A VIRTUAL TEACHING AND LEARNING ENVIRONMENT

M. Vladoiu

ABSTRACT
We may say the knowledge is the new global asset – so people have to be continually learning, crafting innovative solutions to changing circumstances, staying informed and responsive. *Computer Based Learning (CBL)* provides perhaps the best opportunity for person self-guided learning. If we take into consideration the role played by the Internet in everybody's life nowadays and if we make a further step forward to a CBL process using the Internet, we reach a more powerful variant of CBL: *Computer On-line Learning (COL).* Keeping in mind these two important needs we can easily see that general and efficient organization of multimedia (MM) information is one of the main requirements for developing courseware, which can be accesed by anyone's computer quickly and smoothly. MM DataBase Management Systems (MM DBMSs) offer a good solution for this problem. They allow storing and manipulating such data in an efficient manner with a high level of generalizability. Vast digital libraries of information will soon be available on the Internet as a result of emerging technologies for manipulating MM. These libraries will profoundly impact the educational activities. A new virtual teaching and learning environment is evolving.

KEYWORDS
Knowledge, computer on-line learning, hypermedia courseware, multimedia information, multimedia/virtual world databases, educational archives, digital libraries, virtual teaching and learning environment

INTRODUCTION

Our world – more precisely, our conception of the world – is continually becoming more and more complex. New information is added every day to the overall body of existing knowledge. We may say that knowledge is the new global asset – so people have to be continually learning, crafting innovative solutions to changing circumstances, staying informed and responsive.

It has been estimated that the available information regarding every facet of the world (technical, scientific, commercial, etc.) is doubling every five years. Probably, soon enough, this will happen even faster. This huge amount of knowledge makes it very difficult for an individual to acquire information on even a small area of interest. A big part of this knowledge is now available for every person who has a personal computer connected to the Internet. There is still a big problem: searching for the needed information is becoming more and more difficult.

Hypermedia (HM) information technologies will have as much impact on the next millennium as the invention of Gutenberg's movable type press has had for the centuries that followed it. Not only communications will change in this "new age", but also our perceptual response to the world in which we live, our construct of reality, and the nature of knowledge. Education is emerging as the leader in the new order but this does not necessarily mean traditional schools.

This paper presents the relationship between the information available to people and the need to improve their personal capabilities by learning and practicing using the capabilities of digital libraries and virtual reality techniques. It also stresses the importance of organizing information efficiently for (educational) use on the Internet.

COMPUTER ON-LINE LEARNING

Computer Based Learning (CBL) provides perhaps the best opportunity for individually self-guided learning. This is self-paced and self-planned with the learners (the studying individuals) themselves choosing their own paths through the mass of information encompassed by the *CBL package*. By using such packages, the learners will get other important abilities like self-assessment of studies, information technology skills, creativity and, of course, self-motivation.

If we take into consideration the role of Internet in everybody's life nowadays and if we make a further step forward to a CBL process using the Internet, we reach a more powerful variant of CBL: *Computer On-line Learning (COL)*. The first question someone might ask is what is COL? Although there is no formal definition for this, we can say COL is an exciting way to create, deploy, manage and use instructional materials (ranging from a simple "page-turner" presentation to highly interactive HM packages, such as tutorials, simulations and quizzes) using computers linked to the Internet or to a local intranet [3]. COL uses interactive and multimedia (MM) technology to present lesson content. It allows users to navigate through teaching material, respond to questions, listen to sounds, watch a video, view special graphics, and explore hyperlinks to related topics. COL can make content come "alive" in ways that classical teaching and learning processes cannot. COL also allows one to confirm the fact the learners understand and retain the knowledge delivered. But COL is not just an engaging way to present information – it is also a cost-effective solution that enhances and, in some cases, replaces, traditional instructor-led and print-based training.

A COL application is the instructional material developed for delivery to the learners through the Internet. It may be just one lesson or it may be a module comprising several lessons from a course/seminar/laboratory/examination etc. A group of related COL applications constitutes a *COL courseware*. MM-based learning materials (*MM courseware*) usually incorporate some characteristics of hypertext so we can use the notion of *hypermedia courseware*.

It is a well-known fact that the Internet has revolutionized communications. New ways to present ideas, collect and share information, and achieve worldwide interactive access are reshaping the possibilities for COL. The Internet is an ideal distribution medium for COL applications, providing the flexibility and functionality to maximize the content impact on learners.

COL distributed over the Internet has many advantages over traditional training. One important advantage is, as we said, *cost savings*. Schools, universities and other organizations often need to stretch funds while maintaining high-quality training programs. The cost of developing, distributing and maintaining a COL application is often much less than the cost of an instructor-led training program. The Internet reduces development and distribution costs because it is multi-platform. Course developers can create one version of their application, and users can access it with an IBM/Macintosh-compatible or any other type of computer. Changes can be made at any time in a single location and an updated version published easily. There is no need for costly and time-consuming reprinting or re-manufacturing of printed materials or CD-ROMs.

