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ABSTRACT

This paper addresses online classroom and electronic library issues which include the myriad of technical difficulties encountered, along with physical and intellectual property rights. It also makes a statistical comparison of two proportions of Internet access between city and rural schools. An inescapable time lag between the introduction of new technology and attempts to address its legal, ethical, and moral implications are discussed. A statistical inference of exponential growth in the number of Internet hosts from 1981-1997, advertised in the Domain Name Server are also reviewed. The study concludes that, as electronic libraries and online classrooms proliferate, containing vast databases of information linked together by the information superhighway, distributed, standards-based, scaleable online classrooms and electronic libraries are inevitable. To place these global virtual online classrooms and electronic libraries at the fingertips of a world-wide clientele will require the development of intelligent client programs that can aid the user in exploring the thousands of distributed information servers. It will also require application of advanced techniques for information retrieval, information filtering, resource discovery, and the application of new techniques for automatically analyzing and characterizing data sources ranging from texts to videotapes. Additionally, it will require that new laws and legislation be enacted based solely on the use of computer technology. (Contains 14 references.) (AEF)

The Electronic Library and the Online Classroom: A Technical, Legal, Ethical, and Moral Perspective

By:

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THE ELECTRONIC LIBRARY AND THE ONLINE CLASSROOM: A TECHNICAL, LEGAL, ETHICAL, AND MORAL PERSPECTIVE

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INTRODUCTION

Plato posed the central ethics issue addressed in the Republic: Suppose you had a ring which when you turned the stone, made you invisible; why then should you act justly? The same question faces today's computer user who, with the aid of this phenomenal technology and an Internet connection, can effectively become invisible. The problem was ancient in Plato's time; the philosopher made his point with the Ring of Gyles, already a legend in 400 B.C. However, the legal and ethical questions encountered today are as old as the pyramids, and the circumstances as new as the latest computer technology hardware/software. This paper will address online classroom and electronic library issues which include, but are not limited to, the myriad of "technical difficulties" encountered by using said technology, along with physical and intellectual property rights. This study will also make a statistical comparison of two proportions of Internet access between city and rural schools. Furthermore, the inescapable time lag between the introduction of new technology and attempts to address its legal, ethical, and moral implications will be discussed. Lastly, a statistical inference of exponential growth in the Number of Internet Hosts, from 1981-1997, advertised in the Domain Name Server (DNS), will be reviewed.

ONLINE CLASSROOM USAGE IN THE UNITED STATES

By now almost everyone involved in education acknowledges that we are in the midst of an information explosion. We are no longer surprised by proclamations such as the one made by futurist Marvin Cetron (1988) that "by the year 2000 high school seniors will come into contact with as much information in the course of a year as their grandparents did in the course of a lifetime." Indeed, we sometimes fail to be astonished when we hear people like Ivan Trujillo (1989) tell us that the body of scientific information is doubling every eighteen months. We are becoming accustomed to the information explosion just as our forbears became accustomed to the automobile, air travel, and color television. But one aspect of the information explosion appears to be sneaking up on us. Between 1989 and 1992, for example, schools' inventory of computers increased by nearly 50%. In addition, surveys have confirmed the increasing prevalence of the Internet and other online services in schools. Currently, the U.S. Department of Education reports that 35% of public schools have access to the Internet, and an additional 14% more have access to other wide-area networks such as CompuServe, America Online, and Prodigy. [1] (Office of Educational Research and Improvement, 1995).

Technological innovation has necessarily kept pace with the expansion of readily accessible information. To be sure, the information explosion is directly attributable in large part to technological innovation. New technologies allow us to deal with more massive and disparate sources of information than ever before, and to do so more easily than we were able to deal with much smaller, more localized information just a few years ago.

This trend has been encouraged by numerous educators and government leaders, including President Clinton. In his State of the Union speech in January 1996, the President pronounced: "Every classroom in America must be connected to the information superhighway . . . by the year 2000."

Table one below provides a partial listing from The Digest of Education Statistics 1996 which indicates that the objective to have "every classroom in America" online by the year 2000 is well under way.

