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Τίτλος: Potential of the World Wide Web in Education

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Abstract
Since its popularisation in 1993, the contribution of the Internet and the World Wide Web (Web) in education has dramatically increased. Apart from the presence of academic institutions, offering academic materials and resources, there is a mass movement towards distance learning over the Internet. The Web is providing a number of opportunities for teachers and students. Resources can be accessed which might otherwise have been unavailable, as it is currently the largest and most diverse information resource in the world with cross-platform portability. Teaching programs presented in a clear, attractive, and practical manner can be accessed and used by students as part of their modules or as distance learning courses. Students and teachers can communicate synchronously and asynchronously, thus fulfilling the essential component for interpersonal interaction in the teaching and learning process. This paper serves as a review, focusing on the features of the Web with potential to education and the technology that supports them, as well as recent developments in the area. It also looks at the basic features of Web-based courses and presents an account of the main advantages and disadvantages.

Περίληψη
Από το 1993 και μετά η συνεχώς αυξανόμενη δημοτικότητα του Διαδίκτυου και του Παγκόσμιου Ιστού αντικατοπτρίζεται και στην ολοένα και μεγαλύτερη εφαρμογή τους στην εκπαιδευτική διαδικασία. Εκτός από την δικτυακή παρουσία εκπαιδευτικών ινστιτούτων –προσφέροντας πληροφορίες για τη λειτουργία τους και εκπαιδευτικό υλικό– έχει αναπτυχθεί μια ιδιαίτερα αυξημένη τάση χρήσης του Διαδίκτυου για εκπαίδευση από απόσταση. Ο Παγκόσμιος Ιστός παρέχει ένα μεγάλο αριθμό ευκαιριών για μαθητές και δασκάλους. Ένα πλήθος από πηγές μάθησης γίνονται εύκολα προσβάσιμες, μιας και είναι η μεγαλύτερη και πιο πολυποίκιλη πηγή πληροφοριών στον κόσμο, συμβατή με κάθε τύπο Η/Υ. Εκπαιδευτικά προγράμματα παρουσιασμένα με καθαρό, ελκυστικό και πρακτικό τρόπο γίνονται προσβάσιμα και μπορούν να χρησιμοποιηθούν από μαθητές ενισχύοντας έτσι το εποπτικό υλικό διαφόρων γνωστικών αντικειμένων. Μαθητές και δάσκαλοι μπορούν να επικοινωνούν σύγχρονα και ασύγχρονα διατηρώντας το βασικό στοιχείο της προσωπικής αλληλεπίδρασης κατά τη διαδικασία διδασκαλίας-μάθησης. Η παρούσα εισήγηση αποτελεί μια μελέτη των βασικών χαρακτηριστικών του Παγκόσμιου Ιστού σε σχέση με την εκπαίδευση καθώς και τις τεχνολογίες που τα υποστηρίζουν. Επίσης εξετάζει τις πρόσφατες τεχνολογικές εξελίξεις και εφαρμογές σε αυτόν τον τομέα. Τέλος, αναπτύσσει τα βασικά χαρακτηριστικά που έχουν εντοπιστεί σε σπουδαστικά προγράμματα μέσω του Παγκόσμιου Ιστού και εκθέτει τα κύρια πλεονεκτήματα και μειονεκτήματα τους.
Λέξεις κλειδιά: Παγκόσμιος Ιστός, Ανοιχτή Εκπαίδευση, Εκπαίδευση από Απόσταση, Χαρακτηριστικά, Πλεονεκτήματα και Μειονεκτήματα
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1. Introduction
Nowadays the most popular platforms for delivering educational hypermedia are CD-ROMs and the Web. Although CD-ROM technology has many advantages such as large storage capacity; portability (large amounts of data can easily be transported); durability (well suited to long-term archiving of large amounts of data); the ability to search reasonably quickly through large amounts of data, they have three main disadvantages. CD-ROMs are problematic as a global distribution medium because they lack the main ingredient of person-to-person interaction, they are difficult and costly to update and in principle they are not cross-platform. The Web, which is the cutting edge of