Universal access is another essential advantage. COL using the Internet enables the delivery of interactive learning to anyone, anywhere, at any time. Once the application is placed on a Web server, it is available immediately to anyone in the world with Internet access and a Web

browser. And the exchange is mutual: COL allows course developers to track and evaluate student scores. This *feedback* gives them the information they need to measure the effectiveness of their courses.

HYPERMEDIA AND THE NEW MODELS FOR EDUCATION

This section tries to answer the questions *Is HM a superficial environment? Does HM improve the quality of the educational process? Will HM cause changes in modeling of education?*

First we summarize the conclusions of the panel discussion *Multimedia and Education: Magic, Myth or Miracle Cure* presented in [28]. Video games are the first MM applications that have entered children's homes. Their reception has been enthusiastic. Psychologists, sociologists, and parents have been struck by the quality of engagement that stands in stark contrast with the half-bored watching on many television programs and the totally bored performance of school homework. The game context with its animated, colorful graphics and rich sounds has captured children's imagination and interest. A growing number of software developers have sought ways to mobilize, in the service of learning, the form of energy and engagement common in videogame playing. A significantly different approach gives children the opportunity to create and design their own software with new media forms. This approach sees the creation of MM artifacts as a process and a context for rich and personally meaningful learning. We can easily extend this approach to our students. The integration of HM in education has important implications in the teaching and learning process. Urgent reviews of educational practices is required in the light of the intellectual process of learning, which HM promotes, in order to evolve a new pedagogy. This pedagogy should harmonize with these opportunities rigor and quality of outcome.

That is a considerable volume of empirical evidence and also research reports that suggest that the use of MM techniques could lead to rapid development of mental models and creation of quality within these models [7-A1,B6,D4,D5, 6-A1,A2,E1]. Research consistently reports that MM instructional materials enhance learning, reduce learning time, and increase retention. The most significant and fundamental fact is that with the help of a MM tool the teacher activates the right cerebral brain hemisphere of the student. This arouses the non-verbal, intuitive form of thinking and enables a special kind of training aimed at stimulation of the students' creative ability. It should be noted that the students' learning ability is being enhanced not only by the visual effects of a MM lecture. MM presentations help save time for information reproduction and to devote more time for the explanation process [4, 20].

The Internet is seen as having enormous potential in education. It promise to impact general teaching/learning paradigm [19, 25, 7-A2,B1,B4, 6-F4] (e.g. the role of teacher will change from dispenser of knowledge to coach, facilitator, and mentor; the student will take advantage of anonymity on help seeking and on self-assessment [7-A3]; the on-line learning provides for an open learning environment [7-F1]). Traditional models of professional education are no longer suitable [6-A4,D3, 16, 18, 22]. Development of MM networks and virtual reality techniques have made it possible to establish new models for professional training [7-A4]. MM network technique has a great influence upon people's politics, economy and life. This influence is so profound as it may change every aspect of traditional education. Revolutionary changes could take place in these areas: model of teaching by teachers, learning by students, arrangement of courses and the structure and organization of school [7-A5,D1].

Some observers go so far as to predict that electronic learning will not only become prevalent but will lead to universities and colleges losing their exclusivity in the delivery of postsecondary education [20]. However, most teachers in educational institutions at all levels now realize that it is necessary to prepare our children for living in the Information Society. No matter how this Information Society will be built and will look like, let us hope the fears of Lowell Monke showed by the following questions are and will be groundless: *The computer promises my students an endless supply of information, but what good will that do if they can't make sense of any of it? Technology promises to help my students express their ideas better, but what good is that if they don't have any ideas to express?* [7,A6]

COL AND MULTIMEDIA DATABASES

By adding MM elements to a course we can get better results from the learners. It is a fact very strongly connected with the human nature. MM additions can animate, inspire, teach and motivate. An old Chinese proverb says: *I hear, I forget / I see, I remember / I do, I understand.* Providing a course containing only long text content is a boring way to deliver information. Only the people who are really "addicted" to studying will be satisfied enough with this kind of course. Students must be motivated in order to learn effectively. If the course developer adds to classical text, in a controlled manner, some MM components (like still images, video, audio, animation) the results of the teaching and learning process are significantly increased. Students can use the computer to perform practical tasks and their motivation is upheld through the combination of seeing, hearing, and doing [23].

