

Thanasis Daradoumis, Santi Caballé, Joan Manuel Marquès, and Fatos Xhafa (Eds.)

Intelligent Collaborative e-Learning Systems and Applications

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Preface

Intelligent Collaborative e-Learning Systems and Applications

One of the main research focuses in Computer Supported Collaborative Learning (CSCL) investigates on the improvement of on-line collaborative learning processes through the development of collaborative e-learning systems and applications which are empowered with intelligent methods and techniques. As a result, collaborative learning systems and applications are to be more powerful and flexible and also more adaptable to the learning process and thus provide better answers to the paradigmatic principles of on-line collaborative learning. In addition, virtual learning environments should be able to deeply influence the learning process by providing precise and exhaustive information and complex knowledge to all actors of the collaboration about the real dynamics of the group activity. By means of the obtained knowledge, tutors can offer an adequate support at the appropriate time and situation and evaluate the entire learning process more objectively, as well as personalize the course and its contents to the characteristics, preferences and rhythm of each learner. From the learners' standpoint, this knowledge brings them different forms of awareness about the current state of group activity as well as helps them self-regulate their individual behavior by observing and comparing each other's performance.

Moreover, important research on on-line collaborative learning practices includes the study of infrastructures that give support to those communities of contributors whose resources are managed in a peer-to-peer fashion. On-line collaborative learning processes can be improved through the employment of large scale distributed and decentralized infrastructure and the use of heterogeneous resources contributed by either the members of the learning group themselves, academic and research institutions, or third-part companies providing resources in exchange for an economic benefit. A key issue in this context is the use of economic algorithms to guarantee the efficient allocation of the contributed resources in the infrastructure. This will allow all the actors of the learning process to complement and increase the amount of the available resources. A second objective related to the infrastructure is the management of deployed learning services and applications using the contributed resources. This will require defining new mechanisms to guarantee the availability of services and learning applications as well as to evaluate its correct behavior in learning environments. Such mechanisms must take into account several variables such as demand of services, expected availability, volatility of resources and temporality.

Finally, ‘learning design’-based e-learning environments seem to be promising contexts for the design of pedagogically sound e-learning events. The key principle in learning design is that it represents the learning activities and the support activities that have to be performed by different people (learners, teachers) in the context of a unit of learning. Nevertheless, there is an absence of tools that could support teachers’ attempts for ‘learning design’ by explicitly taking into account the development of learners’ cognitive skills. In addition, there is a lack of a coherent and integrated framework that could support the design of tools that should allow teachers to be involved in learning design –especially on the design of tools that support both synchronous and asynchronous communication – and focus on the development of learners’ cognitive structures and critical thinking. In any collaborative learning effort, it is very important to provide appropriate intelligent tools and methods to support effective and meaningful communication among participants – both synchronous and asynchronous discussions – so that to encourage the development of core thinking skills as well as critical and creative thinking in learners.

The merge of all these synergies represents an attractive but quite laborious challenge that will yield systems capable of providing more effective answers on how to improve and enhance the on-line collaborative learning experience.

Despite the considerable progress in this field, there are still plenty of issues to investigate on how to employ the emergent computational technologies to fully support online collaborative learning and teaching activity. Four such issues concern the employment of methodologies and tools that support, on the one hand, the development of more powerful e-collaboration settings and, on the other hand, the structuring, analysis and regulation of collaborative learning interactions; the use of models that support e-learning in collaborative work experiences; and finally, the development of distributed and decentralized infrastructures to support resource allocation and services composition in collaborative peer-to-peer or Grid-based environments.

As a result, in this book we present up-to-date research approaches for developing both conceptual frameworks and computational technologies to support functional online collaborative learning and work settings. The book aims at providing tutors and researchers of online collaborative work and learning with approaches for effective and efficient means that would assist e-learning participants in enforcing and improving their online learning and working activity at both individual and group levels. Moreover, approaches in the book appeal for providing researchers and developers of online collaborative systems with fresh and innovative ideas to extend existing e-learning platforms so that they can be used efficiently in a distributed environment where learning design and material producers, service providers, and users (either tutors, learners, or academic coordinators) share similar collaborative learning and work experiences.

