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E-Learning Methodologies and Computer Applications in Archaeology



DIONYSIOS POLITIS

E-Learning Methodologies and Computer Applications in Archaeology

Dionysios Politis
Aristotle University, Greece

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To Alexia, Cleopatra, Basil, Anastasia, Georgia and George.

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A Virtual Museum Where Students can Learn 388

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Addressing the learner of the 21st century, this chapter explains how learning and relearning implement a widespread culture of life-long education. The new teaching model is presented, which, enhanced by state-of-the art technological achievements, reshapes the way users may access and use content. Mobile computational devices, smart learning environments and other utilities facilitate the creation and sharing of digital resources within the Internet community, leading the way to a new version of e-learning, e-learning 2.0.

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The design principles for virtual spaces focused on e-learning and e-collaboration are presented in this chapter. Technologies like virtual reality (VR), 2D or 3D-centered multiuser tools, and microscopic or macroscopic visualization, offer high levels of interaction along with a sense of immersion. Accordingly, virtual learning environments (VLEs) are designed, enhancing the student's learning experience.

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Open and Distance Learning Tools and Strategies	34
<i>Cristina Girona, Universitat Oberta de Catalunya, Spain</i>	

The role of information and communication technologies (ICTs) and their impact on open and distance learning (ODL) are encountered in this chapter. The learning process, the instructional design, the use of study plans, the design and editing process of multimedia learning materials and resources, and author and teacher training, are some of the processes influenced by the new educational paradigm emerging with e-learning.

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The establishment of Virtual Learning Communities alters the way instruction is offered. Education, knowledge work, metacognitive skills, and learning are offered via hypertext-hypermedia, telematics, and rich multimedia content. Ideas that may alter traditional formation are presented, aiming to reinvent education and learning offered in a Web page-based environment.

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<i>Cèsar Carreras, Universitat Oberta de Catalunya, Spain</i>	

Evaluation methods and techniques are vital elements of the e-learning process. By evaluating the learning processes, the teaching materials and the learning, along with the students' reactions and performance, we may form an image of how successful the pedagogic model and the methodologies we have used are.

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From Observation to Interpretation	79
<i>Cynthia Jaulneau, Archaeologist, France</i>	

This chapter presents the ontologies and the domain specific vocabulary used for knowledge representation and reasoning in archaeology. Taking into account a specific archaeological site, it explains how the retrieval of ground data leads by proper analysis and reconstitution to a meaningful interpretation.

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<i>Athanasios Karamalis, Computer Scientist and Researcher, Germany</i>	

The problems when handling multiple archaeological excavations using one database are presented in this chapter. The design, realization, and the linking with Internet applications is examined along with

the challenges for using the database interface for visualizations and other complex applications, like expert tools and geographical information systems.

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Geographical Information Systems (GIS) and Learning Applications in Archaeology 128
Dimitrios Margounakis, Computer Scientist and Researcher, Greece

The rapidly growing technological field that incorporates graphical features with tabular data in order to assess real-world problems is presented in this chapter. Geographical information systems have the capacity to integrate spatial information with higher end statistical and analytical processes, transforming the simplicity of a single map to the interactivity of GIS information, linking spatial with descriptive data.

Chapter IX

Virtual Reconstructions in Archaeology 146
Dimitrios Margounakis, Computer Scientist and Researcher, Greece

Methods and techniques for archaeological reconstructions are presented in this chapter. By explaining what virtual reality (VR) is and its potential for reconstructions, an introduction to the techniques that may present artifacts in high-level graphics systems with photorealism is attempted.

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The Use of Virtual Museums, Simulations, and Recreations as Educational Tools 157
Dionysios Politis, Aristotle University of Thessaloniki, Greece
Ioannis Marras, Aristotle University of Thessaloniki, Greece

This chapter describes in depth two vertical applications that demonstrate the simulation fidelity of computer-made virtual worlds. The first application is a dynamic virtual museum that can be used for cognitive walkthroughs, while the second application is comprised of virtual environments that reproduce ancient greek music. Both applications have a clear pedagogical dimension.

Chapter XI

Social Modeler: The Use of Expert Systems in Archaeology 199
Panagiotis Linardis, Aristotle University of Thessaloniki, Greece

This chapter links computational intelligence, expert systems and archaeology. A rule-based system is presented, using a relatively simple model that can be adapted to solving a number of problems in archeology linked with social scenarios.