From a practical point of view, COL courseware is actually a collection of files that work together to display and run a course. It consists of HM authoring software packages, HTML documents, MM files in Internet-ready formats, and some other pieces (like Java and/or ActiveX programs) that add functionality to the COL applications. When we are designing a COL application to be distributed on the Internet, we must balance the creative possibilities with the reality of the limited bandwidth on the Internet. However, we are not forced to create a text-only application – it is still possible to design an attractive, informative, and useful COL application, that runs quickly and smoothly on the Internet – we have only to carefully prepare and plan all necessary MM files. If we now focus on the efficient use of the media files contained in COL courseware, we should consider two aspects:

- The media files should be provided in a generic format that work on all hardware and software platforms;
- The MM data are never included into a COL application because of their big dimension – only the reference to them is stored in the COL application; the actual digital data remains stored in the original media source file.

Keeping in mind these two important points we can easily see that the general and efficient organization of MM information is one of the main requirements for developing courseware, which can be accessed by anyone's computer quickly and easily. Multimedia DataBase Management Systems (MMDBMSs) offer a good solution to this problem. They allow storing and manipulating such data in an efficient manner with a high level of generalizability.

According to [17] a MM DataBase (MMDB) is a high-capacity/high performance DBMS that supports MM data types (text, still images, graphics objects, video data, audio data), as well as other basic alphanumeric types, and also handles very large volumes of MM information. The ideal MM DBMS is a tight integration of three fundamental technologies: conventional DB

capabilities, hierarchical storage system support, and information retrieval (IR) capabilities. This integration can be seen easily in the Figure 1:

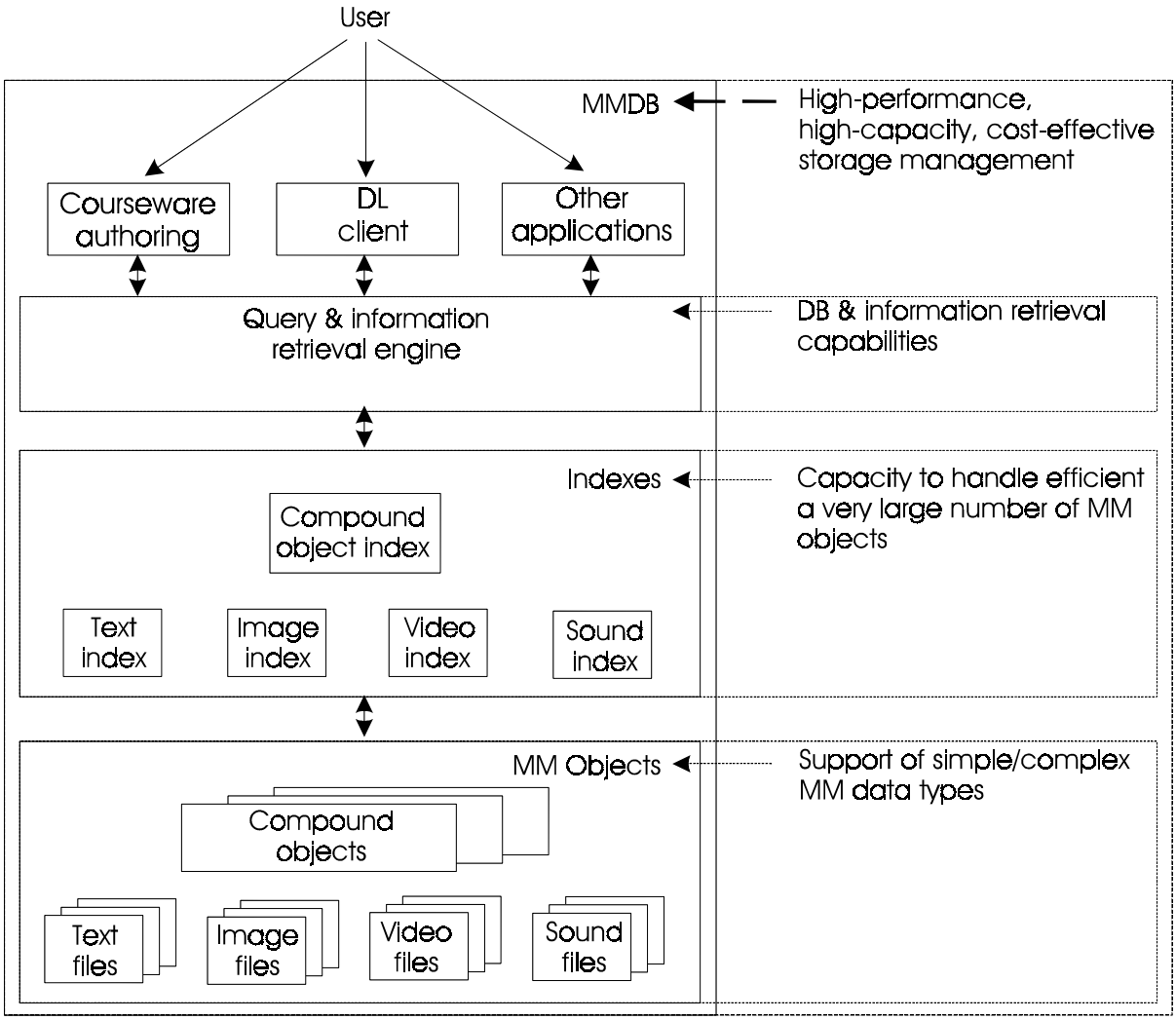

Fig. 1 MM DBMS capabilities

COL, MMDBs AND DIGITAL LIBRARIES

A digital library can be defined as *an assemblage of digital computing, storage, and communications machinery together with the content and software needed to reproduce, emulate, and extend the services provided by conventional libraries based on paper and other material means of collecting, cataloging, finding, and disseminating information* [13]. But no matter how we define them, digital libraries are a key technology of the coming years allowing the effective use of the Internet for education, research, work, and personal purposes. A digital library allows access to huge amounts of documents, where the documents themselves are considerably large. Beside text documents, a digital library (DL) contains hypermedia documents of several kinds – e.g. video clips, digital maps, audios, animations etc. All these document classes may have specific storage requirements and retrieval methods, meeting the Quality of Service parameters for using them properly in a DL.

The main capabilities for a DL should be [4]:

- manipulation of document servers;
- support for different types of documents in database systems;
- document acquisition and interchange;
- ability to use extensions for DL of object-(relational)oriented database technology;
- storing, indexing and querying large sets of documents;
- integration of heterogeneous metadata and documents;
- combining querying on structured metadata and content-based retrieval;
- integrating vague and fuzzy queries;
- distribution of queries;
- support for several user views on large sets of documents;
- visual interfaces to DL.

MMDBs are a very important base on which we can actually build an efficient DL. The following features of DL need database support:

- high performance, trusted documents servers;
- document delivery and data dissemination;
- efficient retrieval functionality;
- security and user access models;
- alerting services;
- intelligent user agents and personal DLs.

Two very important issues in development of COL courseware are the needs for *coordination and reuse*. Although some lecturers develop their teaching materials in isolation, teachers see collaboration as being an important aspect of course development. Collaboration take place between teachers but also at the learner level – using collaborative HM COLs a group of students may collectively be involved in the development of a piece of work. Academics often feel that they do not have the technical skills and computer expertise necessary to develop and implement effective HM courseware. A procedure for quality assurance is also desired by some, indicating a need for standards set from the beginning. Linked to these opinions is the idea of a HM courseware digital library which could be used to store samples of good courseware and that could provide for its reuse.

TOWARD A VIRTUAL TEACHING AND LEARNING ENVIRONMENT

Development of information technology (IT), in particular, multimedia networks, emerging digital libraries and virtual reality techniques, makes it possible to establish new models for teaching and learning. These models have to:

- offer to the learners opportunities for lifelong learning and training;
- provide various learning/training contents and patterns, that can be changed quickly;
- improve the abilities of learners, rather than simply offer knowledge;
- reduce the dependence of physical equipments to a minimum;
- provide for long distance, worldwide education;
- make possible using of individualized teaching and learning environments;
- supply access to various sources of knowledge.

The new pedagogical models and methods will have to be stored in educational archives, together with user's profile and history, COL courseware, virtual reality modules, assessment tools, study planning tools, and modules for dynamic generation of the courseware (by taking into consideration learner needs and some well chosen pedagogical models). These educational archives will reside into huge digital libraries available on the Internet. In the Figure 2 we can see the components of an educational archive:

