Preface

ABSTRACT

Collaboration can facilitate and augment learning in many ways. At the same time, information technology plays a more and more important role in supporting collaborative learning globally. Aiming at further contributing to this directive, this chapter elaborates a series of issues related to the current state, objectives and future trends of collaborative learning. Particular attention is given to design issues as well as to different opportunities for researchers to tap into the Web 2.0 tools to foster collaborative learning. Keywords: computer-supported collaboration, technology-enhanced learning, social networking, Web 2.0, blog, wiki.

INTRODUCTION

The changing nature of our society and organizations, being more and more knowledge-based (Holtsapple & Joshi, 2002), has a major impact on how individual and organizational learning is - and will be - delivered or experienced. In this evolving context, it is broadly considered that collaboration is a highly desirable and effective action towards learning. David Johnson and Roger Johnson are probably the most consistent advocates of cooperative learning. They found that social skills and competencies tended to increase more within cooperative situations as working together increases students’ abilities to provide leadership, build and maintain trust, communicate effectively and manage conflicts constructively (Johnson & Johnson, 1989). More specifically, argumentative collaboration, conducted by a group of people working towards solving a problem, can admittedly facilitate and augment learning in many ways, such as in explicating and sharing individual representations of the problem, maintaining focus on the overall process, maintaining consistency, increasing plausibility and accuracy, as well as in enhancing the group’s collective knowledge (Koschmann, 1999; Andriessen et al., 2003; Ravenscroft & McAlister, 2006).

Information technology takes an important role in supporting learning such as providing information in multiple modes, using technologies as mindtools, and scaffolding conversations virtually with anyone in the world (Jonassen, 2000; Jonassen, Peck, & Wilson, 1999). Leveraging Web-based technologies towards building responsive environments that motivate, engage and inspire learners (these environments are embedded in the business processes and human resources management systems of organizations) is highly critical. Accordingly, the research field of technology-enhanced learning continues to receive increasing attention. However, as widely admitted, learning evolves, and this is only partly due to the
reduced cost of the related software and hardware. Learning and teaching technologies should further
focus on (i.e. exploit and augment) the collaboration among learners. The related technologies should
support self-directed and personalized learning through the engagement of learners in collaborative
learning settings and scenarios (Dillenbourg, 1999; Stahl et al., 2006). Formal and informal learning
should be considered in parallel, together with the overall social and organizational context. The
appropriate management of the related knowledge resources and user-generated content is another critical
issue to be addressed during the development of the contemporary collaborative learning technologies.
In any case, these technologies should make it easier for learners to follow the evolution of an ongoing
collaboration, comprehend it in its entirety, and meaningfully aggregate data in order to resolve the is-
sue under consideration.

In the context sketched above, this chapter elaborates a series of issues related to the current state,
objectives and future trends of collaborative learning. Particular attention is given to the identification
of requirements imposed by contemporary communities and learning contexts, as well as to the consid-
eration of approaches that could significantly contribute to their fulfillment.

**SUPPORTING COLLABORATION AND OPTIMIZING THE LEARNING
EXPERIENCE**

Learning is best accomplished when the individual needs of learners are established well in advance.
These needs include the learners’ prior knowledge, learning styles, and cognitive traits. The learning
environment (whether classroom traditional teaching, virtual Web world, or any form of hybrid learn-
ing structures) and collaboration tools must support the learners’ needs to facilitate and enhance their
learning experience. Web Based Learning Environments (WBLE) - also known as Web Based Learning
Systems (WBLS) - incorporate the process of ‘adaptation’ and address rightly the cognitive traits and
learning styles. The ‘adaptation’ process includes detecting the individual learning needs of learners and
then adapting courses according to the identified needs (Kinshuk & Graf, 2007). There is a wide range
of free software and/or open source learning management systems (e.g., eFront) and course management
systems (e.g., Dokeos, ILIAS, Moodle, and so forth). Many well-known virtual learning environments
are available to facilitate the creation of virtual class rooms (e.g., Blackboard, FirstClass, Desire2Learn,
CyberExtention, It's Learning, WebTrain, and so forth).