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Machine Translation Systems 211
Athanasios Tryferidis, Electrical and Computer Engineer, MLS SA, Greece
Theofanis Korlos, Aristotle University of Thessaloniki, Greece

Machine translation (MT) is a subfield of computational linguistics that investigates the use of computer software to translate text or speech from one natural language to another. MT is changing and broadening

its scope of interest to encompass all branches of computational linguistics and language engineering. For archaeology, MT is performed as a simple substitution of atomic words in one natural language for words in another. Using corpus techniques, specific dictionaries for use in Archaeology can be made, promoting better handling of differences in linguistic typology.

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<i>Ioannis Iglezakis, Aristotle University of Thessaloniki, Greece</i>	

Electronic publishing is a new concept, aiming at replacing traditional publishing media and making available the electronic delivery of digital content. However, authors are sceptical about the copyright protection of their intellectual property. This chapter gives insight on how protection may be given to authors by the grant of exclusive rights. The same time it points out the loopholes of protection as well as the limitations that exclusive right may have.

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Twenty years of excavation at Drama-Merdžumekja are concisely presented in this chapter. This article briefly reviews the exercise of electronic publishing in archaeology and introduces some major attempts for its development. By examining the challenges and opportunities for the digital presentation of the archaeological procedures and excavation findings, the article attempts to pinpoint potential directions of development.

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This chapter presents methods that promote the sustainability of electronic publishing in archaeology. Electronic publications are not merely an alternative that allows some savings because we do not require the physical distribution and reproduction of printouts; they are a pertinent way to promote articles on archaeology to vast audiences that use the Internet as their primary communication medium.

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Communication Barriers and Conflicts in Cross-Cultural E-Learning 276

Rita Zaltsman, International Center of Modern Education - Prague, Czech Republic

A chapter devoted to the globalization of e-learning cultural changes. Important for archeological studies where different languages and cognitive styles are still used.

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Peter E. Doolittle, Virginia Polytechnic Institute & State University, USA

Andrea L. McNeill, Virginia Polytechnic Institute & State University, USA

Krista P. Terry, Radford University, USA

Stephanie B. Scheer, University of Virginia, USA

The role of interactive multimedia in education and training is examined.

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Knowledge Through Evolution 311

Russell Beale, University of Birmingham, UK

Andy Pryke, University of Birmingham, UK

The advances in applied artificial intelligence and their prospect for archaeological implementations are presented in this chapter.

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Collaborative Geographic Information Systems: Origins, Boundaries, and Structures 325

Shivanand Balram, Simon Fraser University, Canada

Suzana Dragicevic, Simon Fraser University, Canada

A further insight on geographical information systems, as a supplement to chapter 8, promoting the idea of collaborative work.

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Towards an Ontology for Information Systems Development: A Contextual Approach 342

Mauri Leppänen, University of Jyväskylä, Finland

The role of databases in archaeology is revisited in this chapter. Contemporary issues in database design and the development of information systems (IS) are concisely presented.

Chapter XXI

Personalization Issues for Science Museum Web Sites and E-Learning 371

Silvia Filippini-Fantoni, The University of Paris I Sorbonne University, France

Jonathan P. Bowen, London South Bank University, UK

Teresa Numerico, London South Bank University, UK

In this chapter, e-learning is linked with the visualization sciences and techniques.

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A Virtual Museum Where Students can Learn 388

Nicoletta Di Blas, Politecnico di Milano, Italy

Paolo Paolini, Politecnico di Milano, Italy

Caterina Poggi, Politecnico di Milano, Italy

The role of a virtual museum as a learning tool is examined in this chapter. Emphasis is given on the new experiences that technological innovation offers over traditional learning techniques and methodologies.

Chapter XXIII

Enhancing Learning Through 3-D Virtual Environments 407

Erik Champion, School of ITEE, University of Queensland, Australia

This chapter examines the new experiences that 3D learning environments may offer to students, learners and the general public in general.

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Foreword

Using the opportunity given under the SOCRATES-MINERVAEU funded project “SEEAchWeb - South Eastern Europe Archaeology Web: An Interactive Web-based Presentation of Southeastern European Archaeology,” managed by the multimedia lab, Department of Informatics, Aristotle University of Thessaloniki, a consortium of prestigious European institutes focused on the implementation of state-of-the-art e-learning strategies for the subject domain of archaeology.