global education delivery, overcomes these disadvantages. Through helper applications and internal mechanisms the Web can connect a learner to almost any part of the Internet. Because of this the Web shares the advantages and disadvantages of the rest of the Internet. McManu's (1995) description of the Internet fits the Web equally well: "The Internet can deliver video, but not as quickly as videotape, television, or CD-ROM. It can carry real time personal interaction, but not as well as telephone or video conferencing. It can display textual information, but not as useful as a book or magazine. Why then will the Internet ever be used? The Net has two real advantages over other media. It combines advantages of other media so that it conveys video and sound better than a book, is more interactive than videotape and, unlike CD-ROM, it can link people from around the world cheaply. The second advantage, and the one that is often overlooked when discussing the Internet as delivery system, is that it can also be a content provider. The Internet is arguably, the largest and more diverse information resource in the world today. It is possible to incorporate the wealth of information available on the Net in your design. For instance if you are designing a module on renaissance art history, you can include links to the Vatican Library and the Louvre, as well as the Art History exhibit of the Australian National University, just to name a few. This sort of immediate access to information and resources can not be found with any other medium". The following paragraphs will discuss in detail the features of the Web with potential for education and the technology that supports them.

2. Features of the Web with Potential for Education

HTML mainly delivers hypermedia documents on the Web. Since the first day that HTML was created it has evolved, new features have been added that can facilitate more flexible and interactive layout styles. In addition, the advancement of hardware and software allowed new ways of delivering interactive hypermedia over the Web.

However, what is essential in an educational environment is communication. The Web offers a range of communication channels, both asynchronous and synchronous. Electronic mail (e-mail) and bulletin boards are the most common forms of asynchronous communication. E-mail involves transferring text and any type of attached files from one computer to another over the Internet and makes it possible to communicate with virtually any other user connected in the Internet, anywhere in the world. Although e-mail provides transmission of files is not recommended for large files, instead the File Transfer Protocol (FTP) can be used that allows fast transmission of any file regardless its type and size over the Internet. The bulletin board is an electronic location where users can leave messages for other users. It also allows limited conferencing between users when accessing the bulletin board at the same time.

Synchronous communication channels include Internet Relay Chats (IRC), Multiple User Dungeons (MUDs), and computer teleconferencing. IRC are real-time group discussions and MUDs, which are essentially an IRC in a particular subject, provide users with the ability to interact with each other in real time. MUDs are multi-user interactive role-playing games on the Internet. MUD technology can be used in education to implement text-based virtual forums and virtual seminars where students and teachers can meet in real time and exchange ideas. However, more popular in education are MOOs, which are object-oriented MUDs, since they have sophisticated built-in programming language that allow individual users to extend the environment by 'building' or creating new objects. A MOO can be described as a network-accessible, multi-user, programmable, interactive system well suited to the construction of text-based adventure games, conferencing systems, and other collaborative software (Curtis and Nichols, 1993). Its most common use, however, is as a multi-participant, text-based virtual reality. Participants give coded text-based commands that are interpreted as appropriate. Such commands may cause changes in the virtual reality, such as the location of a character, or may simply report on the current state of that reality, such as the appearance of some object. The database contains representations of all of the objects in the virtual reality, including the MOO programs that the server executes to give those objects their specific behaviours. In an educational context the ability of MOOs to allow users to create new objects can permit the student to become an active participant in the learning experience. In addition, MOOs provide a strong sense of 'place', possibly bringing back some of the social interchange of 'campus life' that is lost in distance education. A MOO server can also be configured to act as an HTTP server. This means that a Web browser can be used to look at locations, rooms, people, artefacts, etc. in the MOO. These objects can have hypertext URLs attached and therefore be used to structure information on the Web (Hobbes and Taylor, 1996).

An important synchronous communication technology being integrated into the Web is teleconferencing programs, such as CUSeeMe, NetMeeting etc. Such teleconferencing programs, allow users to see and hear each other by converting the data from a video camera into an Internet compatible format. Functionality such as this combined with the Web's built-in audio-visual capabilities suggests new possibilities for group-based on-line education. The shared whiteboard is also a real-time tool supported by the Web. Internet whiteboard applications allow two people to view a shared drawing space. In addition to graphics, writing on the board can be used for communication, though whiteboard applications are usually combined with other Internet communication systems, such as teleconferencing technology.