For designing and adapting courses in WBLS, it is important to understand the learners’ skills and
match them with the right challenges through the right level of courses targeted at them. It is beneficial
to incorporate the differences in cognitive architecture based on psychology related theories/models such
as Kolb’s Experiential Learning Theory, Felder-Silverman learning model, Theory of Multiple Intel-
ligences, Myer-Briggs Type Indicator, and so forth, in order to avoid cognitive overload and facilitate
learning for students with weak cognitive abilities. Research has pointed out that learners with strong
learning preference for a specific learning style might experience difficulties in learning if their learn-
ing style is not supported by the appropriate teaching environment. Cognitive traits do not change with
time and remain more or less stable. Changing learning styles requires training for the weak learning
preferences in order to enhance them; which means even learning style is stable over time. Developing
a proper technology enhanced learning environment is a key to enhance learning and making learning
accessible to all learners by incorporating their individual cognitive traits and learning styles through
the concept of ‘adaptation’.
Recent advances in computing and Internet technologies, together with the advent of the Web 2.0 era, resulted to the development of a plethora of online, publicly available environments such as blogs, discussion forums, wikis, and social networking applications (Summerford, 2008). These offer people an unprecedented level of flexibility and convenience to participate in complex collaborative activities, such as long online debates of public interest about the greening of our planet through renewable energy sources or the design of a new product in a multinational company. Information found in these environments is considered as a valuable resource for individuals and organizations to solve problems they encounter or get advice towards making a decision. In any case, people have to go through some type of sorting, filtering, ranking and aggregation of the existing resources in order to facilitate sense-making. Yet, these activities are far from being easy. This is because collaboration settings are often associated with ever-increasing amounts of multiple types of data, obtained from diverse sources that often have a low signal-to-noise ratio for addressing the problem at hand. In turn, these data may vary in terms of subjectivity, ranging from individual opinions and estimations to broadly accepted practices and indisputable measurements and scientific results. Their types can be of diverse level as far as human understanding and machine interpretation are concerned. They can be put forward by people having diverse or even conflicting interests. At the same time, the associated data are in most cases interconnected, in a vague or explicit way. Data and their interconnections often reveal social networks and social interactions of different patterns.

The above bring up the need for innovative software tools that can appropriately capture, represent and process the associated data and knowledge. Such tools should shift in focus from the collection and representation of information to its meaningful assessment and utilization. They should facilitate argumentation, i.e. discussion in which reasoning and disagreements exist, not only discourse for persuasion, logical proof and evidence-based belief (Kunz & Rittel, 1970), the ultimate aim being to support collaborative sense-making (and/or decision-making), and accordingly enhance learning. This can be seen as a special type of social computing where various computations concerning the associated context and group’s behavior need to be supported.

Designing software systems that can adequately address users’ needs to express, share, interpret and reason about knowledge during an argumentative collaboration session has been a major research and development activity for more than twenty years. Technologies supporting argumentative collaboration usually provide the means for discussion structuring and visualization, sharing of documents, and user administration. They support argumentative collaboration at various levels and have been tested through diverse user groups and contexts. Furthermore, they aim at exploring argumentation as a means to establish a common ground between diverse stakeholders, to understand positions on issues, to surface assumptions and criteria, and to collectively construct consensus. While helpful in particular settings, the above solutions prove to be inadequate in cognitively-complex situations.

Apple, Microsoft, Frog Design and Canesta are creating technology and products/devices based on human-computer interaction, human factors and human-gesture interface design that respond to people’s physical movements by using sensors to recognize natural gestures. For example, a television that can be turned on and off by waving at it. Andrew McAfee, principal research scientist at the Center for Digital Business in the Massachusetts Institute of Technology’s Sloan School of Management, suggests the use of Enterprise 2.0 as new collaborative tools for an organization (McAfee, 2009; Gaudin, 2010). He defines Enterprise 2.0 as the business use of an emergent social platform and the design and implementation of intelligent tools that allow people to interact as they want to. For example, the Central Intelligence Agency (CIA) is using this technology to broadcast an individual’s expertise to people inside the intelligence
community. This allows them to find the candidate(s) with the appropriate background not only within CIA but also in the Federal Bureau of Investigations (FBI) and the National Security Agency (NSA).