THE DIGEST OF EDUCATION STATISTICS 1996

TABLE 1-Percent of public schools and school classrooms having access to the Internet, by school characteristics: 1994 and 1995 (note: this is a partial listing)

School Characteristics	Estimated number of schools	Percent of schools having access to Internet		Percent of instructional rooms \1\ having access to Internet		Mean number of all computers, \2\ per school	Percent of computers \2\ with Internet access
	1995	1994	1995	1994	1995	1995	1995
All public schools	77,853	35	50	3	9	72	14
Instructional level\3\							
Elementary	57,705	30	46	3	10	60	13
Secondary	18,083	49	65	4	8	112	13
Size of enrollment							
Less than 300	20,673	30	39	3	11	41	15
300 to 999	50,044	35	52	3	10	71	15
1,000 or more	7,136	58	69	3	4	164	8

Metropolitan status							
City	17,906	40	47	4	8	84	11
Urban fringe	18,464	38	59	4	8	83	13
Town	19,539	29	47	3	10	72	16
Rural	21,944	35	48	3	10	54	14

\1\ Includes all classrooms, computer labs, and library/media centers.
\2\ Includes computers used for instructional or administrative purposes.
\3\ Excludes combined elementary/secondary schools because of small sample size.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Fast Response Survey System, Survey on Advanced Telecommunications in U.S. Public Schools, K-12.
[2] (URL http://www.ed.gov/NCES/pubs/D96/D96T411.htm) [Accessed Feb. 1997]

The above statistics reinforce that linking the nation's schools to the Internet is a widely held goal. Nonetheless, based on the above data, this study made a 90% confidence interval for comparing two proportions between city and rural schools having access to the Internet in 1995.

PROCEDURE

The two groups being compared are called population 1 (City Schools) and population 2 (Rural Schools), and the two populations of successes p_1 and p_2 . The data consist of the number of city schools n_1 = 17,906 and rural schools n_2 = 21,944. The proportion of successes in each sample is the percentage of schools having access to the Internet: X_1 = 8416 (47%) and X_2= 10533 (48%) which estimates the corresponding population proportion. The question then posed by this study was is there a difference in preference between city and rural schools for having access to the Internet? Table 2 reflects the applied values for the required calculations.

TABLE 2 Applied Values

Population	n	X	$\hat{p}$ = X/n
1 City Schools	17,906	8416	.470
2 Rural Schools	21, 944	10533	.480

In TABLE 2, the $\hat{p}$ column provides the sample proportions of city and rural schools which had access to the Internet during 1995.

RESULTS

To compute a 90% confidence interval for the difference between city and rural schools which prefer access to the Internet, first the standard error S_D of the observed difference had to be calculated:

$$S_D = \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$$

$$S_D = \sqrt{\frac{(.470)(.53)}{17906} + \frac{(.480)(.53)}{21944}}$$

$$S_D = .0050$$

The 90% confidence interval is: $= (\hat{p}_1 - \hat{p}_2)$ + or - (z) (S_D)

= (.470 - .480) + or - (1.645) (.0050)

= (-0.0018, -0.0182)

With 90% confidence, it can be said that the difference in the proportions is between -0.0018 and -0.0182. Therefore, since the interval does not contain zero, this study concludes that neither group has a stronger preference for having access to the Internet.

Regardless, if every student, faculty, and staff member is provided with access to online resources; opportunities to engage with experts, mentors, and peers; and supports to master real-world information and communication skills, it is obvious that such resources would help each group succeed in today's technological society.

TECHNICAL DIFFICULTIES

The implementation of this technological endeavor requires an enormous investment. It is not just a matter of hardware, software and wires; it is, for example, the technical difficulties of ensuring the proper levels of access once the database has been queried. It is determining the heterogeneous communications protocol environment required for the use of online classrooms and electronic libraries.

Furthermore, it requires profound thought regarding the user interfaces which will be utilized with said technology. It also requires a new way of teaching, learning, and adapting to the new technology. Additionally, it requires the support of the whole educational community, from the government to superintendents, principals, teachers, and parents.

DEFINING THE ELECTRONIC LIBRARY

Electronic libraries use electronic networks and computer-based technologies to perform their traditional activities--information organization, storage, retrieval and interlibrary loan; as well as many newer activities such as electronic document delivery, online database searching, and current awareness services.

The design and development of the electronic library has been based on a particular vision of electronic libraries and how they will develop and proliferate in the future. This vision assumes that there will be many sites that will want to contribute material to and access material in "The Library." This library will be a global virtual library because the traditional collection model of gathering all information possible into one place is no longer tenable, or desirable. We must envision a vast population of users scattered around the globe who are able to access easily and conveniently the complete contents of thousands of large and small repositories containing texts, images, sound recordings, videos, maps, scientific and business data, as well as hypermedia combinations of these elements. The library must, therefore, be a network-based distributed system with local servers responsible for maintaining individual collections of digital documents ranging from sets of electronic texts to video-on-demand services. In effect, this virtual library will actually consist of a set of publishers of electronic information and a set of consumers distributed across the network.