A good example of how the Web technology is being advanced is real media. Real media is digitised audio and/or video that have been compressed into a format that a server can break down into packets and then broadcast across a network to a Web client. The client then reassembles the data packets into the correct order and plays back the audio and/or video in real time without breaks or frustrating download delays that have hitherto presented an obstacle to informational, recreational and creative use of audio and/or video. Such a technology provides new capabilities in educational settings as it gives the possibility to learners and teachers to interact and share information in real time.

Also important is the establishment of the Virtual Reality Modelling Language (VRML) as a standard method for describing three-dimensional virtual scenes on the Web. Although VRML was a static description language during its initial phase, it is currently being extended to support interactive virtual environments and behaviour of virtual world entities. Its originator, Mark Pesce (1996) defines it as "a language for describing multi-user interactive simulations - virtual worlds networked via the global Internet and hyperlinked with the Web". Like HTML, the 3D worlds that VRML provides can be hyperlinked to other resources on the Web. VRML can be thought as a 3D equivalent of HTML, providing a three-dimensional interface to the Web. VRML could make navigating through on-line museums, libraries, marketplaces, and every other space as common as interacting with textual information (Vacca, 1995).

Another area that is of particular interest for teaching and learning that greatly advances interactivity is the software agents or most commonly known as intelligent agents. An intelligent software agent encapsulates knowledge bases and reasoning mechanisms about the user's interests or preferences, its application domain and its environment. In other words software agents help users manage their personal information resources and activities, both locally and across the network. Apart from communicating with their humans, they usually interact with various databases, software applications and other agents.

Besides the above, new developments in Web technology by the W3 Consortium set up by Tim Berners Lee can provide even more opportunities in teaching and learning. The most recent are as follows (www.w3.org/Consortium/):

1. Integration of Web and television technologies will enable linking Television programs into the Web, and linking from television programs into the Web. By merging these two major media into one, the wealth of background information available on the Web is made available to television viewers, and the wealth of audiovisual information being broadcast on television is made available to the Web audience. Education and training can only gain by this.
2. Another new advancement is the Synchronized Multimedia Integration Language (SMIL) developed by W3C's Synchronized Multimedia Activity, which is designed to enable simple authoring of TV-like multimedia presentations such as training courses on the Web. The SMIL language is an easy-to-learn HTML-like language. Thus, SMIL presentations can be written using a simple text-editor. A SMIL presentation can be composed of streaming audio, streaming video, images, text or any other media type combined in real-time. Simply put, it enables authors to specify what should be presented when, enabling them to control the precise time that a sentence is spoken and make it coincide with the display of a given image appearing on the screen.
3. The Document Object Model is a platform and language-neutral interface that will allow programs and scripts to dynamically access and update the content, structure and style of documents. The document can be further processed and the results of that processing can be incorporated back into the presented page.
4. The Voice Browser Activity under development by the W3C is aiming to expand access to the Web to allow people to interact with Web sites via spoken commands, and listening to pre-recorded speech, music and synthetic speech. This will allow any telephone to be used to access Web-based services, and will be a benefit to people with visual impairments or needing Web access while keeping theirs hands and eyes free for other things, thus providing great advantages to learners with special needs.

