Chapter 35
A Framework for Networked Experiments in Global E-Science: Perspectives for E-Learning in Global Contexts

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ABSTRACT

This chapter presents a framework that creates, uses, and communicates information whose organizational dynamics allow individuals to perform a distributed cooperative enterprise in public educational environments. The approach presented here assumes Web services (possibly offered over a grid) are the enacting paradigm used to formalize educational interactions as cooperative services on various computational nodes of a network. By examining a case study involving a well known micro-array experiment in the growing field of bioinformatics, this chapter will detail how specific classes of interactions can be mapped into a service-oriented model that can be implemented in a variety of e-learning contexts. This framework illustrated by this case study allows for a sophisticated degree of e-learning that can be applied to a range of local or international contexts.

INTRODUCTION

The topic of e-learning is often associated with a sophisticated and often manned teaching platform used to allow remote users to access educational information that enhances an individual's knowledge about a topic. In this chapter, a broader view of e-learning is taken by examining how knowledge exchanges can be distributed across a network of notes. In particular, the chapter presents a framework educators can use to facilitate cooperation and discovery associated with research and teaching practices.

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In today's world, both researchers and educators face problems linked to the virtualization of resources and to the orchestration of services in the heterogeneous and distributed context of e-science (De Roure, Gil, & Hendler, 2004). In this sense, distributed network e-science approaches, like the one proposed in this chapter, could provide tremendous benefits to e-learning by improving an institution's or a programs' ability to recruit a higher portion of the human capital (i.e., researchers and educators) who are not yet fully involved in scientific research and teaching. Additionally, such approaches can help educational institutions in other nations – particularly developing nations – overcome the subtle form of digital divide affecting educational practices in those nations by providing researchers, educators, and students with access to instrumental information associated with effective science education.

SCIENCE, NETWORKS, AND COLLABORATION

Today, effective science research and education are increasingly a question of having a critical mass of skilled people, often with complementary backgrounds, who can collaborate to become a kind of unique global organism in pursuit of a substantial common goal. Historically, scientifically specialized workforces have involved concentrating the right group of individuals in unique sites where special scientific instruments are available. Today, however, the availability of information and communication technologies enables researchers to interact as part of a distributed network of individuals living in different locations, but collaborating through information communication technologies (ICTs) to engage in a variety of projects.

In the current global context, many of the problems faced in the present renaissance of biology do not need a unique, big site, while other disciplines, like geology, are intrinsically distributed for data collection. Such differences can have important effects on or consequences for science education. Within this context, important educational benefits can arise from the use of possible networks of experimenters who are not necessarily located in the same physical space, but who can use different technologies to collaborate on the same major experiments in a way that involves all of their complementary competencies.

In the cases of bioinformatics paradigm of e-science examined in this chapter, a proper virtual organization is required to manage the flow of information over a given network. A networked organization such as this might be logically defined through workflows acting over Web services, possibly exploiting a grid context. The technology addressed in this chapter allows the most competent scientist to use such a networking approach to design project workflows even if the individual is not at a very high level of competence in ICTs (which are, in a sense, logically embedded). Rather, the proposed context offers participants a special opportunity to electronically learn complementary skills, with respect to the ones already possessed. The idea is that participating individuals, through their distributed collaboration on a project, can constitute a kind of learning tool related to the whole process on which they are working. In this way, a distributed approach to doing scientific research could provide educators in a variety of fields with a framework for developing effective and distributed e-learning platforms.

COLLABORATION AND E-SCIENCE

In recent years, the concept of virtual organization has been developed as a result of the grid computing paradigm (Foster, Kesselman, Nick, & Tuecke, 2002; Foster & Kesselman, 2004) that is used as a general conceptual model to coordinating activities. Such virtual organization is a set of individuals and institutions that all have direct access to services, knowledge, tools, data,

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