Among the many features highlighted in the book, which provide a significant support to the design and development of intelligent collaborative e-learning systems, we could distinguish the following:

Learning design approaches, such as adaptation, collaboration scripting, and critical thinking. Adaptive approaches to scripted collaborative learning can be

seen as methods for improving the learning interactions among the students during a learning experience. Moreover, the realization of effective synchronous and asynchronous communication can be further enhanced by tools that help form such interventions that encourage the development of core thinking skills as well as creative and critical thinking in learners.

Interaction analysis approaches. Tracking group and individual activity is very important for being aware of learners' participation and performance, group functioning, as well as for assessing individual contribution in online discussions. In collaborative learning activities that span over a long period of time, supporting a collaborative activity based on an asynchronous discussion or help students and teachers establish good social interaction patterns is essential. Monitoring learners' progress, identifying potential problems within groups or students and sorting them out quickly may contribute to the successful achievement of their learning goals.

Combination of supporting media, tools and other learning elements. In real complex online collaborative learning contexts, the combination of media, such as streaming, educational software, as well as other elements, such as interactions, perspectives, learning experiences and solution strategies, may result crucial in encouraging collaboration in groups which encounter many difficulties that may originate by the technical content of the learning activity and/or by the intrinsic complex nature of the collaborative work itself.

E-learning at work. E-learning is not exclusive only in educational settings. Important learning activity can also take place at work experiences. For this reason, models that support the interoperability among organizations, as well as personalized, contextualized, effective and efficient e-learning at work are needed. Moreover, communities of practice continually emerge and proliferate in the Web. New approaches are needed for organizing and encouraging group interactions and other democratic group production situations in order to enhance and improve the construction of effective knowledge.

Resource allocation and services composition in collaborative peer-to-peer or Grid-based environments. Virtual organizations (VO) normally gather several resources and interests of their members in a way that they can lend resources to or borrow them from other VO. This results in the need of designing decentralized resource allocation systems, especially for the case of collaborative peer-to-peer environments. Also, effective semantic description model are needed to automate tasks such as discovery, matching, composition and invocation of services in collaborative learning scenarios that share a variety of network resources.

Introduction

This book consists of 11 chapters organized into four major areas: (i) *Methodologies and tools that support the development of more powerful e-collaboration settings*, (ii) *Models that support e-learning in collaborative work experiences*, (iii) *Methodologies and tools for the structuring, analysis and regulation of collaborative learning interactions*, and (iv) *Distributed and decentralized infrastructures that support resource allocation and services composition in collaborative peer-to-peer or Grid-based environments*.

Methodologies and tools that support the development of more powerful e-collaboration settings

The chapters in this area are organized as follows:

The first Chapter by Demetriadis and Karakostas provides a comprehensive introduction to adaptive collaboration scripting, examining several pedagogical and technical issues. The authors bring together and emphasize the benefits of two important learning design approaches, namely adaptation of the learning environment and scripted collaborative learning. They analyze some of the major pedagogical and technical issues related to the design and development of systems for adaptive collaboration scripting (ACS systems) at two levels: at the pedagogical level, they provide methodological steps on how to build systems for adaptive collaboration scripting; at the technical level, they present a generalized architecture for systems that adaptively support learners during scripted collaboration sessions.

Constantinou et al., in Chapter 2, present an approach that combines streaming media and collaborative elements to support lifelong learning. In particular, they describe the educational value of streaming media combined with asynchronous collaborative learning and then describe the particular characteristics and limitations of the supporting Asynchronous Multimedia Collaborative Systems (AMCL). They show the new trends in AMCL systems that come to address the limitations of the current systems and to enhance the educational value of streaming media. The chapter provides ideas for educators who employ educational technologies to have the challenge of creating systems like AMCL that will make students become active consumers of digital audiovisual learning content.