DESIGN ISSUES

The ever-growing influence of Internet in our everyday life has implied a paradigm shift in terms of relationships between customers and companies. New interaction means in Web 1.0 have undergone a dramatic change in quantity and quality with the advent of the so-called Web 2.0, the Social Web. The upcoming Web 3.0, the Semantic Web, will also impact the design of collaborative learning solutions tremendously. This section elaborates a series of issues to be thoroughly considered during the design of contemporary collaborative learning solutions. These concern diverse collaboration aspects and should be taken into account together with the overall collaboration context.

Incremental Formalization

When engaged in the use of existing technologies and systems supporting argumentative collaboration, users have to follow a specific formalism. More specifically, their interaction is regulated by procedures that prescribe and - at the same time - constrain their work. This may refer to both the system-supported actions a user may perform (e.g. types of discourse or collaboration acts), and the system-supported types of argumentative collaboration objects (e.g. one has to strictly characterize a collaboration object as an idea or a position). In many cases, users have also to fine-tune, align, amend or even fully change their usual way of collaborating in order to be able to exploit the system’s features and functionalities. Such formalisms are necessary towards making the system interpret and reason about human actions (and the associated resources), thus offering advanced computational services. However, there is much evidence that sophisticated approaches and techniques often resulted in failures (Shipman & Marshall, 1994; Shipman & McCall, 1994). This is often due to the extra time and effort that users need to spend in order to get acquainted with the system, the associated disruption of the users’ usual workflow (Fischer et al., 1991), as well as to the “error prone and difficult to correct when done wrong” character of formal approaches (Halasz, 1988).

Complex contexts imply additional disadvantages when using formal approaches. Such approaches impose a structure which is not mature enough to accommodate the management of huge amounts of data coming from diverse sources. They do not allow users to elaborate and digest these data at their own pace, according to the evolution of the collaboration. Instead, a varying level of formality should be considered. This variation may either be imposed by the nature of the task at hand (e.g. decision making, deliberation, persuasion, negotiation, conflict resolution), the particular context of the collaboration (e.g. medical decision making, public policy making), or the group of people who collaborate each time (i.e. how comfortable people feel with the use of a certain technology or formalism).

The above advocate an incremental formalization approach. In other words, formality and the level of knowledge structuring should not be considered as a predefined and rigid property, but rather as an adaptable aspect that can be modified to meet the needs of the tasks at hand. By the term formality, we refer to the rules enforced by the system, with which all user actions must comply. Allowing formality to vary within the collaboration space, incremental formalization, i.e. a stepwise and controlled evolution from a mere collection of individual ideas and resources to the production of highly contextualized and interrelated knowledge artifacts, can be achieved.
Visualization and Reasoning

It has been widely argued that visualization of argumentation conducted by a group of experts working collaboratively towards solving a problem can facilitate the overall process in many ways, such as in explicating and sharing individual representations of the problem, in maintaining focus on the overall process, as well as in maintaining consistency and in increasing plausibility and accuracy (Kirschner et al., 2003). Moreover, it leads to the enhancement of the group’s collective knowledge. For the above reasons, visualization issues should receive much attention while shaping the proposed innovative collaborative learning solutions.

Alternative projections of a virtual collaboration space may constitute the ‘vehicle’ that permits incremental formalization of argumentative collaboration (Karacapilidis & Tzagarakis, 2007). A projection can be defined as a particular representation of the collaboration space, in which a consistent set of abstractions able to solve a particular organizational problem during argumentative collaboration is available. With the term abstraction, we refer to the particular data and knowledge items, relationships and actions that are supported through a particular projection, and with which a particular problem can be represented, elaborated and be solved. The foreseen solutions should enable switching from one projection to another, during which abstractions of a certain formality level are transformed to the appropriate abstractions of another formality level. This transformation should be rule-based (and context-specific); such rules can be defined by users and/or the facilitator of the collaboration and reflect the evolution of a community’s collaboration needs. It should be up to the community to exploit one or more projections of a collaboration space (upon users’ needs and expertise, as well as the overall collaboration context).

