Design, Development, and Implementation of Electronic Learning Environments for Collaborative Learning

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Developments in society and business, and related changes in higher education and lifelong learning, require educators and educational designers or technologists to rethink education. Examples of such changes are the growing importance of achieving complex learning, the integration of learning and work in education, and the need for improved flexibility with regard to time, place, and individual needs. These changes cannot simply be responded to by adding technological solutions implemented according to existing educational approaches. Instead, an integrated view of e-learning is necessary, characterized by the combination of pedagogical, technical, social, and organizational factors. This two-part special issue elaborates on the different characteristics of integrated e-learning, from design through future topics for research.

☐ Higher education suffers from its stress on the individual acquisition of knowledge and skills in an academic setting while society and industry cry out for learning outcomes that can often only be achieved in authentic collaborative contexts (Kirschner, Van Vilsteren, Hummel, & Wigman, 1997). Examples of such learning outcomes are negotiation of meaning in discourse and argumentation, solving ill-structured or wicked problems in interdisciplinary teams, and continuous or lifelong learning throughout a series of employment cycles. It is therefore no wonder that curriculum evaluations at the university level (e.g., academic audits or accreditation reviews) are critical of skills development in general and collaborative ability in particular.

Universities and corporations are also making increasing use of information and communications technologies (ICT) to help them reach current and potential students and employees. As Reeves, Harrington and Oliver (in press) note, a survey of college administrators (Allen & Seaman, 2003) indicates that "nearly one-third of. . . academic leaders expect that learning outcomes for online education will be superior to face-to-face instruction in three years, and nearly three-quarters of them expect learning outcomes for online education to be equal to or better than face-to-face instruction."

To help meet the needs of today's universities and tomorrow's society, there is a conscious drive toward the integration of learning and working together as a guiding principle for both the educational approaches used in these institutions (i.e., using constructivist techniques in teaching or learning) and the position and use of ICT (i.e., using technology to help students, educational staff, support staff, and employers to

work together). This approach has a dual function, namely, supporting the use of effective discursive-learning methods (making things explicit, discussing, reasoning, reflecting, convincing) while allowing for the acquisition of essential social and communication skills (Dillenbourg, Baker, Blaye, & O'Malley, 1996; Mirande, Riemersma, & Veen, 1997).

This thinking about higher education reform is in line with the integration of the vocationalist and the reflexive views of learning posited by Goodyear (1998). The *vocationalist* view of learning, one of operational competence, holds that employers want higher education to attend more closely to what they consider they need in the graduates they recruit. These demands may include the kinds of specialized technical knowledge acquired by some students on some courses, but increasingly they refer to generic skills or competencies (otherwise known as core skills or transferable skills). Frequently mentioned generic competencies include literacy, numeracy, communication, foreign language, leadership, teamwork, and information technology skills (e.g., Assiter, 1995; Harvey & Mason, 1996). Harvey and Knight (1996) concluded that organizations that recruit graduates are looking, above all else, for transformative potential. That is, they want new graduates entering their employ to have the capacity to transform their organization, not merely to enhance its productivity and competitiveness along current lines.

Society and industry do not want graduates merely trained in generic and specific skills. They want graduates to be able reflect upon what is needed, what the possible solutions are, what the repercussions of different solutions are, and then to make a well-considered decision. This *reflexivity* is best articulated in the writing of Barnett (e.g., 1997a; 1997b), who argued that individual reflexivity (i.e., the capacity to go on interrogating one's taken-for-granted universe) is necessary for dealing with an essentially unknowable modern world. Higher education needs to respond by supporting students in their acquisition of discursive competence, encouraging self-reflexiveness by framing their initiation into a field of thought such that they see its essential openness and how they may be actors in it, and encouraging informed but critical action by understanding the power and limitations of the field as a resource for action (Barnett, 1997a).

These views of learning cannot be made operational in traditional didactic teaching settings that are more often than not both individual and competitive in nature. The generic skills, attitudes, and competencies in the vocationalist and reflexive views require the implementation of a different approach to learning in a setting with a number of qualities:

- Shared realistic and relevant problems.
- Shared needs and goals.
- Room for multiple perspectives on the problems and their solutions.
- Shared responsibilities both for the process of achieving a final product and for the product itself.
- Mutual trust between the participants such that they are valued for their contributions and their initiative.

In other words, this can only be achieved in a collaborative or cooperative learning setting, often in electronic form.

Before discussing what is needed to achieve the type of learning and instruction strived for, we need to take a short look at what we do *not* need.

WHAT IS NOT NEEDED?