3. World Wide Web-based courses

Currently there are a large number of on-line courses on the Web, covering a wide range of topics similar to those that academic and training institutions offer. The nature of these courses is mainly varied from higher education courses, to training courses. Within higher education two types of on-line courses have been identified. The first type is concerned with the delivery of support material for physical modules such as lecture notes and syllabus for on campus students. The second type is concerned with the delivery of primary learning resources aimed to support off campus students in distance learning. Distance learning Web-based courses are offered from conventional institutions with physical location, such as the Open University, U.K, as well as from virtual universities like '*Learning On Line University*' (LOLU) (www.lolu.org) and '*Athena University*' (www.athena.edu). LOLU claims that is an online school with courses featuring lectures, live chats throughout the school population, continuing class discussion in online forums, course glossaries, optional assignments, inter-student e-mail, self-scoring tests, and other educational features in an exceptionally robust and user friendly setting where everything is Web-based. Further, the Virtual Online University Services International (VOUSI) administers Athena University. VOUSI claims that it offers a novel and effective approach to academic excellence, professional development, and life-long learning. "Where the conventional distance education program leaves one isolated, our electronic campus allows one-to-one collaboration, debate and interaction between fellow students and instructors by way of a distinctly innovative model for distance education" (www.vousi.com). Athena shares VOUSI's mission to provide a quality liberal arts education to students in a more cost-effective and accessible manner. To accomplish this, Athena has established a virtual education environment which, can be accessed from anywhere on the globe at any time by exploiting present telecommunication technology. Its campus is constructed from a MOO, incorporating features and objects specifically built to provide a comprehensive educational environment.

Despite the fact that some of the existing on-line courses are still in experimental stages due to the novelty of the medium, there is still a respectable number of courses that have been running for the last couple of years and their providers claim that they have a satisfying number of students. For instance, in the academic year 1998/99, 5.100 students have been enrolled to the '*Object Oriented Approach*', an introductory computing course provided by the UK Open University. A Web-based database from the University of Texas, U.S., called '*The World Lecture Hall*' (www.utexas.edu/world/lecture/) contains links to pages created by faculties worldwide who are using the Web to deliver class materials. It offers an alphabetical index with 73 different areas of study from accounting to zoology, and links to Web-based courses in each of the area. In June 2000 the database includes 2.762 links. In addition, it offers translation service from or into English, Spanish, French, German, and Portuguese, and a facility to add new materials in this database.

Another fact that indicates the significance of Web based courses and predisposes for their future proliferation is that Internet software companies are offering services for the development of Web-based courses. Examples of such services are the '*CourseInfo*' (courseinfo.com), the '*Chalk*' (chalk.ifactory.com), and the '*CyberExam*' (www.vlearning.com). These companies offer methods by which instructors can easily place course materials online by creating an Internet Web site. The software is designed by the instructor who wants to provide a new facet of interaction with students but does not have the time to learn complex authoring languages. The providers of these services claim that they supply tools for creating and maintaining a Web site, which are extremely easy to use, yet perform many complex functions such as online collaborative classroom activities as well as off-line interactions, including asynchronous self-paced assignments, discussion groups, etc.

3.1 Basic Features of Web-based Courses

In order to identify the basic features involved in Web-based courses a number of courses were examined. The following nine basic features were identified within Web-based courses. The first six are included to a lesser or greater degree in all Web-based courses. However, the last three features in this list are used almost exclusively in Web-based courses aimed at distance learning.

1. *Presentation of class materials* - The course syllabus and items that would otherwise appear on a classroom overhead projector such as lecture notes, slides etc. are presented in hypermedia format. There are also links to other Web resources that apply to the course curriculum.
2. *On-line Databases/Libraries* - The students have access to on-line databases where data relevant to their course are stored in digital format. In addition, students can access on-line libraries, browse electronic book catalogues and make reservations.
3. *Electronic mail (e-mail*) - Is the primary form of communication for all the types of courses, where messages, questions and comments can been exchanged between students and instructors.
4. *File Transfer Protocol (FTP)* - Is used for downloading large files from Internet resources or the institution itself to the user's computer so they can been processed later by the user off line.
5. *Bulletin boards* - Bulletin boards are used to post messages to students and tutors. Unlike chat session, bulletin boards do not require the sender to be logged in at the same time as other participants; it is asynchronous communication. Participants can check back to see new postings by other members on the topic they have suggested.
6. *Quizzes and exercises* - Students undertake instantly self-scoring tests, which provide feedback on their performance; if needed they submit them to their tutor via email for further assessment.
7. *MOOs* - They are used to create open discussion areas, known also as 'chat rooms' to facilitate one to one or group, real time formal or informal discussions in subject areas. In the case of

distance education courses MOOs are used for real time lectures and conferences, and also as a facility to incorporate objects specifically built to provide an educational environment.