The last few decades have witnessed the rapid growth and development of information and communication technology (ICT). Due to the application of the new technologies in learning and teaching, e-learning has emerged as a highly effective teaching tool. E-learning is not simply about transfer of know-how to a particular field of studies, such as archaeology. It is about enhancing the teaching-learning process, and therefore requires an in-depth understanding of it.

Archaeology is a multifaceted discipline. Its learning curriculum encompasses a wide range of subject/period themes and methodological and theoretical approaches, as well as practical experience in the field. A map of core competencies is needed to transform these perspectives into a well-gearred carrier of instructional events using educational technology. These include, among others, the usage of virtual reality environments, databases acting as excavation repositories, geographical information systems, and animated reconstructions.

How can an archaeologist use these diverse tools in a constructive manner? How can an instructor in archaeology use integrated packages that deliver teaching without becoming a computer scientist? How can a junior archaeologist take advantage of computer-based training and alter his cognitive paradigm? All these and other relevant issues are addressed in the chapters that follow, with the aim of enhancing the existing learning styles.

The motivation for preparing this concise handbook with introductory and interrelated subjects was given by the 1st SEEAchWeb Conference, “*E-learning and Computer Applications in Archaeology*,” that was organised in Thessaloniki on September 29-30, 2006. The new ideas presented in the conference appear in this collective volume, an opus from the SEEAchWeb experience.

I offer my congratulations to the scholars involved in this consortium, and I hope that this is only the beginning of a fruitful scientific process that will promote the practice and the teaching of archaeology.

Professor Ioannis A. Tsoukalas
Secretary General for Research and Technology
Ministry of Development, Greece

Ioannis Tsoukalas is currently the secretary general for research and technology of the Greek government. He was born in Thessaloniki in 1941. He has studied physics in the Aristotle University of Thessaloniki. He has received his PhD in solid state physics from the same university. He has committed post graduate studies in the UK (Liverpool University), Germany (Braunschweig Polytechnic University), France (Grenoble) and USA (MIT). He has published more than 100 papers and articles in books, highly ranked journals, newspapers and international conferences. He has lectured in various universities as visiting professor (England, France, Germany, USA, and Japan), and was head of the Department of Physics (1984-1989) and of the Department of Informatics (1990-1997). He has directed or participated as a member in various committees, boards and research projects, which include, among others, the EU funded project VALUE (1990-1993), "Information Society SA" (2001-2004), the Data Protection Authority in Greece (2003-2004), and the Senate of the Aristotle University in Thessaloniki (1984-1997, 2003-2004). He has served as first coordinator of the EU funded multinational project "SEEAchWeb – South Eastern Europe Archaeology Web" (2003-2004).

Preface

TEACHING, LEARNING AND RELEARNING WITH TECHNOLOGY IN ARCHAEOLOGY

One of the most obvious events of the last decade has been the explosion of the World Wide Web and its effect on learning with multimedia. In parallel, this decade has witnessed a fundamental shift on paradigms for learning and instruction that have altered our learning culture and learning styles. Learners are not passive beings, waiting to be taught basic skills by adults; these skills, rather, emerge as a function of adaptation to the real world (either present or past), where they pick up the ability to communicate with peers and solve problems. As such, learners gradually become natural speakers, scientists, writers, and problem solvers, utilising information that is offered via various technological means.

Therefore, within the context of the current technological status-quo, e-learning methodologies and techniques have been developed. E-learning is a very promising way of delivering training and is broadly used in tertiary education. In this introductory chapter, the benefits that e-learning offers over traditional methods of education are concisely presented, and its imperative for archaeology is rationalized. For this reason, special focus is given on the progress of information and communication technology (ICT) in shaping our information society, and on the degree to which e-learning has been incorporated in the citizens' everyday routines.

The rapid growth of ICT over the last few decades has opened up new possibilities for governments and individuals. Governments are increasingly using Wide Area Networks, the Internet, and mobile computing in their daily interactions with citizens and businesses. E-government applications are improving interactions with businesses by centralizing information sources into topical gateways, using Web-based expert tools to help businesses access rules and regulations, and developing applications to allow electronic tax filings. For citizens, they are attempting to make transactions, such as renewing licenses and certifications, paying taxes, and applying for benefits, less time consuming and easier to carry out.

Apart from government services, ICT has been also utilized in other sectors such as health, commerce, and of course, education. The increased use of ICT has actually been the motivation force for e-learning. By its name, e-learning can be understood as any type of learning delivered electronically. Clark and Mayer (2002) define e-learning as training delivered on a computer (including CD-ROM, Internet, or Intranet) that is designed to support individual learning or organizational performance goals.