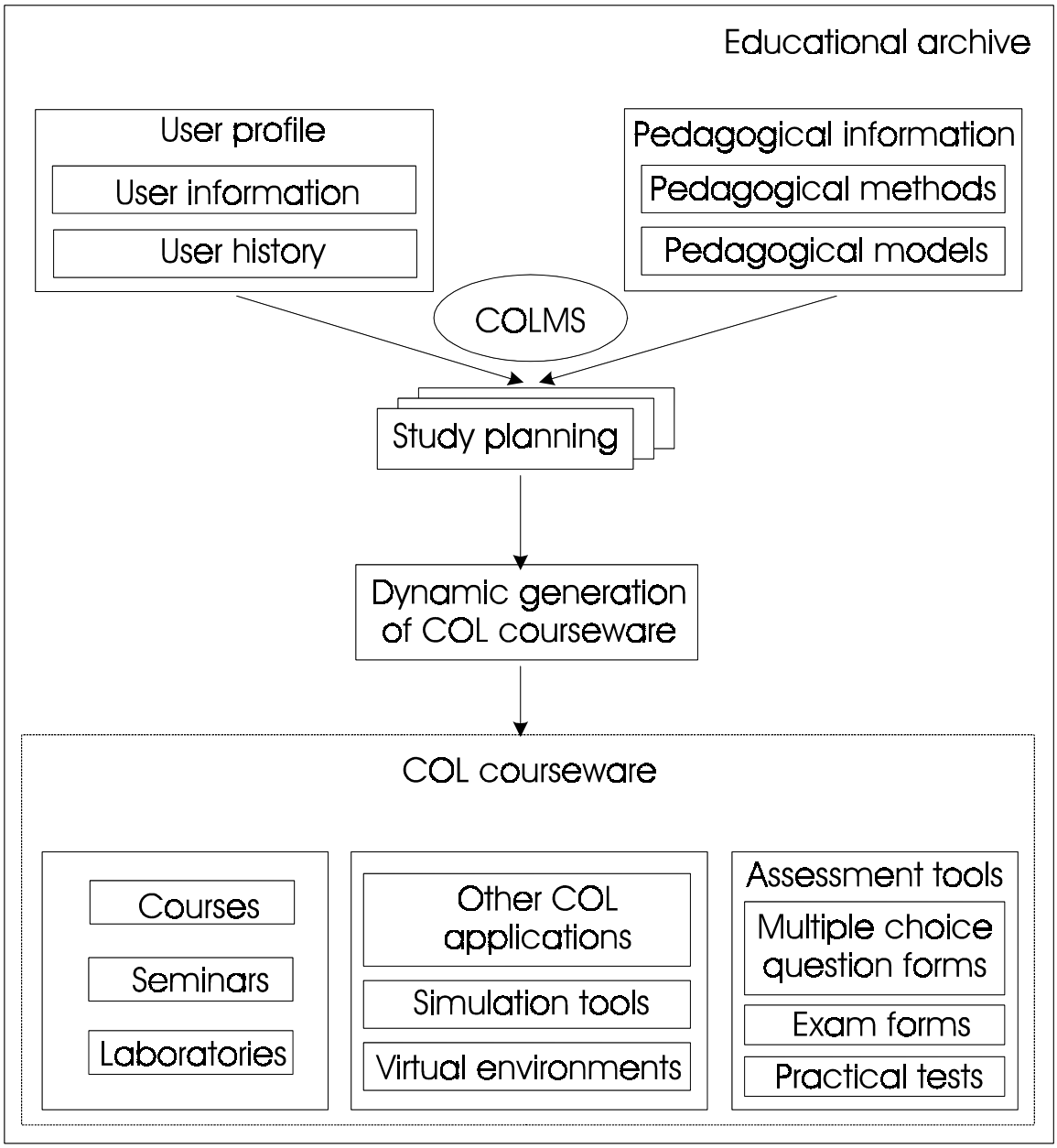

Fig. 2 Educational archive

Of course, all these changes to the traditional learning system will transform it into something else, more close to a virtual teaching and learning environment (VTLE). In this science fiction like environment we will have:

- new studying places (home, work place) together with the classical classroom;

- new teaching materials (CDs, computers, Internet) enriching the benefits of using traditional books;
- new teaching means and tools (whiteboard, projection, hypermedia and virtual reality techniques, digital libraries);
- new experimenting opportunities (computer simulation) and a lifelong education period (unlike the traditional education made by stages).

A deeper look into this VTLE will reveal to us learners "reading" hypermedia books obtained from a virtual library, practicing in a virtual reality environment, and attending a virtual school [19]. And all these take place under the control of a computer on-line learning management system (COLMS), which oversees the deployment and management of COL applications.

Hypermedia books are obtained using hypertext techniques for organizing various media information (text, still image, animation, sound, video, and even sense of taste, touch etc.) in a non-linear form. This new organization of the books is more suitable for learner's non-linear way to think. In addition to that, the parts of such a book can come from several servers, worldwide located.

The new *virtual (digital) school* can be seen as a workstation using the services of educational archives. This station could be anywhere in the network (maybe a cheap Network Computer), from which anyone can start to study at any time, to attend to examinations according to his or her needs, and, finally, to get a degree. The virtual school can overcome the limitations of time, place, age and even the quality of education.

The *virtual (digital) library* can be imagined as a worldwide library built upon the Internet. It does not need a huge place for storing books or a reading room. There is no opening or closing time restriction. The learner will get a book upon request. The learner will never have to wait for a book to be returned. Learners can use intelligent search engines to find the needed books or information. The stored information is hypermedia-like, highly classified and specialized. Of course, we must not forget to provide a connection with the classical libraries existing all over the world.