Each projection of the collaboration space should provide the necessary mechanisms to support a particular level of formality (e.g. projection-x may cover only needs concerning collection of knowledge items and exploitation of legacy resources, whereas projection-y may provide decision making functionalities). The more informal a projection is, the more easiness-of-use is usually implied; at the same time, the actions that users may perform are intuitive and not time consuming (e.g. drag-and-drop a document to a shared collaboration space). Informality is associated with generic types of actions and resources, as well as implicit relationships between them. However, the overall context is more human (and less system) interpretable. As derives from the above, the aim of an informal projection of the collaboration space should be to provide users the means to structure and organize data and knowledge items easily, and in a way that conveys semantics to them. Generally speaking, informal projections may support an unbound number of data and knowledge item types. Moreover, users may create any relationship among these items; hence, relationship types may express agreement, disagreement, support, request for refinement, contradiction etc.

While such a way of dealing with data and knowledge resources is conceptually close to practices that humans use in their everyday environment, it is inconvenient in situations where support for advanced decision making processes must be provided. Such capabilities require resources and structuring facilities with fixed semantics, which should be understandable and interpretable not only by the users but also by the tool. Hence, decision making processes can be better supported in environments that exhibit a high level of formality. The more formal projections of a collaboration space come to serve such needs. The more formal a projection is, easiness-of-use is usually reduced; actions permitted are less intuitive and more time consuming. Formality is associated with fixed types of actions, as well as explicit relationships between them. However, a switch to a more formal projection is highly desirable when (some members of) a community need to further elaborate the data and knowledge items con-
sidered so far. Such functionalities are provided by projections that may enable the formal exploitation of collaboration items patterns and the deployment of appropriate formal argumentation and reasoning mechanisms. A switch to a projection of a higher level of formality should disregard less meaningful data and knowledge items, resulting in a more compact and tangible representation of the collaboration space. This effect is highly desirable in cognitively-complex situations.

Information Triage

Concepts originally coming from the area of spatial hypertext and the information triage process (Marshall & Shipman, 1997), i.e. the process of sorting and organizing through numerous relevant materials and organizing them to meet the task at hand, should be also exploited towards the proposed collaborative learning solutions. According to the above, users must effortlessly scan, locate, browse, update and structure knowledge resources that may be incomplete, while the resulting structures may be subject to rapid and numerous changes. Information triage related functionalities enable users to meaningfully organize the big volumes of data and knowledge items in a collaborative setting.

Spatial hypertext is admittedly a promising approach to address issues in argumentative collaboration environments, as it introduces a visual language in an attempt to take advantage of the humans’ visual memory and their ability to recognize patterns. Exploiting these human capabilities can greatly reduce the negative impacts of cognitively-complex environments. Spatial hypertext removes the barrier between reading and writing processes enabling articulation of tacit knowledge and ambiguity, as well as establishment of emerged problem-solving strategies. Thus, users are incrementally processing information and are not forced to predefined structural commitments. The corresponding features and functionalities should enable users to create and organize information by making use of spatial relationships and structures, giving them the freedom to express relationships among information items through spatial proximity and visual cues. Such cues could be related to the linking of collaboration items (e.g. coloring and thickness of the respective links) and the drawing of colored rectangles to cluster related items.

As highlighted above, the foreseen solutions should permit an ordinary and unconditioned evolution of data and knowledge structures. Such solutions should also provide abstraction mechanisms that allow the creation of new abstractions out of existing ones. Abstraction mechanisms may include:

- annotation and metadata (i.e. the ability to annotate instances of various knowledge items and add or modify metadata);
- aggregation (i.e. the ability to group a set of data and knowledge items so as to be handled as a single conceptual entity);
- generalization/specialization (i.e. the ability to create semantically coarse or more detailed knowledge items in order to help users manage information pollution of the collaboration space);
- patterns (i.e. the ability to specify instances of interconnections between knowledge items of the same or a different type, and accordingly define collaboration templates).

