Preface

Distance Education (DE) is a growing mode of teaching and learning. The developments of computer
networks, the improvement of the processing capability of personal computers, and the advance of
multimedia technologies, among other factors, contributed to the creation of this scenario. However,
despite consisting of an effective teaching method, distance education still presents some challenges,
including the need for a pedagogical and computerized support appropriate to the characteristics of each
person. This support is possible through the process of making the teacher a facilitator, no longer the
main source of information but instead driving the learning process.

One of the ways to provide DE is through the use of mobile devices. This modality is known as Mo-
bile Learning. This way of providing education allows students and teachers to take advantage of the
resources offered by mobile technologies. One of these benefits is the possibility to access, view, and
provide content irrespective of time and location. However, even with the benefits offered by mobile
learning, we should consider the particular characteristics of each student, including the resources of
which he holds. This is necessary not only to provide content that meets the needs of students but also
to provide content in an appropriate way regarding the constraints of mobile devices since they have
distinct and limited resources.

In this context arises the concept of context-aware environments. This kind of environment fits the
user, considering information provided by the selfsame user beyond that captured dynamically from his
interaction with the learning environment. This learning modality based on context-aware and mobile
environments is called Ubiquitous Learning. The increasing use and diffusion of Web technologies and
the ubiquity of educational tools has provided breakthroughs in learning environments. Students should
no longer be treated in a homogeneous way. A ubiquitous learning (or u-learning) environment provides
students with a teaching method that would not be possible in a conventional Web-based course. A u-
learning environment may be understood as a context-aware mobile learning environment, providing
the most adaptive content for learners. Context awareness describes a paradigm in which the context of
a user is considered to define his profile. There is no consensus about the definition of “context.” This
one is specific of the application and the desired intention, requiring the identification of functions and
properties of the individuals’ domains.

This book covers subjects related to u-learning. U-learning generally refers to learning supported
by technology, performed anytime and anywhere. So, u-learning occurs when learning does not have
a fixed location, or when students take advantage of mobile technologies. Some authors consider it as
an evolution of the concept of mobile learning (m-learning). In this sense, the idea of ubiquity in the
learning process provides valuable contributions to thinking about invisible learning, which by nature
is dependent of the student context. A major contribution of adoption of ICT in everyday life is the
extension of pre-established limits of what is traditionally known as learning spaces. In other words, technology is opening new possibilities to convert other spaces into learning spaces.

These new opportunities represent a new educational paradigm because they enable anybody to produce and disseminate information so that learning can occur at any time and space. In other words, learning occurs not only in the classroom, but also at home, at work, in the courtyard, in the library, in the museum, at the park, and in daily interactions with others. For example, through mobile devices, the learner is able to interact with the environment, by capturing images, sounds, videos, and location information. That ability to capture information in different contexts motivates the students to create new learning situations through interactions with the environment.

This book has as overall objective to clarify the new technologies, applications, and studies in the u-learning area. It intends to help students, teachers, and researchers obtain a larger understanding of both the potential of the related new technologies and the trends that are being followed to make u-learning more effective. The successful implementation of u-learning is not a trivial task. The accumulated experience and know-how of the researchers, who have invested time and effort in study in the attempt of solving problems in this area, are, therefore, important success factors. This book shares this know-how with other researchers, students, and interested professionals. We intend to show the current trends, practices, and challenges faced by designers of u-learning environments. These include theoretical assumptions, empirical studies, practical implementations, and case studies. In the end, the readers should have a clear notion about which is the actual stage and which are the future tendencies in this area.

This book is very valuable to researchers and teachers working in both computer-supporting learning and traditional learning environments. It is also useful for scholars, academics, researchers, educators, students, beginners, and experts with interest in the e-learning research area. Given its depth and breadth of coverage, this book is also of interest to a wide audience of researchers in the fields of education as well as computer science. It is helpful for scholars and business professionals entrusted with implementation of mobile, interactive, and flexible learning environments. The major scholarly value of this book is to provide a general overview of the studies on non-conventional technologies for computer-supporting learning and its applications, as well as a notion of the recent progress in works in this area. This overview can support future academic studies with the background provided by the experts in this book. In addition, it points out to scholars what they should do (best practices) and should not do (bad practices).

In relation to the contribution to information science, technology, and management literature, one important improvement that is provided by this book is the discussion of new methodologies, technologies, and approaches being used in u-learning and their advantages and challenges. The topics covered in this book, which include the current best practices in u-learning, can also stimulate the implementation and the use of related technologies in an academic and industrial context. In addition, this book serves to highlight some of the most important gaps in the development of u-learning support tools, patterns of development, and so forth.