Virtual reality techniques provide for the creation of an artificial world, re-composed by the multimedia computer and peripherals' technology, according (or not) to the real world. In this virtual world students can learn, practice, experiment and train in using all of the theoretical knowledge, with obvious advantages vs. the traditional way. The core attribute of virtual reality is its ability to immerse the learner in a three-dimensional world that can be manipulated interactively in a very impressive manner. This sense of immersion is what makes the computer-generated world feel real. *Virtual reality (VR)* has three branches: the *standard virtual environment* (in which the computer generates everything that the user sees/hears/touches/smells), the *augmented reality* (that enhances the real world with computer-generated overlays) and the *virtual presence* (that allow the user to manipulate and sense remote objects) [17]. In its most basic form, a VR system consists of a display mechanism, a computer-based image generator, a tracking device that provides the interactive attributes, a three-dimensional database, and the VR application software.

When building, working, or experiencing virtual worlds, a user is faced with a variety of data types. The nature of these types is heterogeneous due to different formats and ways of compression, to different tools used for virtual world building and to different types of interaction/sensing devices. Database systems (named *virtual world databases*) that manage all

these data types, during the entire life of a virtual world (from virtual world building and design, to data delivery in a running virtual environment), do not exist at the moment. This is a largely unaddressed research task [2,5,11,13,19,25].

COLMS is a system that provides for course instructors and administrators anywhere in the world to carry out the following activities:

- certifying that a learner has received a course;
- guiding learner through the learning process;
- monitoring learners' activity and observe their progress;
- examining the learners and to record test results;
- storing all valuable feedback;
- assessing their own teaching materials for appropriateness and efficacy;
- communicating (e-mail, threaded discussion group, or interactive chat).

All these issues will lead to a new real-virtual world perspective, with a very deep impact on every facet of the human life, from living to learning and working.

The interaction between a learner and the described VTLE should probably look as in Figure 3:

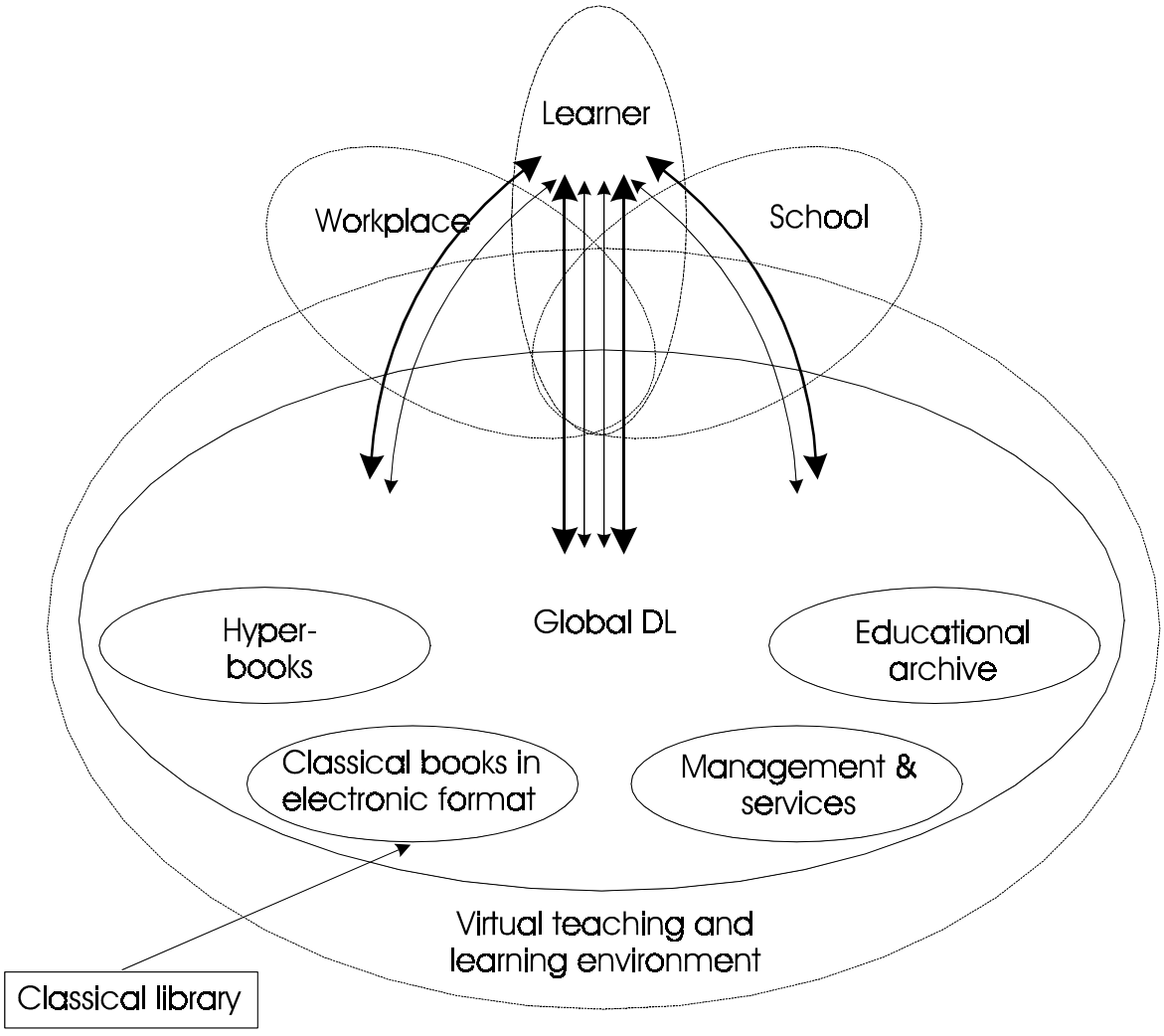

Fig. 3 Learner – Virtual Teaching and Learning Environment interaction

An example scenario of resolving a user query in such an environment could be:

Query: Find all lectures on R-tree that are available in this educational archive (or in all other available archives).
Answer: The solution to this query provided to the learner should be a browsable HM presentation, including, for example, small clips of the relevant video.

CONCLUSIONS

An HM COL application represents an intersection of content, form and function. Developing such an application that works, the way it was supposed to, and that successfully and efficiently delivers content, requires the joining of many diverse skills: careful planning and project management, mastery of the material to be presented, understanding of the technical development issues, good aesthetic sense, and a thoughtful approach to using design elements and special effects. The skills of a teacher, an artist, a software engineer, and more must be combined to produce effective courseware. Courseware development provides new opportunities and challenges to researchers, practitioners, and designers from a number of disciplines such as computer science, education, library science, communication, art, psychology, sociology, and management.

Using the Internet to distribute the COL applications has many advantages as we have already pointed out. Some challenges exist though: for example actual bandwidth limitations can make the transfer of media files slow and tedious for the user. We must also keep in mind that actual Internet limitations will be surmounted by using the new high speed Internet technologies (the emerging Hyper Internet using optic fiber and satellites) providing real on-line access to "prohibited" media (e.g. big files containing videos or high resolution images).

There is also another problem regarding the efficient search for MM objects within MMDBs. We should look for solutions in the new databases, virtual reality and Internet technologies. Hardware browsers are now being created. Probably the coming intelligent COL terminals will get another view over computer on-line learning. We also must remember we are working with evolving technologies that are improving very rapidly.

However, vast digital libraries of information will soon be available on the Internet as a result of emerging technologies for manipulating HM. National initiatives for DL have been started in several
countries, including the DLI in the USA and the Global Info in Germany. These libraries will profoundly impact educational activities. To be really useful, a new technology is needed for searching efficiently through these vast data collections and retrieving the most relevant selections. Virtual reality will provide new methods of navigating the ever-growing information highways and virtual world databases.

Modern educational models and methods will be used [27] in this virtual teaching and learning environment. These models will have new capabilities such as:

- learning patterns will be changed from groups to individuals. However there will be the possibility to learn and work within meta-teams, composed by persons who are in different geographical locations!
- restrictions regarding the spatial and temporal limitations for the classroom will be replaced by an open environment;

- passive learning will be transformed to self-initiatiated learning;
- source of knowledge will not be simple anymore, but multiple;
- periodic current studying pattern will be replaced by a lifelong learning model;
- main education goal will be obtaining the ability to acquire knowledge.

In this paper I was trying to imagine how the new teaching and learning environment could look – it seems this will be virtual. Virtual environments have, in fact, existed for decades, in the form of flight simulators and battle displays. What is actually new is that the technology that makes virtual reality possible has become more affordable, starting a stampede in the number of companies attempting to make virtual reality commercially available. In addition to that, the new virtual environments will not be isolated – there will be a virtual worldwide educational environment.