The "glue" that holds together this distributed library will be conformance to a set of standards for document description and representation, and a set of communication protocols. The use of multiple standards for both document description and representation for communication are inevitable in the near term. For eventual standardization of document description and representation, It is noted that SGML (Standard Generalized Markup Language) will provide the basis for text and compound document architectures (supported by additional standards for image, video, and compound documents). SGML is an International Standard Organization standard (ISO 8879:1986) which supplies a formal notation for the definition of generalized markup languages.

Several Internet FTP (File Transfer Protocol) sites supporting SGML provide a wealth of valuable information in disk files, but access to that information via the file systems is sometimes not optimal for the beginner.

There is a SGML Web Page [3] (URL:<http://www.sil.org/sgml/sgml.html> [Accessed Feb. 1997]) with links to other WWW servers, GOPHER servers, and FTP servers, as well as to important SGML documents archived locally. The SGML Web Page should nonetheless prove helpful for researchers who need a basic orientation to SGML, especially with respect to resources freely available on the Internet. For communications, the standard protocol for low-level query/response and document delivery will be some extended version of the American National Standards Institute ANSI Z39.50 [4](URL:<http://www.cni.org/pub/NISO/docs/Z39.50-1992/www/50.brochure.part02.html> [Accessed Feb. 1997] information retrieval protocol. This standard specifies an Open Systems Interconnection application layer service definition and protocol specification for Information Retrieval. The Information Retrieval protocol allows an application on one computer to query the database of another computer.

Currently, Electronic Library's are supporting multiple communications protocols for access to the contents of the its database (including the World-Wide-Web's HTTP (HYPERTEXT Transfer Protocol), Gopher, and FTP). Eventually, a higher-level protocol such as the CNRI's (Corporation for National Research Initiatives) KIS (Knowbot information server) may be used as well.

"As the diversity of computer applications increases, the burgeoning flow of megabit traffic between machines will be accommodated by wider and smoother highways. Worldwide digital communication will be facilitated by Knowbots and packet switching (as distinguished from circuit switching). Fiber-optic packet technologies, including Fiber Distributed Data Interface (FDDI); Distributed Queue Dial Bus (DQDB); Frame Relay, Integrated Services Digital Network (ISDN); gigabit-speed capabilities of computers linked in parallel; Synchronous Optical Network (SONET); Asynchronous Transfer Mode (ATM); and Broadband ISDN can be organized into a hierarchy. The layers of this hierarchy, from bottom up, are envisioned as 1) physical, i.e., the means of transmission of signals, whether electronic, radio frequency, or optical; 2) link, where these signals are made into chunks; 3) network, where packet switching permits computer-to-computer communication; 4) transport, or the Internet where flow and congestion are controlled, and where current public (DARPA, NSF, NASA, US Dept of Energy) and private (Xerox, IBM, Digital Equipment Corporation) research and development are focused; 5) session, where programs interact; and 6) presentation, where information is exchanged. Network management is concerned with all these levels." [5] (Cerf, Vinton G. (Corporation for National Research Initiatives, CNRI) Networks. Scientific American; September 1991; 265(3): 72-81).

This standards-based model allows individual information providers (or publishers) to experiment with different implementation schemes while allowing the system to scale and preserve interoperability. That is, the use of open standards and the distributed client/server model will permit production servers (even commercial servers) to operate in parallel with experimental research-oriented servers and will permit both to be accessed from any client. Materials in the Electronic Library may be accessed via any protocol-compatible client and provided by any protocol-compatible server.

The final portion of the "technical difficulties" involves providing the users with various Search Tools/Engines to obtain "specific" information and an interface design that is "user friendly."

