Preface

Web-based interactions are becoming more prominent in every aspect of a person’s activities, transforming both individuals’ lives and society as a whole. In this context, learning as an integral part of personal and social development should not be excluded from this phenomenal proliferation of Web-based activities. The availability of vast Web technologies and resources could potentially be turned to advantage in favor of better learning environments, available to all individuals regardless of demographic limitations.

This notion of e-learning environments and applications that are accessible to anyone, anywhere, and anytime has indeed generated academic research and applicable realizations. All these efforts are quite differentiated from traditional instructional methods, due to the very different nature of the context and the medium. However, the extent of the success of these efforts is yet to be established, since it remains unresolved whether e-learning could offer an equal or even optimized learning outcome, compared to traditional instruction.

To that direction, there are indeed some possibilities in Web-based instruction that may as well be proven beneficiary for learners, apart off course from the ubiquitous accessibility, with individualization being one of the most promising aspects of e-learning. This is actually the main subject of the book: the incorporation of cognitive, affectional and pedagogical theories into the domain of Web-based education, in order to provide individuals tailored-suited learning environments. Instead of a uniform approach that, at its best, would simply replicate traditional classroom instructional methods, the aim of this book is to propose a meaningful integration of human factors in Web-based learning processes, providing added value to the use of Web technologies in education.

This approach is related to personalization, by placing emphasis on individual differences, which have been proven to have a significant impact on how individuals learn. Therefore, the research that is presented in this book is focused upon understanding cognitive, emotional and social processes of learners, in order to propose and construct Web-based learning environments that adapt on these characteristics, or at least provide a considerable degree of flexibility. Such an approach would essentially lead to the augmentation of the potential of Web-based education, by addressing learner needs and abilities that are out of the scope of traditional instruction, which in general employs a uniform methodology.

As implied above, the book covers three main axes of learning: cognitive characteristics, emotional/affectional processes, and social pedagogical approaches. It should also be mentioned that in the short history of developing adaptive educational applications, the construct of style was proven quite popular. Both cognitive and learning style, and the corresponding theories that propose typologies of learners, provided a basis for personalized learning environments. On the other hand, a solid theoretical and experimentally evaluated approach has not been adopted by the educational community, underpinning the importance of further elucidating the possible uses of style in e-learning. This is the main reason why research on style is presented on all sections of the book.
Additionally, while research on individual differences and Web-based learning progresses into greater depth, the importance of cognitive constructs, such as working memory, is brought into the foreground. Therefore, the first axis of the book addresses issues that are related to how each learner assimilates information according to individual cognitive characteristics.

In parallel, the affective aspect of learning and the effect of emotional parameters are lately concentrating the attention of the research community. Learning cannot be considered merely the outcome of cognitive processes, regardless of the affective state or traits of the learner. The effect of emotion may be more elusive in terms of measuring and manipulating, but affect is a significant part of human behavior that Web-based learning environments should be adapted upon. This rather new direction of research is also addressed by the book, raising concerns and methodological issues on a field that may as well be of significant importance in future applications, especially if e-learning becomes a predominant rather than a complementary method of instruction.

The social dimension of Web-based learning on the other hand is probably becoming one of the main directions of relevant research. The so-called social Web is increasingly popular, and it inevitably leads to the incorporation of social parameters in Web-based learning and training environments. Besides the differences in the cognitive and affective characteristics of learners, which can be considered as an individualistic approach, learning also involves social interactions, or at least occurs in a social environment (e.g., in a classroom). Terms such as social pedagogy and collaborative learning are becoming more common in the theoretical basis of e-learning applications, substantiating a new approach on the issue. Therefore, a corresponding section in this book widely covers the social and collaborative approach in Web-based learning.

On the basis of the aforementioned axes, there have been quite a few actualized learning environments or platforms for development of applications, which can be considered as interdisciplinary, bridging the theory with the design and development of personalized environments. It is considered that the presentation of these endeavors would provide a clear insight on how it would be feasible to integrate individual differences and social theories into Web applications design. Therefore, a number of authors propose ways of building Web-based environments based on cognitive, affective, and pedagogical parameters.