Exploitation of Legacy Resources

The foreseen solutions should also reduce the overhead of entering information by allowing the reuse of existing resources. Generally speaking, when legacy resources have to be reused during a collaborative session, complexity is increased. This is not only due to the additional amount of data involved, but
also to the conceptual overhead and distractions imposed to the user from switching among applications and environments. One way of dealing with this situation is to enable the ubiquitous access of legacy resources from within the collaboration environment by seamlessly integrating the systems involved. Towards this direction, interoperability among various applications should be carefully considered.

**Social Networking**

Management of social structures, interactions and relationships is also critical in a contemporary collaborative learning framework. Applications and projects dealing with social relationships mainly support explicit and abstract structures. However, social structures may gain from the expertise of structure domain research, including various structure abstractions or ways for implicit structuring. Another issue to be addressed concerns the elaboration of social relationships in their contexts, that is, how they relate to assets, locations, or change over time. Social network analysis (Castells, 2004) has to be extensively used to find who is depending on whom in a network. Such an analysis will also help to detect hidden hierarchy of social networks. Other requirements of this category concern the (semi)automatic role-specific cognitive mapping for each participant based on his/her overall behavior and the development of artifacts-related collaboration metrics.

The foreseen solutions should integrate a sophisticated user and role modeling module to tackle the above issues. This module should build on an explicit representation of the notion of user/group, which in turn should be based on a predefined attribute hierarchy. The associated attributes can be domain-specific. They can be categorized, depending on how they are populated and who may modify them, as explicit (their values are provided by users themselves and include personal data such as name, address, birth date, preferences, competencies, skills etc.) or implicit (their values are not provided by users explicitly, but implicitly, by observing their behavior within the system). User/group modeling should be also associated with mechanisms for the acquisition of the abovementioned implicit information of users/groups. These mechanisms will observe and log the operations and discourse moves of users within the system and record them in the user’s profile. Finally, such a sophisticated user and role modeling module should integrate an inference engine. The role of such an engine is to analyze all data present in the profile, together with data from the collaborative workspaces, in order to extract meaningful information about social structures, interactions and relationships. Contrary to most user modeling approaches, this approach pays much attention to community-related aspects (i.e. relationships between individual users and relationships between users and artifacts).

**DEVELOPING ADAPTIVE COURSES THROUGH WEB BASED LEARNING ENVIRONMENTS**

There are many ways of simulating the different intelligences of Multiple Intelligences (MI) theory with the use of the software programs where these programs act as triggers of MI. A MI theory based WBLE, supported by interactive e-books, eText, word puzzles, word games, word meanings, thesaurus, spell checks, electronic libraries, electronic essays and paragraphs, word restricted short and long answer type questions, and word processing software can help in activating Verbal-Linguistic Intelligence. Critical thinking programs, quizzes, webquests, scientific demonstrations, mathematical exercises, problem-solving, true-false questions, questions with direct answers and logical reasoning software programs
and activities will stimulate Logical-Mathematical Intelligence. The use of PowerPoint Presentations, virtual reality programming, draw and paint programs, clip-arts, collaborative writing projects, and all kinds of graphics can stimulate a learner, who is driven by Visual-Spatial Intelligence. A web based course using software programs of virtual reality, hands-on construction kits and simulation software, interactive modules, videoconferencing, and interactive games can lead to Bodily-Kinesthetic Intelligence. Musical-Rhythmic Intelligence can be enhanced by using ‘music’ as a part of course development where musical digital interfaces are used and question-answer format questions where musical sound represents correct and wrong choices. A musical-oriented learner will answer questions with a view of hitting the right answer leading to an appropriate musical note. Audio lectures can be a great tool for enhancing Musical Intelligences. Such a WBLE supported by musical recognition and interface will be both challenging and enterprising for the musical oriented learner. Electronic bulletin boards, interactive gaming technologies, chat sessions, discussion forums, information sharing via computer/Internet, class Web sites, videoconferencing, email, and collaborative e-Projects in Web based courses will lead to a development of Interpersonal Intelligence where information is shared among individuals in different locations, areas or even different parts of the world supported by use of computer technologies. Learning supported by self-paced presentations, flexibility, personal choice software, and self-mode selection and presentation will fulfill the needs of Intrapersonal Intelligence. For strengthening and stimulating Naturalist Intelligence, WBLE can use creative multimedia presentations software, creation of tables, graphical displays, chat sessions, videoconferencing, email, discussion forums and class Web sites. All these elements and characteristics can be added to Web based online courses (integrating Web with classroom environments).