First, we need not postpone action in *anticipation of technological solutions*. One reason for not putting off until tomorrow is that all of the technological tools that we need are available today, although some are in early forms of development. We have many tools—both proprietary and open source—to create, order, store, disseminate, revise, and maintain all manner of materials. These are commonly known as word processors, authoring systems, learner content management systems, electronic learning environments, and so forth. There are also ever increasing and ever faster networks to transport information and communicate with others: e-mail or person-to-person-networking for one-to-one and multiple one-to-one communication; broad- or webcasts and listservs for one-to-

many communication; agents for many-to-one communication; and discussion groups, multicasts, or forums for many-to-many communication. Finally, there is a wealth of tools and widgets that can be incorporated in computer-mediated information and communication systems, such as shared whiteboards, collaborative writing environments, and Internet relay chat programs.

Second, we must not think that technology alone will solve the problem. The technological tools that we choose to introduce often do not achieve what we hoped they would because of a combination of human nature and conventions. Gaver (1996) eloquently argued that:

> [N]ew technologies seldom simply support old working practices with additional efficiency or flexibility. Instead they tend to undermine existing practices and to demand new ones. In this disruption, subtleties of existing social behaviors and the affordances upon which they rely become apparent, as do the new affordances for social behavior offered by technology. (p 112)

This suggests that the process of technology design and implementation requires careful attention to established practices within the target community. An interesting example is the introduction of the escalator. Originally meant to speed up the movement of people on a staircase (i.e., you can move twice as many people in the same time because their stair climbing speed is enhanced by the speed of the escalator) it has slowed the pace down and has led to congestion at the top and bottom of escalators because people have chosen to stand still and ride the escalator. Another example is the way in which secretaries who learned to type on typewriters may use word processors (spaces instead of tabs and tabs instead of tables). Technologies and social practices are always systemically interconnected, and changes in one need to be considered with the other in mind.

Finally, we must not attempt to implement these new ways of teaching and learning via existing educational approaches. There is not yet a suitable educational approach specific to the computer-supported collaborative learning context (i.e., the use of asynchronous distributed learning groups in electronic environments). The use of already existing approaches falls prey to two pitfalls (Kreijns, Kirschner, & Jochems, 2003). The first is taking social interaction in groups for granted. Many educators think that because it appears that social interaction is easy to achieve if not already present in contiguous learning groups, the same will be true in distributed learning groups because the environments—as shown in the previous paragraph—allow it. The second pitfall is that the stimulation of social interaction in such environments is usually restricted to only the cognitive aspects of learning (i.e., on-task behavior). Most educators are either unaware of or ignore the fact that social interaction is also important for the socio-emotional processes underlying group forming and group dynamics and, as a result, think that group forming and group dynamics are processes that—similar to social interaction—happen automatically. These necessary processes are often the result of what is pejoratively called off-task behavior (to be avoided at all costs!).

If we do not need new technologies and cannot make use of traditional educational approaches, what then *do* we need?

WHAT IS NEEDED?

The first thing that we need to do is *rethink* the design, development, and implementation process (Van Merriënboer & Kirschner, 2001). Traditional educational and software–interface designers are similar in that both tend to design highly prescriptive, solution-driven, context-sensitive solutions through an iterative and integrative process. In education, it is usually the educational designer, often in a team with teachers and subject matter experts, who first painstakingly determines what should be learned and how it should be taught (e.g., via cognitive task analysis), designs and develops a system (e.g., formatively evaluating it in a series of iterative steps), implements it, and then evaluates it (Kirschner, Carr, van Merriënboer, & Sloep, 2002). In software–interface design it is usually the predetermined usability of a system that is of paramount importance and which guides the design process. *Usability* is concerned

with whether a system allows for the accomplishment of a set of tasks in an efficient and effective way that satisfies the user. In order to achieve usability, a number of design principles (Norman, 1990) and prescriptive usability principles (Nielsen, 2001) are formulated.

A possible alternative for both of these design procedures is *interaction design*, which is not only aimed at usability, but is also concerned with the *utility* of the system—the set of functionalities a system incorporates. Usability and utility are both components of the *usefulness* of a system. Interaction design includes the usefulness of a system within its scope.

This new design approach (see Kirschner, Strijbos, Kreijns, & Beers in this issue) also avoids the more rigid traditional approach of trying to capture all human behavior within *prescriptions*, thinking that if the list of prescriptions is large enough, a system will correctly respond to every possible situation imaginable. This was and sometimes still is the human computer interaction design approach to solve all of the interaction problems between the user and the machine or computer (Shneiderman, 1998, Suchman, 1987). Furthermore, interaction design is also concerned with *aesthetics* and *emotion*, and how the interaction may appeal to and benefit the users, in a way that it absorbs the user within the interaction itself. Norman (2002) suggested that aesthetics and usability are connected, as are affect and cognition. In his view, as long as the design is pleasant, people are willingly tolerant of minor difficulties, irrelevancies, and blockages. The ultimate goal of interaction design is condensed in the term *user experience*, "creating user experiences that enhance and extend the way people work, communicate and interact" (Preece, Rogers, & Sharp, 2002, p. 6).