Chapter 3, by Kordaki, proposes a learning framework - the MULTIPLES framework (Multiple: Learning Tools, Interactions, Perspectives, Learning Experiences and Solution Strategies) - that can be used in e-collaboration settings to encourage the development of multiple perspectives for each individual student regarding the learning concepts in focus. This framework has been designed within the context of social and constructivist learning theories, acknowledging the role of asking learners, working in both groups and individually, to face appropriately designed learning tasks by using multiple learning tools and representation systems while at the same time performing various interactions in order to produce multiple solution strategies 'in as many ways as possible'. To this end, a case study is reported that illuminates the role played by MULTIPLES in the enhancement of each individual student's views by generating different solution strategies to the tasks at hand, while at the same time expressing their inter- and intra-individual differences.

Models that support e-learning in collaborative work experiences

E-learning can be an important matter at a collaborative working environment as well. These types of environments may raise several issues that are to be addressed. Such issues are how to support the interoperability among organizations, as well as how to support personalized, contextualized, effective and efficient e-learning at work. Focusing on these issues, Capuano et al. propose a model in Chapter 4, called the Knowledge Virtual Enterprise model, where the Virtual Enterprise vision is extended with Knowledge-based assets. This model offers several advantages which are best explained by defining some real-world business scenarios, to be executed within the context of a Knowledge Virtual Enterprise instance. The scenarios are based on the idea that several organizations could put together their competences, human resources, expertise, technologies, etc. to carry out complex project activities, requiring re-sources that are usually difficult to be found in a single organization.

Thaw et al. suggest that democratically organized computer-supported cooperative work (CSCW) systems provide an ideal platform for organizing and encouraging group interactions in e-Learning and other democratic group production situations where physical meetings are not feasible. To this end, they present a system in Chapter 5, called Communities of Practice Environment (CoPE), which generated several findings. The development of workflows, for example – a process of abstracting system concepts into plain language – provides substantial benefit to non-technical users. Their experience with the system, however, revealed that while the potential for benefit is substantial, the benefit will best (if not only) manifest when the system is engaged by users who have a need for the type of democratic collaboration the system is designed to facilitate.

Methodologies and tools for the structuring, analysis and regulation of collaborative learning interactions

This area is being introduced by chapter 6 (Kordaki and Daradoumis) which presents critical thinking as a framework for structuring synchronous and asynchronous communication within learning design-based e-learning systems. The successful development of the learners' core cognitive skills and critical thinking which is strongly related to an effective discussion structuring can be achieved by the design of specific tools which can be used by both teachers and students. To that end, the authors propose a Cognitive Skill-based Communication Wizard (CSC-Wizard) for helping discussion participants formulate appropriate interventions that express their intentions more clearly and thus facilitate the development of their cognitive skills more adequately. The design of this CSC-Wizard is based on modern social and constructivist views of learning and dialogue modeling. The idea, the rationale, the architecture and the interface associated with the proposed CSC-Wizard is presented through implementing a specific example within LAMS and MOODLE systems.

Chapter 7, by Casillas and Daradoumis, goes a step further in the modeling of collaborative conversations by proposing a multi-agent system for discovering the meaning over natural-language collaborative conversations. The analysis of natural language dialogues is a complex task due to the diversity of meaning for words and expressions according to the context. This work aims at presenting a multi-agent approach for dealing with the problem of discovering the meaning of expressions written in Spanish, based on a flexible recovery system and Bayesian principles. At a first stage, agents are supposed to identify the role of the words composing a sentence. At a second stage, a second set of agents is ready to coordinate among them in order to assemble a meaning. This research sets the basis for developing an intelligent analysis tool of collaborative conversations that take place among participants in a web-based collaborative learning environment with the aim to identify participants' intentions and assess individual contribution in an automated way.