A WBLE based on Multiple Intelligences will be directed towards satisfying and stimulating 7-11 intelligences as defined by the instructor. A requirement for providing adaptation in Web based courses through WBLE is to know the learners’ characteristics. Instructors play an important role in the development of such a WBLE and the environment helps in prioritizing the levels and kinds of intelligences deemed fit for a particular course. The first and best online instruction is the creation of a class Web site in which learners share information with all class participants (Gardner, 1993; Gallagher, 2003). The website design and pedagogy can be refined by the instructors based on the learners’ motivation levels and intelligences. Instructors can visit each learner’s interactions with WBLE and interpret their learning actions performed on various knowledge objects. This will help the instructors to understand the learning styles and preferences of all learners and will lead to the course adaptation and customization by improving significant areas of MI theory. We believe that the adaptive Web based courses using WBLE can support various learning formats, i.e. either in a face-to-face classroom environment or a Web based online course with class Web sites, multimedia presentations, audio lectures, chat sessions, discussion forums, interactive programming, virtual reality, videoconferencing, graphical displays, email, listservs, and the use of hypermedia. Hence, we offer the following propositions:

- WBLE development based on Multiple Intelligences catering to Verbal-Linguistic Intelligence, Logical-Mathematical Intelligence, Visual-Spatial Intelligence, Bodily-Kinesthetic Intelligence, Musical-Rhythmic Intelligence, Interpersonal Intelligence, Intrapersonal Intelligence, and Naturalist Intelligence and the subsequent use of matching Web-based learning tools and activities (class Web sites, multimedia presentations, audio lectures, chat sessions, discussion forums, interactive programming, virtual reality, videoconferencing, graphical displays, email, listservs, and the use of hypermedia) should result in higher levels of adult student satisfaction with the learning in a course.
• WBLE development based on Multiple Intelligences and the subsequent use of matching Web-based learning tools and activities should result in higher levels of academic performance by adult students in a course.
• WBLE development based on Multiple Intelligences and the subsequent use of matching Web-based learning tools and activities should result in deeper, more lasting adult student learning in a course and beyond the course (in other courses as well as their professional career).
• WBLE development based on Multiple Intelligences and the subsequent use of matching Web-based learning tools and activities should increase the ability of adult students to learn in a course and beyond the course (in other courses as well as their professional career).

**USING WEB 2.0 TO ENHANCE COLLABORATIVE LEARNING**

Web 2.0 is broadly defined as a second generation or more personalized communication mode that emphasizes active participation via the World Wide Web. Users of Web 2.0 not only create and own data but also mix, amend and recombine content and are relatively more “open to the world”, welcoming comments and revisions (McLoughlin & Lee, 2007). Many of us collaborate, create and share new information on the Web through various Web 2.0 tools such as social bookmarking systems, blogs, wikis, and video sharing platforms. Commonly used Web 2.0 platforms include Twitter, Facebook, Wikipedia and Youtube.

Blog is a text-based online environment which enable creators to publish in the Internet. The creators can embed pictures, videos and other online resources whilst the viewers can make comments. The difference between publishing as web pages and blogs is that blogs preserve old postings and the new creations are shown in reverse chronological order (Viégas, 2005). Wikis are also widely adopted as a Web 2.0 tool which facilitate collaborative work. Users can publish their products on the Internet easily without knowing how to write HTML codes (Heafner & Friedman, 2008). The history features of wikis are particularly helpful for users to trace the content and timing of the revision.