The basic aim of this book is not to merely present theories that would potentially be useful for an educationist, but to also provide a practical framework for further developing e-learning applications. It is expected that the coverage of a wide array of issues involved in learning processes will motivate educationists and Web developers to include human factors in their instructional approach in a necessarily interdisciplinary way. The overall objective is to bring into effect a more coherent design and development procedure for Web-based environments, by providing insights over a number of human characteristics. The argument for the equivalence or even prevalence of e-learning in relation to traditional methods of instruction could mainly be strengthened by increasing the efficiency of Web instruction; each chapter of this book is oriented towards the realization of optimized interactions between the learner and the Web environment.

Therefore, it is anticipated that both educationists and Web designers will find this book useful, since a new approach could be adopted by bridging two distinct fields of research. This is also in line with the notion of human-centered design that is often mentioned in the area of human computer interaction as a main trend. It could also be supported that a potential conclusion for the reader of this book would be that it is highly important to place the learner and his characteristics in the centre of research and development, the same way that every product or service seems to be designed today.
Additionally, the fact that e-learning is in the center of future educational policies generates extensive academic research; the numerous theoretical perspectives included in this book are expected to provide academic researchers with a comprehensive Web-based educational background, and to trigger the emergence of innovative and efficient combined approaches. The field of Web-based learning at an academic level is quite diversified, and it could be supported that there is a need for grounding the proposed theories and conducting extensive empirical evaluation. To that end, this book also aims to provide a basis for integrating various learning approaches into a broad theoretical framework, as a common ground among diverse directions of research on e-learning.

The book consists of four sections. Section I places in the centre of interest the cognitive aspects of learning, with emphasis on individual differences, cognitive/learning style, and working memory. Section II addresses emotional and affective issues, while Section III presents personalized environments that are based on theories and issues discussed in the previous sections. Finally, Section IV is focused on the social and collaborative aspect of learning.

In Section I, the first chapter of the book, written by Michael Grimley and Richard Riding, summarizes the whole concept of incorporating individual differences in e-learning. Human factors such as style, gender, working memory, prior knowledge and anxiety are taken into consideration as variables that have a significant impact. Furthermore, these concepts are not only described and discussed, but actually placed within the context of Web-based learning, in order to propose ways of adapting the learning environment on each individual. It is also very important that these factors are not only discussed separately, but their interactions are also taken into account.

The need to personalize Web-based learning environments to individuals is the main argument of the second chapter by Steve Rayner. To that end, the activation of a “differential pedagogy” is proposed, by taking advantage of personalization technologies, in contrast to uniform traditional instructional practices. From the perspective of an educationist, the issue of learner diversity is addressed and discussed, substantiating the notion of individualization in learning. In particular, style is considered as a basic parameter of a new e-pedagogy, in order to applicable reform future educational practices.

Martin Graff, in the next chapter, focuses on the role of cognitive style in learning hypermedia environments and hypertext systems, elucidating the relation between style and behavior of users. Concept maps, navigational strategies, hypertext segmentation, and overview provision are also related to patterns of behavior, while cognitive style is shown to have an additional impact. Previous research work is presented, exploring the efficiency of Web-based learning, and a method for optimizing e-learning design is suggested.

The controversy over the efficiency of e-learning is discussed in the fourth chapter of the book by Michael Workman, in parallel to the effect of the medium on the quality of learning. Style is also considered as a significant factor, both from the instructor and the learner perspective. An integration of the theory of style in Web-based learning, but within the limitations of the medium, is considered as beneficiary, along with methods of reducing cognitive load and facilitating the acquisition and application of problem solving skills. In sum, the author underpins the importance of increased flexibility and the provision of multiple modes of delivery of information.

George Spanoudis and Eleni A. Kyza adopt a deeper cognitive approach in their chapter, by relating findings from cognitive and developmental psychology with the design of e-learning applications. The basic mechanisms of cognition and their development are first presented, while the concept of learning and how one could utilize theory and research results from cognitive psychology is discussed afterwards. The notion of individual differences is placed within the context of cognitive, metacognitive and problem
solving skills. The chapter concludes with a synopsis of essential parameters that should be taken into account when designing the content, representations and interactional features for a computer-based learning environment.

An analogous cognitive approach is presented in the final chapter of the first section by Zoe Bablekou. The construct of working memory is comprehensively described, by analyzing the major models of this key process of the human cognitive system. This analysis aims to clarify which model suits better the needs of Web-based education, and to render possible for designers and educationists to deeply understand the concept of working memory. The conclusion is that e-learning should be flexible and incorporate adaptive techniques, placing working memory in the backbone of cognitive processes within Web-based interactions.