E-learning can be synchronous or asynchronous, depending on the extent to which it is bound by place or time. E-learning is synchronous when two or more events occur at the same time. For example, when attending live training simulating a class or a workshop, e-learning is synchronous, because the event and the learning occur at the same time. In the opposite case, learning is asynchronous, for example when attending an online course and completing events at different times (Codone, 2001).

There are a number of other terms also used to describe this mode of teaching and learning, such as online learning, virtual learning, network, and Web-based learning. They all refer to educational pro-

cesses that utilize ICTs to mediate asynchronous, as well as synchronous learning and teaching activities. However, e-learning comprises a lot more than any of these terms. As the letter “e” in e-learning stands for the word “electronic,” e-learning would incorporate all educational activities that are carried out by individuals or groups working online or off-line, and synchronously or asynchronously via networked or standalone computers and other electronic devices (Naidu, 2005).

E-LEARNING AND EFFECTIVE TECHNOLOGY INTEGRATION

E-learning, among others, is a tool for expanding and widening access to tertiary education. A key attribute of ICT is its ability to enable flexible access to information and resources. Flexible access refers to access and use of information and resources at a time, place, and pace that are suitable and convenient to individual learners rather than the teacher or the educational organization. Using ICTs, e-learning allows more people to participate in tertiary education: working students and adults, people living in remote areas, nonmobile students, and even foreign students can now access education. In a few words, e-learning has the ability to provide information to anyone, anytime, anywhere (Roblyer, 2003).

E-learning also promises to improve the quality of tertiary education and the effectiveness of learning. Due to the use of ICTs, e-learning gives easier and almost instant access to data and information in a digital form that allows manipulations that are sometimes not possible otherwise. E-learning can lead to innovative pedagogic methods, and new ways of learning and interacting, because of the easy sharing of these new practices among learners and teachers, as well as by easier comparisons between teaching materials and methods. E-learning can also be seen as a promising way to reduce the cost of tertiary education, which is critical for expanding and widening its access worldwide.

E-learning in its nature is rather autonomous, allowing learners to select the topics they want, control the pace at which they progress, and decide whether to bypass some lesson elements such as examples or practice exercises. The opposite takes place in traditional education, where the learning process is highly dependent on the reactions of the student-instructor relationship. Although more reliable, in turmoil the classic way of studying may lead to abrupt, chaotic and misleading professionally trajectories.

Figure 1. Differences between learning in the 20th and 21st century

Learning in the 20 th century (Instructor oriented)	Learning in the 21 st century (Student/group oriented)
Lecture	Support for autonomous learning
Autonomous learning and self-study	Group oriented learning
Taking classes / attending lectures	Collaborative study
Information transmission	Strengthening the learning potential
Instructor = hub of information	Instructor has a supportive role
Static content	Dynamic content
Homogeneity of learning sources	Variety of learning sources
Tests and exams	Applications and upgraded task performance

In Figure 1, the differences between learning in the 20th century (instructor-oriented) and learning in the 21st century (student/group-oriented) are presented, as encoded by Chute, Thompson, and Hancock (1999).

Depending on the use of ICTs and the level of reform, learning can be separated in four categories, as shown in Figure 2. Successful e-learning requires both the use of ICT and reform. Therefore, successful e-learning does not imply merely that the tools of the trade have to be used; it also means the Web-based training provider should analyze needs and carefully select the delivery methods (Driscoll, 2002).