BIBLIOGRAPHY

1. Angelides M.C., Dustdar S., *Multimedia Information Systems,* Kluwer Academic Publishers, 1997
2. Apers P.M.G., Blanken H.M., Houtsma M.A.W., *Multimedia Databases in Perspective,* Springer - Verlag, 1997
3. Asymetrix Learning Systems, Inc., *The Asymetrix Guide to Interactive Online Learning*, 1999
4. Bailey H.J, Thornton N.E., *Interactive video: innovative episodes for enhancing education.* Computer Applications in Engineering education. 1(1), 97-108, 1992
5. Bertino E., Heuer A., Ozsu T., Saake G., *Multimedia Database Support for Digital Libraries,* Dagstuhl Seminar Report 99351, 1999
6. Chapman G.M., *Computer Based Learning in Science - CBLIS'97, Proceedings, The Third CBLIS Conference,* The Montfort University, Leicester, UK, 1997
7. Chapman G. M., *Computer Based Learning in Science - CBLIS'99, Proceedings, The Fourth CBLIS Conference,* University of Twente, Enschede, The Netherlands, 1999
8. Chung S. M., *Multimedia Information Storage and Management,* Kluwer Academic Pub., 1996
9. Faloustos C., *Searching Multimedia Databases by Content,* Kluwer Academic Publishers, 1996
10. Ferrari D., Ed., *ACM Multimedia 94 - Proceedings- Second ACM International Conference on Multimedia* - San Francisco, California, ACM Press, 15-20 Oct 1994
11. Fuhr N., Dittrich G., Tochtermann K., *Hypertext - Information Retrieval- Multimedia 1997,* Proceedings HIM '97, UVK UniversitatsVerlag Konstanz, Konstanz, 1997
12. Furht B., *Multimedia Technologies and Applications for the 21st Century - Visions of World Experts*, Kluwer Academic Publishers, 1998
13. Gladney H.M, Fox E.A, Ahmed Z., Ashany R., Belkin N.J. and Zemankova M., *"Digital library: Gross Structure and Requirements,* Proceedings of the First Annual Conference on the Theory and Practice of Digital Libraries, 1994
14. Grosky W.I., Jain R., Mehrota H., *The Handbook of Multimedia Information Management,* Prentice - Hall, 1997
15. Hollan J.D., Foley J.D., Ed., *ACM Multimedia 97 - Proceedings - The Fifth ACM International Multimedia Conference* -San Francisco, California, ACM Press, 9-13 Nov 1997
16. IOP, *The Future Pattern of Higher Education in Physics*, The Institute of Physics, London, 1990
17. Khoshofian S, Brad Baker A, *Multimedia and imaging databases,* Morgan Kaufmann Publishers, Inc., San Francisco, California, 1996
18. Long G., Pence H., Zielinski T.J., *New Tools vs. old Method. A Description of the CHEMCONF'93 discussion*. Computers in Education, 24,4,259-269, 1995
19. Lundin R., *Flexible Delivery of Continuing Professional Education: Models Issues and Trends*, UniServe Science, 1998
20. Maybury Mark T., *Intelligent Multimedia Information Retrieval,* AAAI Press, The MIT Press, 1997
21. Morozov M., *Multimedia Lecture Room: A New Tool for Education*, in Brusilovsky P., Kommers P., Streits N., Lectures Notes in Computer Science: *Multimedia, Hypermedia and Virtual Reality - Models, Systems and Applications,* Springer - Verlag, 1996

22. Naizhen Z., I*nformation Technology and Teaching System in the 21st Century*, in Proceedings of Computer Based Learning in Science 1999 (CBLIS'99), at University of Twente, Enschede, The Netherlands, 2 –6 July 1999
23. Nicole D.J., Kane K.A., Wainwright C.L., *Case Study: Improving Laboratory Learning through Group Working and Structured Reflection and Discussion*, ETTI, 31,4,302-310, 1994
24. Noam E.M., *Electronics and the Dim Future of the University*, Science Vol.270, pp247-249, 1995
25. Nwosu K., Thuraisingham B., Bruce Berra P., *Multimedia Database Systems, Design and Implementation Strategies*, Kluwer Academic Publishers, 1996
26. Pickering J., *Teaching on the Internet is Learning*, Active Learning, 2, 1995
27. Prabhakaran B., *Multimedia Database Management System*, Kluwer Academic Publishers, 1997
28. Rada R., *Courseware Coordination and Reuse*, in Furht B., *Multimedia Tools and Applications*, Kluwer Academic Publishers, 1996
29. Schauble P., *Multimedia information retrieval - Content - Based Information Retrieval from Large Text and Audio Databases*, Kluwer Academic Publishers, 1997
30. Sheth A., Klas W., *Multimedia Data Management*, McGrawHill, 1998
31. Shuzhi A., *Model of Vocational Training and Multimedia Network Technology in the 21st Century*, in Proceedings of Computer Based Learning in Science 1999 (CBLIS'99), at University of Twente, Enschede, The Netherlands, 2 –6 July 1999;
32. Subrahmanian V.S., Jajordia S., *Multimedia Database Systems, Issues and Research Directions*, Springer - Verlag, Berlin, 1996
33. TOOLBOOK II Assistant Asymetrix Learning Systems, Inc., *User Guide*, 1999
34. Thuraisingham B., Nwosu K., Bruce Berra P. , A Special Issue of Multimedia Tools and Applications: *Multimedia Database Management System - Research, Issues and Future Directions*, Vol. 4, No.2, Kluwer Academic Publishers, 1997
35. Zelleweger Polle, Ed., *ACM Multimedia 95 - Proceedings- The Third ACM International Multimedia Conference and Exhibition* - San Francisco, California, ACM Press, 5-9 Nov. 1995

Monica Vladoiu
PG University of Ploiesti, Department of Computer Science
39 Bucuresti Blvd, 2000 Ploiesti - Prahova, ROMANIA
Email: mvladoiu@yahoo.com