In Section II, Makis Leontidis and Constantin Halatsis place emphasis on affective issues and the role of emotions in Web-based learning processes. They suggest that the omission of these human factors in adaptive learning hypermedia would result in reduced efficiency of these applications, thus underlining the importance of affective computing. Their chapter presents basic concepts of affecting computing and corresponding theories and models, methods of formal representation of affective knowledge and emotions elicitation, and applications related to the field of affective education. Finally, having discussed the problems of identifying affective mechanisms, suggestions for future research conclude this chapter.

The identification of affective mechanisms and their impact is the main concept of the following chapter by Elena C. Papanastasiou, Aimilia Tzanavari, and Patricia A. Lowe. Particularly, different concepts of anxiety are experimentally evaluated in order to explore their effect on learning performance. Learner trait, test, and computer anxiety were measured, while gender differences were also taken into consideration. According to their findings, computer anxiety has the most significant impact on learning performance, thus introducing an additional parameter in designing educational hypermedia. Moreover, the same consideration applies on the notion of widely using computer testing, since not all individuals are equally familiar with Web-based interactions.

In the area of fully developed and existing or experimental Web-based educational applications that incorporate cognitive, affective and pedagogical theories, which is the main axis of Section III, Nikos Tsianos, Panagiotis Germanakos, Zacharias Lekkas, and Costas Mourlas present empirical results on the effectiveness of personalization on cognitive style and visual working memory. According to this experimental approach, personalization on these factors improves learner performance, while the proposed adaptive mechanisms seem to reflect the implications of the psychological theories that were opted for.

Christian Gütl and Victor García describe in the following chapter a system of guided access to open repositories, providing learners with increased flexibility in relation to their characteristics. The main idea is to offer tailored learning and teaching activities, in contrast to close-ended non adaptive systems, focusing on the notion of concepts. The progress of their work through subsequent dynamic prototypes is described, and according to their evaluation it is feasible to build a system that integrates various information services and correspondingly guides learners with concept and context sensitivity.

Elvira Popescu addresses the issue of modeling learners in Web-based environments, and suggests a complex typology that is derived from multiple style theories. Instead of traditional psychometrical testing and style dichotomies, the author describes an implicit, constantly dynamic method of measuring different dimensions of learners’ style, based on their interactions with a Web-based environment. The mapping process is thoroughly described and experimentally evaluated in terms of accuracy, addressing the issue of learner diagnosis through Web-based techniques.
The next chapter of the book, written by Ray Adams and Andrina Granic, explores the possibility of pedagogically enriching accessible e-learning platforms. They present a framework for effective e-learning that includes numerous aspects of human factors and contextual parameters such as cognitive user modeling, user sensitive design, and usability and accessibility issues to name a few. This results in relating types of human learning to different forms of e-learning solutions, offering a practical taxonomy. Their work follows a cognitive learning approach, in order to identify which are the most appropriate e-learning practices based on human requirements.

William Billingsley and Peter Robinson discuss issues concerning the design of Intelligent Books, which are Web-based textbooks with adaptive content and computer-supported exercises. They describe the optimal characteristics of the specific e-learning method and present existing research on Intelligent Books, while some economical factors are also addressed. The authors focus on design considerations such as content, structure, separation and narrative continuity, and student modeling/adaptation, in order to exemplify the key factors in this Web-based learning approach. They conclude that Intelligent Books are valuable in a practical way, and should be developed in a collaborative way.

Jorge Ferreira Franco, Irene Karaguilla Ficheman, Marcelo Knörich Zuffo, Valkiria Venâncio, and Roseli de Deus Lopes employ Web-based technologies, virtual reality, information visualization/computer graphics techniques, and low cost multimedia tools for the purpose of sharing Web-based knowledge in the context of primary education. They support their multi-level approach with empirical data, and suggest that passive education should be transformed into an active learner centered experience. The authors also take into consideration the issue of digital divide, since their work in schools also aimed to improve computer literacy, and propose an educational policy with the use of the abovementioned technologies.

The final section of the book emphasizes on social and collaborative aspects of Web-based learning. Robert Z. Zheng, Jill A. Flygare, Laura B. Dahl, and Richard R. Hoffman bridge social communication patterns with the construct of cognitive style in the context of online learning. According to their empirical findings, individual differences in cognitive style have an effect on the formation of online social communication. With the use of the method of social network analysis, it is demonstrated that learners exhibit different consistent patterns of behavior according to their cognitive style; thus, learning support should be adapted on the different types of learners. Additionally, according to the authors, a set of additional factors (ranging from complementary personality to online chat experience) is also significant in Web-based collaborative learning.