Continuing with the focus of the research on the analysis of collaborative activity based on asynchronous discussions, Caballé et. al., in Chapter 8, propose the design of a different tool, called CoLPE (Communities of Learning Practice Environment), which is actually an extension of the CoPE system presented in Chapter 5, since it extends it from the cooperative work domain to the collaborative e-learning one. The new system gives more emphasis on the development of advanced mechanisms of information management of group activity. The extracted information is processed, analyzed and provides the tutor with effective knowledge on learners' interaction behavior. This enables the tutor to adequately regulate the learning process as well as to enhance the learning group's participation by means of providing appropriate awareness and feedback. Evaluation of the approach followed showed promising results in supporting both formal and informal discussion processes that occur in current communities of learning practice.

Interaction patterns that take place in collaborative learning depend on the roles assumed by participants in the learning process. In real computer-based collaborative practices, teachers need support to be able to detect these emergent roles and undesired interaction patterns. Marcos et al. address the issue of detecting and solving negative situations in real CSCL experiences in Chapter 9, proposing a role-based interaction analysis approach. This approach is supported by a tool called Role-AdaptIA which is used to detect and help solve problematic situations in authentic computer supported collaborative learning (CSCL) scenarios. Role-AdaptIA is an adaptive interaction analysis tool based on a theoretical framework for the description of roles. The framework permits to define and characterize the roles to be taken into account in a given situation. Based on this information, Role-AdaptIA automatically detects role changes during the development of the collaborative experiences and warns the teacher about these changes. With this advice, the teacher is able to regulate the collaboration, providing support to the students to improve their interaction patterns.

Distributed and decentralized infrastructures that support resource allocation and services composition in collaborative peer-to-peer or Grid-based environments

The last two chapters raise important issues related to resource allocation and services composition in collaborative peer-to-peer or Grid-based environments. They emphasize the role that distributed and decentralized infrastructures play in these situations. Thus, in the first case, Chapter 10, by Vilajosana et al., deal with virtual organizations (VO) that gather the resources and interests of their members in a way that they can lend resources to or borrow them from other VO. To face this issue effectively, they propose DyMRA, a decentralized resource allocation system based on markets that allows inter-VO resource allocation. DyMRA is specially designed for collaborative peer-to-peer environments, where the autonomy of participants is important. The key aspect of DyMRA is that of market decentralization, that allows allocations of resources amongst different VO in spite of markets' failures. This chapter shows how the architecture of such a system is built as well as the main tools that have been developed to make DyMRA a reality. It also shows how the economy can be used to regulate the usage of resources as well as the implications of using different market mechanisms. A thorough evaluation of the system is finally provided.

The last Chapter 11, by Gutiérrez and Jorba, faces the use of distributed technologies in collaborative environments from the Grid perspective. The Learning Grid has been a quite hot issue during the last years. It is based on a secure, flexible and coordinated form of sharing network resources which are dynamically collected by individuals and institutions, and establishing mechanisms for the correct exchange of information and a strict control of the resources to share. Learning services are fundamental components of learning Grid representing functionalities that can be easily reused without knowing the details of how services have been implemented. Semantic modeling of web services promises to automate tasks such

as discovery, matching, composition and invocation of services. The objective of this chapter is to present an overview of a work related with the analysis, design and implementation of semantic models for the description of learning services and their incorporation inside Collaborative Learning Scenarios based on Grid technologies.

Final Words

Intelligent Collaborative e-Learning Systems and Applications is a major research theme in CSCL and CSCW research community. It comprises a variety of research topics that focus on developing systems that are more powerful and flexible and also more adaptable to the learning process and thus provide better answers to the paradigmatic principles of on-line collaborative learning and work. The chapters collected in this book provide new insights, findings and approaches both on the analysis and the development of more powerful e-collaboration settings. Researchers will find in this book the latest trends in these research topics. On the other hand, academics will find practical insights on how to use conceptual and experimental approaches in their daily tasks. Finally, developers from CSCL community can be inspired and put in practice the proposed models and evaluate them for the specific purposes of their own work and context.

We hope the readers will find this book useful and share with us the joy!

July 2009

Editors of the Book
Barcelona, Spain

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