The Internet provides a multitude of "search engines" for information retrieval. Consequently, the amount of information which can be obtained via the online classroom and electronic library is phenomenal. The following is an "abbreviated" list of the types of Search Tools which can be utilized:

Search Tools/Engines [6] (URL http://www.nas.nasa.gov/NAS/WebWeavers/searchpage.html)

Search engines

- Lycos
- Open Text
- InfoSeek
- "Yahoo"--One of the best searchable indexes to WWW information
- Search engine index (from CUI, combines pointers to many search resources)
- Netfind --E-mail address search

Information on Searching Tools

- Nexor's list of robots
- Searching The Web (NCSA)
- Indexing the Web (NCSA)
- Computers: World Wide Web: Databases and Searching ("Yahoo !")
- Netscape Communication's "Internet Search" page
- Z39.50 resources -- a pointer page

INTERFACE DESIGN FOR COMPUTER-BASED LEARNING ENVIRONMENTS

Research in the area of user interface design for computer-based learning environments [7] (Jones, 1993) found that screen and interface design should be considered at the same time during the design and development process. Additionally, the research produced a list of interface design concepts and a corresponding list of guidelines for implementing those concepts. The concepts presented in this paper are broad issues to be considered during the design and development process. Names for some of the concepts were taken from an analysis of the literature in computer-based instruction (CBI), computer-based learning environments, and human computer interaction (HCI).

CONDITIONS FOR BROWSING

* Provide selectable areas to allow users to access information.

Some possible selectable areas to consider are buttons and hot text within a text field. The location of these elements on the screen will depend on the available screen real estate and the function of the selectable areas. It is recommended that the placement of selectable areas be tested with users to find out what is the optimal location for them. The selectable area will be a control element for users to access information. The control chosen will depend on the task to be done. Be consistent in implementing particular controls for particular functions.[8 & 9] (Jones, 1989; Laurel, Oren, & Don, 1992)

* Allow users to access information in a user-determined order.

This may be done through topic indexes of all of the information available in the program, or through the use of different types of menus. Another technique to consider is allowing for user-entered search terms. Exploration should be flexible, and the controls for accessing information should reflect flexibility. [8] (Jones, 1989)

* Provide maps so that users can find where they are and allow provisions to jump to other information of interest from the map.

Because the content of computer-based learning environments tends to be complex, using visual or iconographic maps may be too difficult to include and too confusing for users to understand. What we now consider as maps may have to change drastically. Text based indexes, outlines, and tables of content may be considered as alternatives to maps.[9] (Laurel, Oren, & Don, 1992)

* Provide users with feedback to let them know that they must wait when significant time delays are required for the program to access information.

Many programs use watch cursors or text messages that ask users to "be patient." Another technique to consider is to offer users some type of visual stimulus to maintain their interest while the computer is preparing to present the requested information. However, visual stimulus should be chosen carefully and kept as simple as possible.

* Provide users with information that lets them know that they are making progress.

Because the information in computer-based learning environments is not organized sequentially, there is no determined order that users must follow through a program. Consequently users may feel that they are working in a program without making progress. Some techniques that may be considered to give users a sense of accomplishment are path history mechanisms that tell users what information they have seen, or visual cues that indicate progression.

Another technique would be to break the program up into chunks that may give learners a feeling of accomplishment. [8] (Jones, 1989)

* Arrange information in a non-threatening manner so that users are not overwhelmed by the amount of information contained in a program.

To accomplish this consider setting up information with an overview of a topic that acts as a top layer of information. As users need more information they can move progressively deeper through the layers of information. Moving through the layers of information could be done through the use of pop-up menus, buttons, or hot text.[8] (Jones, 1989)

* Closure

The concept of closure deals with two aspects of information within a computer-based learning environment. The first is the organization of program information into manageable segments so that users are not overwhelmed by the amount of information contained in the program. Organizing information requires that methods be used to allow users the ability to access information in a controllable fashion. The second aspect of closure deals with how users know that a segment of information has been chosen or completed. Implementation of the concept of closure helps users to organize information and feel that they are making progress in an environment that is complex and seemingly infinite. [8] (Jones, 1989)

Now that we have access in a "user friendly" environment, what are the legal and ethical issues regarding this *new* form of media? Or as Plato asked: Suppose you had a ring which when you turned the stone, made you invisible; why then should you act justly?

LEGAL AND ETHICAL ISSUES

Ethics is often described as a group of moral principles or set of values. Ethical practices are then behaviors which conform to that set of values. In today's computer oriented/networked society, what does that mean for the average researcher/faculty/student? How would they choose to report information/data obtained via the Internet? When does it become plagiarism? Who gets the credit? What constitutes fraud?

There are a multitude of legal and ethical issues which can be brought to the forefront in this study. Nonetheless, this study will primarily focus on Copyright Laws and Ethical Conduct in Academic Research and Scholarship.

WHAT ABOUT COPYRIGHT LAWS?