Now that we have a design approach, the second thing we need is an integrated view on what factors need to be a part of this e-learning experience. This two-part special issue discusses three factors, namely the pedagogical, the technical, and the social.

The Factors

Pedagogically, we need to free learning from its sterile, institutional, didactic chains where students *absorb* knowledge and the learning experience to cultivate richer contexts, reflective of real-world contexts beyond the school, where learners actively acquire and construct knowledge. Learning needs to be situated in problem solving in real-life contexts (Brown, Collins, & Duguid, 1989) where the environment is rich in information and where there are no right answers (embedded knowledge). The tasks must be authentic and are best learned through cognitive apprenticeship (Collins, 1988) on the part of the learner in a rich environment. Meaning is negotiated through interactions with others where multiple perspectives on reality exist (Von Glasersfeld, 1988). Reflexivity is essential and must be nurtured. Finally, all of this is best (and possibly only) achieved when learning takes place in ill-structured domains (Kirschner, 2000; Spiro, Coulson, Feltovich, & Anderson, 1988). Only technology can make this possible.

As stated earlier, the *technology* already exists. However, to completely fulfil the needs of learning in distributed groups, computer mediated communication (CMC) systems, with their available add-ons for information and communication transport and transfer, need to be augmented by the integration of a number of already existing tools that permit and support group *collaboration* and *coordination* (Ellis, Gibbs, & Rein, 1991). Group collaboration and coordination need to occur at both the group level (e.g., allocating resources and defining workflow) and the task level (e.g., a shared editor that lets group members know exactly where others are typing). Such an augmented CMC system can be called a CM3C system where *3C* stands for collaboration, coordination, and communication (for a more in-depth discussion of CM3C see Kirschner & Kreijns, 2004; Kreijns, 2004). Yet most computer supported collaborative learning (CSCL) environments in use are very simple: in most cases either an e-mail system or a computer conferencing system (i.e., a discussion forum). The more advanced ones integrate a basic CMC system consisting of e-mail, forum groups, and real-time chat.

Environments that integrate CM3C systems offer a distinct advantage above those based on simple CMC, namely an increase in their potential to support teaching and learning that rely heavily on *social interaction* among the group

members. These sociable environments facilitate the emergence of a *social space*: a human network of social relationships between group members, which is embedded in group structures of norms and values, rules and roles, beliefs and ideals. However, no environment is in or of itself capable of creating a social space. People (i.e., learners or group members) and their activities (i.e., learning tasks) are needed to recognize and exploit this sociability potential of the environment. The greater the sociability of an environment, the more likely that it will result in the emergence of a sound social space with affective work relationships, strong group cohesiveness, feelings of trust, respect, belonging and satisfaction, and a strong sense of community.

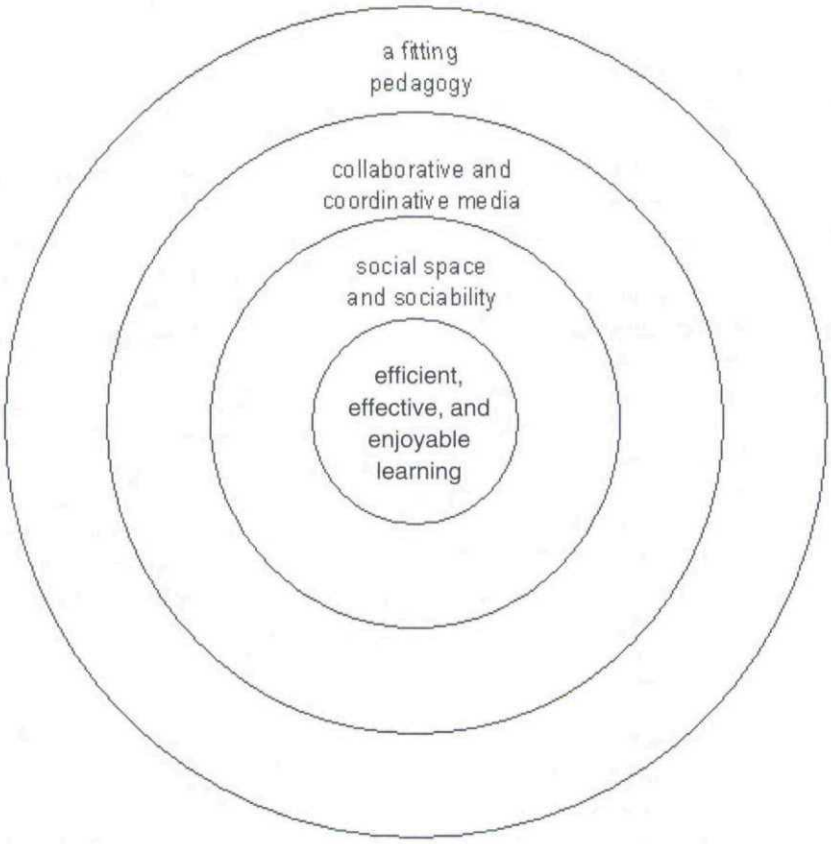
These factors can be thought of as rings surrounding effective, efficient, and enjoyable learning.