8. *Performance Tracking Report* - Students receive feedback and performance tracking report from their tutor via email or from the system. Such an example is a system developed in Eindhoven University of Technology in Netherlands that works as follows: students have to register at the beginning of the course. A CGI program that runs on the Web server and keeps track of the student's actions delivers all the pages of the course. The student is tracked by supplying pages with the student's identification embedded in the URL of each page. A list of pages that have been read, and pages still to be read, is part of a standard banner, added to every page of the course. A student can therefore easily find out which pages still have to be read and the generated list also contains active links to these pages (De Bra, 1996).
9. *On-line exams*. This feature is mainly used in distance learning courses, where exams are taken in a way similar as the campus based courses.

4. Benefits and Costs

In order to identify the benefits and costs of using the Web for teaching and learning the outcomes of a study conducted from a Working Party set up by the Committee of Scottish University Principals in 1992 is of particular interest. The study focused on potential approaches to the problem of teaching and learning in mass higher education and its major consideration was the cost and benefits of innovative teaching methods and the use of technology. "With the transformation of higher education into a system that is adapted to servicing the needs of much larger numbers comes the imperative to develop much greater flexibility. Distance and open learning methods - long practised by the Open University - free students from the constraints of time and place, and even allow for more individualised feedback to students that could be contemplated within the traditional university teaching systems" (Committee of Scottish University Principals, 1992). Some of the benefits identified for computer-based and distance education and also relate to Web-based learning as well are as follows:

- *Modified Traditional Systems* - Favourable changes in all the performance measures of traditional teaching systems could be achieved by a combined use of innovation and educational technology, particularly by the use of distance learning and computer based learning methods.
- *Access* - Intake and recruitment arrangements to a variety of courses could be greatly improved by creating self-paced supported learning courses giving a satisfactory preparation for a range of subjects requiring specific skills as prerequisites.
- *The shift from synchronous single-location learning support to asynchronous networked learning support* - The severe space and time constraints of traditional presentation methods using lectures and laboratories can be removed by a shift to self-paced supported learning using a variety of possible support and delivery mechanisms.
- *The shift from passive learning to active learning* - Learning is an active process in which concepts are acquired, incorporated into appropriate schemas, and tested in action. Computer-based learning support systems offer great scope for the development of active learning environments, and for an increase in the quality and effectiveness of the learning experience.
- *The shift from static presentation to dynamic presentation* - Cost-effective methods of producing and transmitting acceptable quality video and animation will greatly improve the presentation of a wide range of materials, and hence the quality of the learning support system.

- *The shift to multimedia* - The imaginative and skilful use of a wide range of media offers huge scope for imaginative teaching.
- *The shift from unidirectional presentation to interactive presentation* - Interactivity offers great scope for benefits in clarification, elaboration and consolidation, and is the key to the production of highly supportive learning environments. Great benefits in quality and effectiveness could be obtained, given a well-designed support system.
- *The shift from broadcast delivery to personal delivery* - The possibility, given skilful design, of developing learning support systems which tailor their response to an individual needs and performance is of great potential value in the battle to combine volume benefits with quality benefits. Properly developed, it could greatly increase the scope for self-paced learning and for access and remedial teaching, driven by an individual's motivation.

Some of the costs identified are as follows:

- *Infrastructure costs* - These are the costs of purchasing and installing hardware and software, and of providing networks.
- *Courseware costs* - The costs of courseware will depend on its commercial exploitation. Students could be required to purchase digital courseware in the same way as they are currently expected to buy books. However, as far as Web-based learning material is concerned, this is not exactly the case. At the moment there are plenty of teaching materials freely available on the Web, but also there are materials that are aimed primarily at distance education where the user needs to be enrolled in a course and pay tuition fees in order to have access to them. It can be argued that it is quite early to judge how the situation will evolve in the future because the Web as an educational tool is still in its early phase.
- *Research and Development costs* - Every large-scale growth in the use of technology needs a major programme of research and development. The research and development part is a very important component because the application of any innovative use of technology in education needs to address psychological and sociological issues. For instance, learners and teachers may need time to familiarise themselves with innovative ways of learning and teaching. In addition, some learners may perform better in conventional teaching and learning environments. Research and development costs may cut down if the industry is willing to invest in such a programme. This can be the case if it can be demonstrated that the research and development being conducted is likely to lead to wide exploitation