The Clinton administration has proposed tightening or making new intellectual property laws for information transmitted over the Internet. But these laws only make it illegal to copy and sell copyrighted and protected information. The David LaMacchia case is a salient example of this loophole in our current regulatory system.

The primary objective of copyright is not to reward the labor of authors, but "to promote the Progress of Science and useful Arts." To this end, copyright assures authors the right to their original expression, but encourages others to build freely upon the ideas and information conveyed by a work. This result is neither unfair nor unfortunate. It is the means by which copyright advances the progress of science and art.-- Justice Sandra Day O'Connor [10] (Feist Publications, Inc. v. Rural Telephone Service Co., 499 US 340, 349 (1991).

The genius of U.S. copyright law is that in conformance with its constitutional foundation, it balances the intellectual property interests of authors, publishers, and copyright owners with society's need for the free exchange of ideas. Taken together, fair use and other public rights to utilize copyrighted works, as confirmed in the Copyright Act of 1976, constitute indispensable legal doctrines for promoting the dissemination of knowledge, while ensuring authors, publishers, and copyright owners appropriate protection of their creative works and economic investments.

The fair use provision of the Copyright Act allows reproduction and other uses of copyrighted works under certain conditions for purposes such as criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship or research. Additional provisions of the law allow uses specifically permitted by Congress to further educational and library activities. The preservation and continuation of these balanced rights in an electronic environment, as well as in traditional formats, are essential to the free flow of information and to the development of an information infrastructure that serves the public interest.

It follows that the benefits of the new technologies should flow to the public as well as to copyright proprietors. As more information becomes available only in electronic formats, the public's legitimate right to use copyrighted material must be protected. In order for copyright to truly serve its purpose of "promoting progress," the public's right of fair use must continue in the electronic era, and these lawful uses of copyrighted works must be allowed without individual transaction fees. Without infringing copyright, the public has a right to expect:
a) to read, listen to, or view publicly marketed copyrighted material privately, on site or remotely; **b)** to browse through publicly marketed copyrighted material; **c)** to experiment with variations of copyrighted material for fair use purposes, while preserving the integrity of the original; **d)** to make or have made for them a first generation copy for personal use of an article or other small part of a publicly marketed copyrighted work or a work in a library's collection for such purpose as study, scholarship, or research; and **e)** to make transitory copies if ephemeral or incidental to a lawful use and if retained only temporarily.

Although the fate of copyright may seem in doubt to some, copyright has a long and durable history. It has survived countless technological changes over nearly two centuries, including the advent of photography, the phonograph, player pianos, motion pictures, audio tapes and cassettes, and computer programs--and it is still going strong.

But to expect that copyright will survive the new information technologies is not to expect that it will be unchanged, nor that those industries--publishing, music, computer software, etc.--that depend on copyright law will remain unchanged. To the contrary, pressure for change will build on both industry practices and the development of copyright doctrine. Consequently, as a direct result of the "new cyberspace" medium, the U.S. Government has initiated the following changes regarding copyright law:

TECHNOLOGICAL PROTECTION SYSTEMS AND INFORMATION

The Working Group recommends that the Copyright Act be amended to include a new Chapter 12, which would prohibit the importation, manufacture or distribution of any device or product, or the provision of any service, the primary purpose or effect of which is to deactivate, without authority of the copyright owner or the law, any technological protections which prevent or inhibit the violation of exclusive rights under the copyright law.

The Working Group recommends that the Copyright Act be amended to prohibit the dissemination of copyright management information known to be false and the unauthorized removal or alteration of copyright management information. Copyright management information is defined as the name and other identifying information of the author of a work, the name and other identifying information of the copyright owner, terms and conditions for uses of the work, and such other information as the Register of Copyrights may prescribe by regulation.

SUPPORT OF PENDING LEGISLATION

The Report also generally supports legislation that would amend the copyright law and the criminal law (which sets out sanctions for criminal copyright violations) to make it a criminal offense to willfully infringe a copyright by reproducing or distributing copies with a retail value of $5,000 or more (S. 1122). By setting a monetary threshold and requiring willfulness, S. 1122 ensures that merely casual or careless conduct resulting in distribution of only a few copies will not be subject to criminal prosecution and that criminal charges will not be brought unless there is a significant level of harm to the copyright owner's rights.