THE CONTRIBUTIONS

Part I

Kirschner, Strijbos, et al. kick off this special issue with a discussion of the design of and educational approaches in electronic collaborative learning environments. These environments for learning and working are immensely popular. Designers design them according to their own constructivist interpretations of what collaborative learning is and what it should achieve. Institutions (both school and corporate) employ them with different educational approaches and in diverse situations to achieve different ends. Students use them, sometimes very enthusiastically, but often in a perfunctory way. Finally, researchers study them and—as is usually the case when apples and oranges are compared—

Figure 1 □ Factors affecting effective, efficient, and enjoyable learning.



find no conclusive evidence as to whether or not they work, where they do or do not work, when they do or do not work and, most importantly, why they do or do not work. This contribution presents an *affordance framework* for such collaborative learning environments, an *interaction design* procedure for designing, developing, and implementing them and an educational affordance approach to the use of tasks in those environments. It also presents the results of three projects dealing with these three issues.

Gulikers, Bastiaens, and Kirschner follow this up with an article dealing with the role of authenticity in learning, but primarily in assessment. Their argument is threefold. First, they hold that authenticity (in learning or assessment) is a multidimensional concept, where each dimension can be seen as a continuum and not a dichotomy. Second, they view authenticity as being not solely an objective attribute of an artifact (here the learning task or the assessment), but also as a very subjective attribute, determined by both the conceptions and the perceptions of the student-learner. Finally, authentic assessment can only be optimally used when there is a constructive alignment (Biggs, 1996) between the instruction, the learning, and the assessment. Based on an extensive literature study, Gulikers et al. derived a theoretical framework consisting of five dimensions of assessment that can vary in their degree of authenticity. After the description of this framework, they discuss the results of a qualitative study with two levels of college students and their instructors. This study explored whether the framework is a complete description of authenticity or is missing important elements, and what the relative importance of the dimensions are in the perceptions of students and teachers. Finally they discuss the implications of this for the constructive alignment of education.

Part II

In Part II of the Special Issue, to appear in *Educational Technology Research and Development Volume 52* Number 4, Collis and Margaryan take e-learning from the traditional school setting to the corporate setting. In their article they show how collaborative learning can take on special forms in the ongoing professional development of engineers in a multinational corporation as a tool for capturing experience, reusing it, and creating new artifacts and solutions for workplace applications. In a multicultural setting—which is often the case in global corporations—collaborative learning can facilitate better understanding among colleagues from different regions of the world and can also be a tool for developing mentoring relationships, because technology can support teams regardless of the locations of individual members. But there are barriers to collaborative learning in the corporate context. The trend toward just-in-time, anywhere, anytime learning can set up expectations that learning should be at one's fingertips, in just the amounts needed for one's momentary need. Time is a major constraint as well, in that collaboration can take more time than individual study. The design approach being used at the Shell Learning Centre in The Netherlands for *blended learning* emphasizes collaborative learning as well as flexibility. This article gives features of the design approach and an overview of some of the products of collaborative learning activities that are being reused as learning objects in the corporation.

Reeves et al. present a research agenda for collaborative learning. In their view traditional basic-to-applied research methods have provided an insufficient basis for advancing the design and implementation of advanced collaborative learning environments. Instead, most of the significant progress that has been made has been accomplished through development research, design experiments, or formative research. Contemporary development research protocols require intensive and long-term collaboration among researchers and practitioners. Their contribution summarizes the development research success stories in collaborative learning accomplished at several research and development centers in Australia, Europe, and North America. It concludes with a prescription for implementing development research models more widely as well as a collaborative learning research agenda for the next five years.

Elen introduces the notion of instructional design anchor points (IDAPs) as the basis for

instructional design, illustrating this on the basis of the articles in this special issue. He argues that research on IDAPs can become more useful and influential when it meets four conditions: (a) clear description of the IDAP under study; (b) presence of a clear conceptual framework; (c) a deliberate consideration of complexity, and (d) a realistic perspective on improvement and implementation. The arguments are supported by discussing the IDAP electronic learning environments largely based on the contributions.

Finally, Wilson offers an activity-based perspective on e-learning environments, resulting in a flexible stance toward instructional strategies, artifact design, emergent activity, and learning outcomes. This same flexibility should be evident as we appropriate theories from other disciplines and develop some of our own. I support the contributors' call for more design research specifically addressing challenging problems of practice encountered by design practitioners. □

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