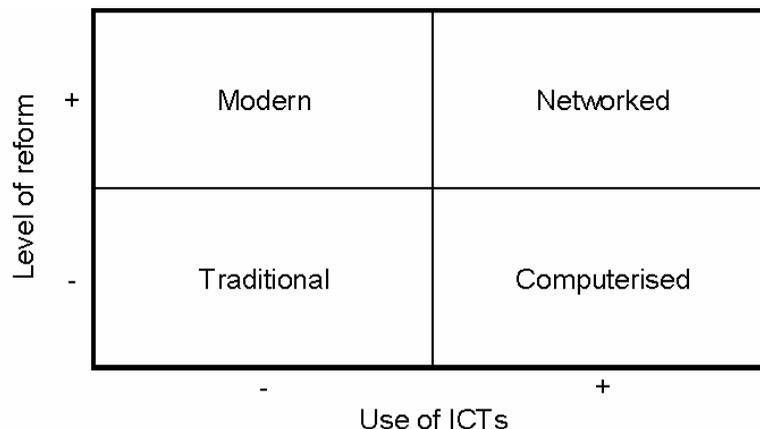
THE RANGE OF E-LEARNING IMPLEMENTATION IN THE KNOWLEDGE SOCIETY

The growing interest for e-learning seems to be coming from several directions. Organizations that have traditionally offered distance education programs see the incorporation of online learning in their repertoire as a logical extension of their distance education activities. The corporate sector, on the other hand, is interested in e-learning as a way of rationalizing the costs of their in-house staff training activities. For instance, multinational companies need to train their employees in new technologies. E-learning is of interest to residential campus-based educational organizations that see e-learning as a way of improving access to their programs. More rigorously, educational institutions see advantages in making their programs accessible via a range of distributed locations, including on campus, home, and other community learning or resource centers.

The increasing significance of ICTs has become a factor defining contemporary influence. We are experiencing a transformation in the nature of economic activity, with associated implications for the shape of society.

The generation and exploitation of knowledge is now the predominant factor in the creation of wealth. Knowledge has always been a factor of production, and a driver of economic and social development. However, technology-related developments have fundamentally transformed the degree to which knowledge is being integrated into economic activity, to the extent that we are witnessing a shift in the very basis of competitive advantage. Unlike capital and labour, information and knowledge have many of the characteristics of what economists call public goods. Once discovered and made public, knowledge

Figure 2. Types of learning depending on the level of reform and the use of ICTs



can be shared at zero marginal cost and its value is not depleted in consumption: it is nonrival. Indeed, the economic and social value of information and knowledge actually increases as it is shared with and used by others (Means, Haertel, & Moses, 2003).

The next society, the one that will succeed the current information society, will be a knowledge society. Knowledge will be its key resource, and knowledge workers will be the dominant group in its workforce. There will be an increased demand for a well-educated and skilled workforce across the whole economy. As access to information becomes easier and less expensive, it becomes more crucial that we have the skills and competencies relating to the selection and use of that information. There is a clear imperative for continuous education and training, and the establishment of incentives for firms and individuals to make the critical adjustment to a culture of lifelong learning. Workers at all levels in the 21st century knowledge society will need to be lifelong learners, adapting continuously to changed opportunities, work practices, business models and forms of economic and social organization. E-learning can offer lifelong, better, faster, and less expensive education for citizens and organizations.

A special interest group of e-learning is the one that enhances relearning. Because many competencies of the working force are technology-related, it is obvious that scientists need to revamp their outpaced knowledge base and potential. This is especially true in Archaeology. That archaeologists “collect data” and “feed them into a computer” are almost taken as givens within everyday conversation (Lock, 2003). However, the use of computer technology is not deteriorated to creating archaeological data repositories and warehouses. A new scientific field has emerged referred to as computer applications in archaeology (CAA).

Computer Applications in Archaeology, using as updated as possible ICTs, support archaeologists in managing, presenting, and utilizing the results of their work with the help of new technology. With such tools, observations from practical work are transformed to virtual reality (VR) reconstructions in such a photorealistic manner that sometimes it is hard to say where reality ends and virtual dreams begin. Clearly, with CAA the procedures of modeling the past perform a cognitive walk in new dimensions.

Amid this canopy studio, the e-learning potential in Archaeology emerges, promoting the increase and the dissemination of archaeological knowledge. Also, it becomes manifested as a cross domain activity, disseminating learning or relearning about technological factors that have changed significantly within the recent years. For example, it is rather unlikely for mid-aged archaeologist to be proficient on encoding mark-up languages like VRML or handling geographical information systems (GIS) for the very simple reason that these technologies were practically nonexistent some 10-15 years ago, when he was studying archaeology. Therefore, e-learning in archaeology does not involve only knowledge dissemination using ICTs for the subject domain only, but also computer aided instruction about the new technologies in focus.

ORGANIZATION OF THE BOOK

This book is organized in 23 chapters clustered in four sections. The last section is comprised of eight chapters, coming from IGI’s InfoSci-Online database; these are selected readings, already published, that enhance and promote understanding for the amalgam of computers applications in archaeology and e-learning tools. A brief description of each of the 23 chapters follows:

Section I, titled “E-learning Technologies, Strategies and Methodologies,” is comprised of four chapters.

Chapter I describes the impact of technology on education, providing definitions on what e-learning is about, and mostly, what e-learning is *not* about, separating facts from speculation and the likely