The Working Group also supports a public performance right for sound recordings. Two bills now pending, S. 227 and H.R. 1506, would grant such a right, although more limited than the Report recommends. [11] <http://www.uspto.gov/web/offices/com/doc/ipnii/execsum.html> [Accessed Feb. 1997]

ETHICAL CONDUCT IN ACADEMIC RESEARCH AND SCHOLARSHIP

The integrity of the research process is an essential aspect of a university's intellectual and social structure. Research is defined as all research, scholarly, and creative activity that supports the intellectual endeavors of the University. Although incidents of misconduct in research may be rare, those that do occur threaten the entire research enterprise.

The integrity of the research process must depend largely upon self-regulation. Formalization of the rights and responsibilities underlying the "empirical" method is imperative in the research process. The University is responsible both for promoting academic practices that prevent misconduct, and also for developing policies and procedures for dealing with allegations or other evidence of fraud or serious misconduct. All members of the University community--students, staff, faculty and administrators--share responsibility for developing and maintaining standards to assure ethical conduct of research and detection of abuse of these standards.

The primary way to encourage appropriate conduct in research and scholarship at the University is for faculty to promote and maintain a climate consistent with high ethical standards. To reduce the likelihood of misconduct in research and scholarship, the faculty and administration should facilitate the following:

1. Encouragement of Intellectual honesty. Because of the importance of a climate of Intellectual honesty in a university community, a commitment to the ethical responsibilities of academia by all of its practitioners is essential. Mentor relationships between academic leaders and new practitioners serve to guarantee the transmission of ethical standards.

2. Assurance that quality of research is emphasized.

3. Acceptance of responsibility by the research supervisor. It is also the responsibility of the supervisor to encourage publication of as much primary data as possible.

4. Establishment of well-defined research procedures. Well-designed and strictly-adhered-to research methods are a deterrent to fraud.

5. And lastly, appropriate assignment of credit and responsibility. Publications should recognize the contributions of others through adequate citation and/or acknowledgment.

As outlined above, the "new" technology of the online classroom and electronic library has brought forth technical, legal, and ethical issues unlike any of its predecessors. However, since this study could not obtain "raw data" regarding online plagiarism, it will look at the data regarding Internet growth.

INTERNET GROWTH: LINEAR OR EXPONENTIAL?

The ZONE (Zealot Of Name Edification) program was originally intended to be used during the host-table-to-DNS (Domain Name Server) transition period. ZONE would "walk" the DNS tree and build a host table of all the information it collected. Hosts are the number of machine addresses on the Internet as reported by the name servers. This host table could then be used by sites that had not yet made the DNS transition. However, ZONE was never used for this purpose. Instead, it was found to be useful for collecting statistics on the size of the domain system and the Internet. This study used data collected by the ZONE in determining whether or not the growth of the Internet has been linear or exponential from 1981-1997. Table 3 below depicts the data:

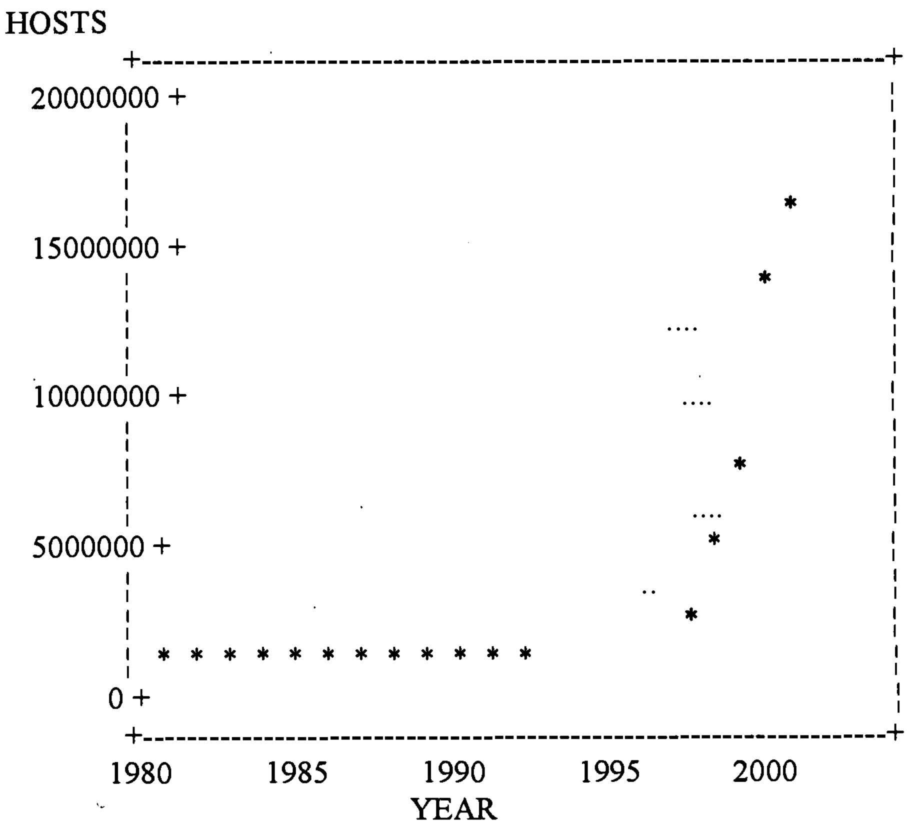
TABLE 3 Number of Internet Hosts, 1981 - 1997