Educators must rethink how Web 2.0 technology can help students collaborate. Oliver (2007) points out the necessity to redesign technology integration courses to leverage new Web 2.0 tools. Barlow (2008) also argues that Web 2.0 tools also offer an exciting opportunity to create a classroom without walls, as they provide a huge and untapped resource for educators, while Klamma et al. (2007) suggest that Web 2.0 concepts and technologies could support lifelong learning communities. Ducate and Lomicka (2008) found that students were more motivated to complete their foreign language writing tasks when using blogs as there were audiences. Goldman, Cohen & Sheahan (2008) also found that blogging helped their students understand other environment health issues. Similarly, there are a number of studies which report wikis can foster collaborative learning, in particular, writing English from primary to university levels (Mak & Coniam, 2008; Wang, 2010; Wilkoff, 2007). Wikis are also useful in fostering deep understanding of social studies (Heafner & Friedman, 2008) and enhance pre-service teachers to produce high quality learning materials (Lai & Ng, in press; Nicholas & Ng, 2009). However, using blogs and wikis might not always generate positive results, for example, some students did not found peer’s comments useful (Ellison & Wu, 2008; Haltic, Lee, Paulus, & Spence, in press; Xie, Ke, & Sharma, 2008).

There are two broad future research directions; one is calling for more research into how to integrate Web 2.0 into pedagogy, whilst another one is conducting research on the impact of Web 2.0 tools on the learning outcomes. As for investigating the learning process, we could use Web 2.0 environments to
facilitate group projects which require different experts and perhaps learners of different backgrounds. This kind of findings would be more convincing and authentic if learners are to collaborate with heterogeneous learners of different locations so that the flexibility and convenience of the Internet can be fully capitalized. Longitudinal research is inevitably considered necessary to examine the potential of using Web 2.0 tools for various learning activities for different disciplines.

There are also various ways to investigate the learning outcomes. Firstly, we could conduct pre-tests and post-tests to find out the subject knowledge of learners. Secondly, to have control groups of using and not using Web 2.0 environments as collaborative learning tools. Thirdly, it is equally important to measure the learning process and learning outcome. Web 2.0 environments are rather different from traditional computer tools due to their user-friendliness and the needs for social interaction. It would be interesting to examine if there is any gender difference in terms of their performances (females were slower to adopt Internet than males (Weil & Rosen, 1995, 1997), and females reported higher levels of discomfort and incompetence of using computers (Schumacher & Morahan-Martin, 2001)). It is imperative to re-design assessment criteria so that assessment should be designed to support learning (Biggs, 1996) and reflect generic skills (such as collaboration, creativity and other information technology related skills) that learners developed.

CONCLUSION

This chapter has elaborated a series of issues related to the collaborative learning paradigm, the ultimate aim being to sketch the appropriate tools and technologies that will facilitate and augment it. A series of critical requirements imposed by contemporary communities and learning contexts have been identified, while approaches that could significantly contribute to their fulfillment have been discussed. We argue that the proper tuning and integration of these approaches is able to fully support the evolution of a cognitively complex (and/or data intensive) collaboration, while it provides the means for addressing the issues related to formality in collaborative knowledge building and learning systems. Ideas of how to develop adaptive courses through Web Based Learning Environments were also elaborated. The value and opportunities of using Web 2.0 environments to conduct research on learning process and learning outcomes were finally discussed.

By no means, one would argue that the list of issues discussed in this chapter covers fully the diversity and complexity of the research field under consideration. Related works, derived from other perspectives, should be also taken into account during the development of innovative collaborative learning systems (see, for instance, (Amy, 2003), (Dimitracopoulou, 2005) and (Kamtsiou et al., 2006)). Furthermore, the improvement of collaboration among learners should not be considered as the sole research direction towards further enhancing web-based learning. The augmentation of the quality (not the quantity) of e-learning material and the establishment (and global adoption) of e-learning standards consist two other essential directions to be thoroughly investigated.
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