Considering the above, an outline of the main advantages of Web-based courses follows:

- Global access to courses and relevant information irrespective of time and location.
- Access to a large, expandable resource base covering a broad range of educational material.
- The ability to update course material easily.
- Easy downloading of paper-based teaching resources.
- The Web facilitates a flexible approach to learning, including group, distance, and collaborative learning. Moreover, it facilitates synchronous and asynchronous interpersonal interactions.
- Appealing presentation of course materials through hypermedia technology.

However, there are some particular drawbacks in Web-based courses associated with the costs identified for computer-based and distance learning that worth consideration. These are:

- An important drawback of on-line courses is the lack of physical communication among participants. Most people are used to working in an environment that affords physical personal interaction with peers and they may find it difficult to respond effectively in electronic communication. An important factor that contributes to this disadvantage is the absence of the

body language and facial expression when text-based discussion takes place in an electronic environment. Moreover, students are depriving the experience of the student way of life.
- Another possible trade off is that students will find using the technology an added learning curve and will need time to become confident in using the Web and its services. There is also the possibility of low levels of student participation in the course. It can be seen that participation varies considerably, and undoubtedly may be influenced by the design of the course. In the case of a second level undergraduate course '*DT2000: An Introduction to Information Technology*' delivered by the British Open University in the first year of the course only 26 per cent of students were contributors to the course (Bates, 1995). Furthermore without good design and moderating skills, it is very easy for online discussions to descend into low level chat or low levels of response from students.
- Other barrier(s) to Web-based courses may be the psychological disorders that may result to the participants such as information overload and addiction to the nature of on-line communication. As far as the nature of the courses is concerned the use of poor teaching strategies can be a major drawback. This can occur when computer programmers rather than academic subject experts lead the course development team.
- Finally, technical problems may be an obstacle to some Web-based courses. Some courses may require high performance computers in order for the user to 'run' effectively some of the hypermedia applications available. Furthermore, the connection to the Internet may be 'slow' when the network is too busy; resulting in slow downloads of information and unpleasant navigation throughout the presented materials.

5. Conclusion

Summarising, the Web is providing a number of opportunities for teachers and students. Resources can be accessed which might otherwise have been unavailable, as it is currently the largest and most diverse information resource in the world with cross-platform portability. Teaching programs presented in a clear, attractive, and practical manner can be accessed and used by students as part of their modules or as distance learning courses. Students and teachers can communicate synchronously and asynchronously, thus fulfilling the essential component for interpersonal interaction in the teaching and learning process. Therefore the Web can be seen as a piece of instructional technology because it can meet the requirements of the instructional technology, as the 'Definition and Terminology Committee of the Association for Educational Communication and Technology' (1972) have defined them: "The educational technology approach has been directed towards expanding the range of resources used for learning, emphasising the individual learner and his unique needs, and using a systematic approach to the development of learning resources". The Web has the potential to deliver individualised instruction. Through hypermedia presentations can give the learners the ability to tailor the learning process to their individual needs.

However, in order for Web-based courses to be undertaken effectively by students and overcome the barriers that are involved, there is a number of issues that need to be considered. For instance, before the student undertakes a Web-based course, training and familiarisation with the technology is recommended. This can be done by the student either participating in an Internet fundamental course, available from most institutions, or get familiar with the Web on his/her own by browsing Web pages, exchanging e-mail, downloading information, participating in news groups and on-line discussions etc. It is also essential that the students familiarise themselves with the reading and writing of electronic documents. As far as the institutions are concerned, technical and design factors must be considered in order for Web-based courses to be effective and successful. Regarding the technical aspect of Web-based courses there is a need for standardisation of the facilities available. That means that the educational software should be designed to be cross platform and compatible with the average performance hardware. The standardisation and integration of the available Internet software and plug-ins will also facilitate the efficient and effective use of Web-based courses.

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