Date	Hosts	Date	Hosts
08/81	213	01/92	727,000
05/82	235	04/92	890,000
08/83	562	07/97	992,000
10/84	1,024	10/92	1,136,000
10/85	1,961	01/93	1,313,000
02/86	2,308	04/93	1,486,000
11/86	5,089	07/93	1,776,000
12/87	28,174	10/93	2,056,000
07/88	33,000	01/94	2,217,000
10/88	56,000	07/94	3,212,000
01/89	80,000	10/94	3,864,000
07/89	130,000	01/95	4,852,000
10/89	159,000	07/95	6,642,000
10/90	313,000	01/96	9,472,000
01/91	376,000	07/96	12,881,000
07/91	535,000	01/97	16,146,000
10/91	617,000		

[12] <http://www.nw.com/zone/host-count-history> [Accessed Feb. 1997]

Chart 1 reveals graphically how the Internet has grown during the time period specified:

CHART 1: Number of Internet Hosts, 1981 - 1997



“*” = data point, “.” = estimate

NOTE: Chart produced via MYSTAT computer software package.

“A variable grows linearly over time if it *adds* a fixed increment in each equal period. Exponential occurs when a variable is *multiplied* by a fixed number in each period. Furthermore, it is characteristic of exponential growth that the increase appears slow for a long period and then seem to explode.” [13] (Introduction to the Practice of Statistics, 2nd edition, 1993, pg. 147 & 148)

It is predicted that by the year 2000 there will be over one hundred million (100,000,000) host computers connected to the Internet!
[14](URL: <http://www.genmagic.com/Internet/Trends/slide-4.html> [Accessed Feb. 1997])

Based on the above "textbook" definition of exponential growth, it is apparent that the Internet has indeed grown at such a rate. However, the way to "check" exponential growth is to apply a mathematical transformation that changes the exponential growth into linear growth. The necessary transformation is carried out by taking the logarithms of the data points. "If a variable grows exponentially, its logarithm grows linearly." [13] (pg. 150)

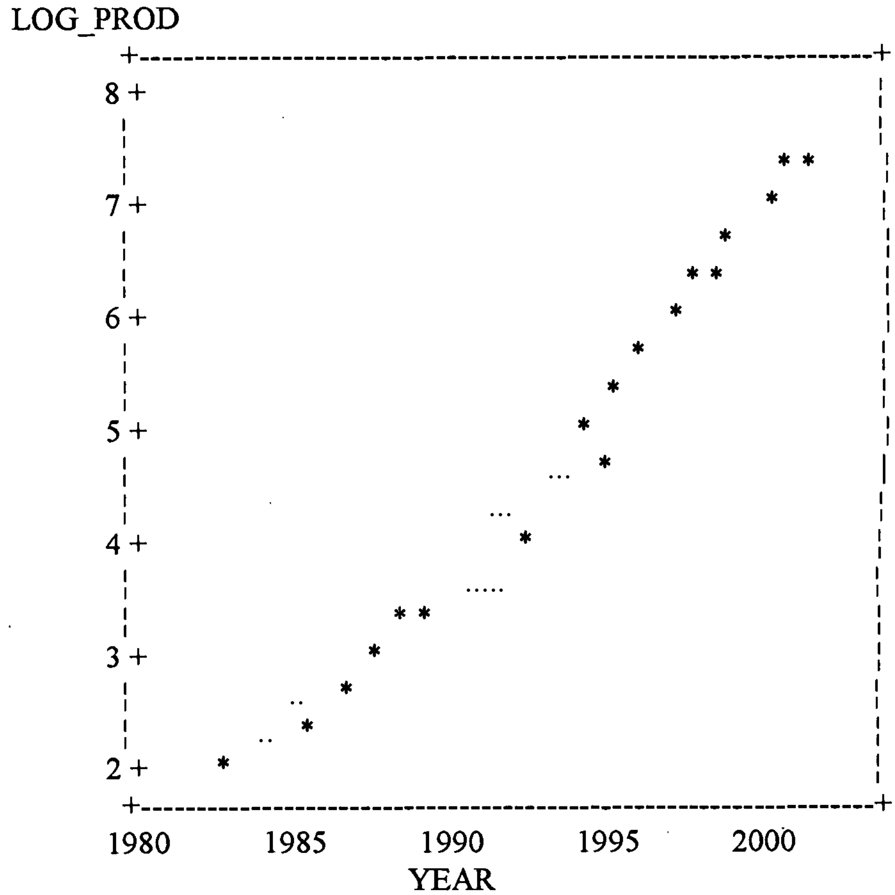
Consequently, this study conducted a logarithmic calculation of the data points from 1981-1997. Table 4 below depicts the "Logarithmic Values Produced" (Log_Prod) of the observed data points:

TABLE 4 Logarithmic Production Values For Number of Internet Hosts, 1981 - 1997

Date	Hosts	Log_Prod.	Date	Hosts	Log_Prod.
08/81	213	2.328	01/92	727,000	5.862
05/82	235	2.371	04/92	890,000	5.949
08/83	562	2.749	07/97	992,000	6.000
10/84	1,024	3.010	10/92	1,136,000	6.055
10/85	1,961	3.292	01/93	1,313,000	6.118
02/86	2,308	3.363	04/93	1,486,000	6.172
11/86	5,089	3.707	07/93	1,776,000	6.249
12/87	28,174	4.445	10/93	2,056,000	6.313
07/88	33,000	4.519	01/94	2,217,000	6.346
10/88	56,000	4.748	07/94	3,212,000	6.507
01/89	80,000	4.903	10/94	3,864,000	6.587
07/89	130,000	5.114	01/95	4,852,000	6.686
10/89	159,000	5.201	07/95	6,642,000	6.822
10/90	313,000	5.496	01/96	9,472,000	6.976
01/91	376,000	5.575	07/96	12,881,000	7.109
07/91	535,000	5.728	01/97	16,146,000	7.208
10/91	617,000	5.790			

Based on the premise that "if a variable grows exponentially, its logarithm grows linearly"; Chart 2 below reveals that in fact that the Internet has grown exponentially.

CHART 2: Number of Internet Hosts (logarithmic)



"*" = data point, "." = estimate

NOTE: Chart produced via MYSTAT computer software package.

As in real life, real data will not fit the exponential model perfectly, so applying logarithms will not produce a perfectly straight line. Nonetheless, the logarithmic model above clearly indicates that the graph is "quite close" to a straight line from 1981-1997. The logarithmic transformation enables the judgement of the appropriateness of the mathematical model by reducing the question to judging whether points lie on a straight line. Furthermore, a comparison of Chart 1 and Chart 2 reveals another advantage: Logarithms compress the vertical scale of the plot, making it easier to see deviations from fit in the earlier stages of exponential growth.

Lastly, since this study could not obtain any "raw data" pertaining to online plagiarism it must leave the reader with a question as opposed to answering one. The question then arises: since it has been determined that the Internet is growing exponentially, is this indicative of online classroom and electronic library plagiarism growing in the same manner? Suppose you had an online computer which when you accessed digital information on the Internet, made you invisible; why then should you act justly?

CONCLUSION

It is clear that the use of online classrooms and electronic libraries, coupled with the exponential growth of the Internet, has brought about some technical, legal and ethical issues as no other medium has before. Again, as electronic libraries and online classrooms proliferate, containing vast databases of information, linked together by the information superhighway, this study concludes that distributed, standards-based, scalable online classrooms and electronic libraries are inevitable. Furthermore, they must support all current and future media in an easily accessible and content-addressable fashion. To place these global virtual online classrooms and electronic libraries at the fingertips of a world-wide clientele will require the development of intelligent client programs that can aid the user in exploring the thousands of distributed information servers. It will also require application of advanced techniques for information retrieval, information filtering, resource discovery, and the application of new techniques for automatically analyzing and characterizing data sources ranging from texts to videos. However, there must also be some "technological" development in the area of determining who had access to what and when? Consequently, it will also require that new laws and legislation be enacted based solely on the use of computer technology. Finally, the use of this technology has "forced" all major institutions to "adjust" to the new medium and age of the global information village.

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