We can find in the specialized literature many publications discussing the use of ubiquitous and pervasive computing. However, to the best of our knowledge, there is no literature that gives guidance on the future trends in this area and its maturity level in the educational perspective. This book fills this gap by gathering recent studies in this area.

Computer-supporting learning is a genuinely interdisciplinary area that strives to create a better comprehension of the requirements of the learning process that is mediated by a diverse set of computer technologies. Therefore, this book is addressed to a wide audience, including researchers and students,
educators and industrial trainers interested in various disciplines, such as education, cognition, social and educational psychology, didactics, and, mainly, computer science applied to education.

Four sections compose this book. Section 1 covers virtual and augmented reality technologies applied to u-learning. The traditional e-learning tools do not meet the specific requirements for all kinds of training. This is due to the constant need of practicing and evaluating acquired knowledge. The use of the Virtual Reality (VR) improves the e-learning environment, which is defined as a high-end user-computer interface that involves real-time simulation and interaction through the stimulation of multiple sensorial channels such as visual, auditory, tactile, smell, and taste. A VR system comprises a computer-generated three-dimensional representation of a real or imaginary environment, called the virtual environment, and peripherals such as visual display and interaction devices are used to create and interact with the Virtual Environment (VE). Unlike other instructive systems, interaction with the VE occurs in real-time and the user experiences, presence, and/or immersion, that is, feelings of being inside the virtual world. Objects within the environment can display real world behavior.

Virtual reality systems have been applied for education, training, and entertainment purposes in the areas of medicine, military, architecture, safety training, flying simulators, and video games. This type of instructional system has been used in different domains where conventional training methods are expensive, complex, or dangerous. The concept of Augmented Reality can be defined as an interface based on computer-generated virtual information with the user's physical environment perceived through technological devices. In the context of learning, Augmented Reality aligns with the theoretical framework of situated learning, as students build connections between their lives and their education by adding a contextual layer. In addition, when operated in conjunction with mobile devices, it positions itself on the border between formal and informal learning, contributing to the evolution of an ecology of learning that transcends the educational institutions and increases the potential for just-in-time learning.

Section 2 covers concepts related to mobile and context-aware learning. Some authors define context as information consisting of properties that combine each other to describe and characterize an entity and its role as a computer-readable form. The location is crucial to the context of the student in an environment for ubiquitous learning. However, the context includes more than just the location. A wide range of context factors combine themselves to form a context definition. Almost all information available at the moment of interaction can be seen as contextual information, among which stand out: 1) the various tasks required from users; 2) the wide range of devices that combine to create mobile systems with associated infrastructure services; 3) resource availability (e.g. battery status, screen size, network bandwidth, etc.); 4) resources in the neighborhood (e.g. accessible devices and servers); 5) the physical situation (e.g. temperature, air quality, brightness level, noise, etc.); 6) spatial information (e.g. location, orientation, velocity, acceleration, etc.); 7) time information (e.g. time of day, date, season, etc.); and 8) physiological measures (e.g. blood pressure, heart rate, respiratory rate, muscle activity, etc.).

Section 3 covers topics related to context-aware learning objects for u-learning. Due to the fast progress of e-learning, some efforts to standardize have appeared in order to enable the reuseability of educational contents and interoperability among systems. A relevant concept in relation to the content of teaching and learning in the field of distance education is the Learning Object (LO). LOs have an important role to assist in electronic courses' development. According to the Learning Technology Standard Committee (LTSC) of the Institute of Electrical and Electronics Engineers (IEEE), a LO is defined as any entity, digital or non-digital, that may be used for learning, education, or training. LOs are considered information blocks and present the following features: 1) reusability – reusable several times in different learning environments; 2) adaptability – adaptable to any teaching environment; 3) granularity – pieces
of content, in order to facilitate its reusability; 4) accessibility – easily accessible on the Internet to be used in many locations; 5) durability – possibility to be used continuously, regardless of technological change; 6) interoperability – ability to operate through a variety of hardware, operating systems, and browsers (i.e. effective exchange between different systems).

Section 4 focuses on the use of intelligent and pedagogical agents for improving collaboration in u-learning. To improve the effectiveness, or even the autonomy of computational learning tools, some techniques of Artificial Intelligence (AI) have been employed. Due to some of their abilities, such as behavior guided by goals, reactivity, reasoning, adaptability, learning, communication, and cooperation, Intelligent Agents have become very popular in computer-supported learning environments. An intelligent agent is any entity which may receive information about the environment by means of sensors and act in that environment by the performers rationally – in the other words, in a correct way and tending to maximize an expected outcome. An autonomous agent set that cooperates to solve a problem that is beyond the capacity of a single agent is considered a Multi-Agent System (MAS).

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