Yin Zhang in the next chapter reports a comparison study over the effectiveness of collaborative learning. Since collaborative learning has been proven useful in a traditional classroom, this evaluative approach aims to investigate whether the same applies in Web-based learning. The author first presents the benefits of collaborative learning, and subsequently describes methods for incorporating this form of instruction in online distance education. As it concerns the empirical findings, distance learning students are found to be more positive in adopting collaborative learning techniques than their on-campus counterparts, and can achieve the same learning goals as the latter.

The relation of collaborative learning, communication styles (as a personality factor) and social networks is explored by Hichang Cho and Richard Gay by adding a personality theory to structural analysis. Their main finding is that pre-existing friendship networks and communication styles have an impact in developing collaborative learning networks. Therefore, it is supported that an appropriate social infrastructure that would trigger the desired interactions is necessary in order to built collaborative e-learning systems, prompting designers not to merely implement new technologies.
Jan-Willem Strijbos, Theresa A. Ochoa, Dominique M. A. Sluijsmans, Mien S. R. Segers, and Harm H. Tillema argue that formative peer assessment perfectly fits the purpose of collaborative learning. They first review both the shortcomings (such as students’ ability and interpersonal variables) and benefits of peer assessment practice, while also addressing the issue of directionality, frequency and constellation of interactivity. What is more important is that the authors propose a set of guidelines for peer assessment in Web-based collaborative learning contexts, systematizing their approach.

Supporting collaborative learning in Web-based environments from the perspective of the tutor is the main theme of the next chapter by Francesca Pozzi. The author proposes a flexible monitoring model that allows the tutor to control the learning process in different aspects and levels. This model consists of four dimensions: participative, cognitive, social and teaching, which are described and analyzed. The evaluation of this approach is conducted through three case studies, in order to ground the importance of individualizing the collaborative learning process with the use of appropriate monitoring techniques.

Andrina Granić, Maja Ćukušić, Aimilia Tzanavari, and George A. Papadopoulos present an extensive incorporation of pedagogical approaches and assessment techniques into an e-learning platform. A number of learning theories and strategies are reviewed, with the presentation of relevant classifications, and a pedagogically enriched e-learning platform is described. Issues concerning the requirements of e-learning are discussed, along with mobile learning considerations. The authors also present and compare learning scenarios that were applied in schools, evaluating the implementation of different pedagogical approaches.

In the last chapter of the book, Paula Peres focuses on providing high quality e-learning standards by including learning theories in the design of Web-based applications. The author proposes a model of instruction that consists of five phases (analysis, design, development, implementation, and evaluation). Each phase is described, with emphasis placed upon the learning approaches that have a pedagogical impact on the design process (ranging from learning styles to socio-constructivism). This five-step procedure aims to aid the selection of the appropriate learning strategies, from a very wide range of theories, resulting in a useful combined learning process.

Conclusively, all of the above chapters contribute to a better understanding of the role of human factors in Web-based learning. Having read this book, a shift in the perspective of Web designers, educationists and academic researchers, from technological determinism and simplified approaches towards combined efforts in satisfying the needs of learners, is anticipated. The cognitive, affective and pedagogical aspects of e-learning are shown to be equally significant and, knowing that, it would be highly surprising to omit these parameters in the design and development of future applications.

Academic knowledge that can be put into practice is perhaps the most important contribution of this work, and the gathering of a vast number of different perspectives in a book is perhaps an unprecedented endeavor, especially in terms of bridging human factors with the design of Web-based learning environments. The wide coverage of human parameters that have an impact in the context of the Web was, from the very beginning, at the core of this book project as a response to the lack of an interdisciplinary corpus of relevant research.

Furthermore, the diversity of the work that is included in this book clearly demonstrates that there is much potential in optimizing Web-based learning environments and providing far more effective applications. Still, this requires a multi-level methodology that has not yet been put into practice, but could be extracted from the contents of this book. The inclusion of research work from various and quite differentiated areas should not be considered as an indication of an isolated segmentation in the field; on the contrary, it contributes to the understanding of the complex nature of human learning processes and
hopefully to the emergence of innovative human-centered instructional methodologies. Web-based learning could then be significantly improved and satisfy the expectations of educational policy makers.

Constantinos Mourlas
Nikos Tsianos
Panagiotis Germanakos

Editors