the session. In June 1993 the authors of this study presented a session at the Virginia Conference on Environmental Literacy about on-line resources available to Virginia educators; over 40 people attended. It is apparent that a dramatic change in educators' attitudes and interests has occurred even during the relatively short duration of this study. It is very likely that if the same people surveyed in October were asked the same questions today, the results would reflect this shift in attitudes. Early in this study it appeared that it would be at least five to ten years before most educators are on-line; a more likely estimate now is three to five years. There are still a few obstacles facing educators who want to get on-line; the most pressing ones are the need for a dedicated phone line and the lack of time necessary to become proficient in networking.

The information disseminators and system administrators who were questioned favor the use of computer networks for disseminating current information and materials to educators. System operators are working to make their systems easier and cheaper to use. New systems and services are coming on-line so rapidly that it is difficult to keep track of them all. Information producers are exploring ways to make their data and information available to and appropriate for educators.

It is apparent that there is a great deal of potential for using computer networks to disseminate information and materials to educators. Educators are becoming aware of the resources available to them on-line and are taking steps to learn about and access them. Although some obstacles remain to widespread use of networks for purpose, such obstacles are gradually being removed. Information disseminators and information producers must ensure that information, materials, and services are appropriate to their audience, based on current research, and include training and assistance to users. Advances in communications technology and the development of the National Research and Education Network should facilitate transfer of information and materials from the scientific institutions that generate them to the educators who will ultimately use them to train the decision-makers of the future.

APPENDIX A
System Objectives and Means of Access

Penn*link
Pennsylvania Department of Education
333 Market Street
Harrisburg PA 17126

Penn*link was developed as a fast and reliable means for the Pennsylvania Department of Education to communicate with the public schools and for the schools to communicate with each other. The system provides electronic mail capabilities and a bulletin board with educational information and reference materials. Penn*link is accessed from PC/modem systems by a local or toll-free telephone call. There is a one-time new account charge (which includes training on the system) and an hourly charge to use the system.

Virginia's PEN
Virginia Department of Education
101 N. 14th Street
Richmond VA 23219

VA-PEN was established to facilitate communication and information exchange between schools, school offices, the Department of Education, and other state agencies and educational organizations. Most users access VA-PEN from a PC with modem by dialing a local or toll-free telephone number, although the system is accessible from the Internet. There are no other charges to use the system, although schools must provide the necessary telephone line.

West Virginia Microcomputer Educational Network
West Virginia Department of Education
1900 Kanawha Boulevard East
Charleston WV 25305

WVMEN is a statewide instructional bulletin board service linking administrators, teachers, non-formal educators, and students. A toll-free number is available to in-state callers.

IKELink
Nevada Department of Education
400 W. King Street
Carson City NV 89710

IKELink provides information on science and math to teachers and students via electronic mail. IKELink relies on equipment and software donated through national math and science programs.

SEND-IT
North Dakota Educational Telecommunications Council
North Dakota State University
Fargo ND 58105

SEND-IT was established to deliver information and materials to K-12 students, teachers, and non-formal educators. Access is by local or toll-free telephone calls. Local phone expenses are paid by the users; all other costs are covered by the state.

Florida Information and Resource Network
Department of Education
Bl-14 Florida Education Center
Tallahssee FL 32399

FIRN provides access to computing resources and data centers to staff and students at all Florida universitites and community colleges (and K-12 students and teachers who can access the system). A particular focus of the system is providing resources to homebound students and parents. The system is connected to the Internet and is also accessed via local or toll-free calls.

AKNet
UACN (University of Alaska Computer Network)
Department of Education
801 W. 10th Street, Suite 200
Juneau AK 99801

AKNet is an information exchange system for educators, accessible from a PC with a modem. Users are charged for a telephone call to the central administration in Juneau.

Learning Link Wisconsin
Wisconsin E. C. B.
3319 W. Beltline Highway
Madison WI 53713

Learning Link Wisconsin is the local node for LinkNet, a national consortium of educational computer networks affiliated with public television stations. Access is via local and toll-free phone calls from a PC with a modem.

Learning Link Hampton Roads
WHRO-TV
5200 Hampton Boulevard
Norfolk VA 23508

Learning Link Hampton Roads is part of the LinkNet system, serving southeastern Virginia. It is accessed primarily by dial-up modem on a toll-free line. Users must supply their own equipment and software but the operating costs of the system are covered by the local public television station and a consortium of regional school districts.

NJLink
Department of Education
CN 500
Trenton NJ 08625

NJLink is a part of the LinkNet system. As with each local node, NJLink provides a menu of national services such as CNN Classroom News, Assignment Discovery, and Election Central, as well as features customized for the local users. System operating costs are partially underwritten by the Department of Education and educational associations. Users must provide their own equipment(PC and modem), but there are no other costs associated with accessing the system.

Newton
Argonne National Laboratory
Building 223
9700 S. Cass Avenue
Argonne IL 60439

Newton is a bulletin board service for teachers and students of science, math, and engineering. It is accessible from a PC with modem through a non-toll-free phone line, but is also accessible via the Internet. There are no additional charges associated with using the system.

National Distance Learning Center
Owensboro Community College
4800 New Hartford Road
Owensboro KY 42303

NLDC is a clearinghouse which provides information about educational materials and distance learning courses as well as information on acquiring these materials. It is accessed through a non-toll-free phone line from a PC with modem, but there are no other charges. The system operators expect to have access via the Internet in late spring of 1993.

Instructional Resources and Technology Services
University of Northern Iowa
Cedar Falls IA 50614

IRTS provides curriculum materials to students and faculty at the University of Northern Iowa, as well as to classroom teachers (K-12) and other non-formal educators throughout Iowa. Users of the system must physically go to the IRTS office to use the system.