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ARGUMENTATION, COMPUTER SUPPORT, AND THE EDUCATIONAL CONTEXT OF CONFRONTING COGNITIONS

THE KNOWLEDGE AGE

The current period in the history of mankind has been coined as the knowledge age (Brown & Duguid, 2000; Bereiter, 2002). This term serves to distinguish this period from its predecessor, the information age. In contrast to information, knowledge entails a knower, is hard to detach from its owner, and seems to be something that we digest rather than hold. Knowledge lies less in databases than in people, and has to be disclosed by some form of collective activity, and people have to be learn how be engaged in collaborative activities that produce new knowledge. In professional contexts at least, the people who construct knowledge are called 'knowledge workers', a term that can be associated with slavery, under those who coordinate them, and who need knowledge for economic reasons. Because knowledge does not really have ownership, it can be turned into economic value by anyone that knows how to do it. Whatever the undertone, currently there is a more than humanitarian interest in collaborative learning, especially in forms of collaboration that allow people to display and develop their knowledge.

The information age was a label indicating a period characterised by rapid developments in information technology, initially inspired by a naive belief that computers, as storage and retrieval devices, could meet all demands for relevant information, and thereby solve most of our learning problems. Now we know better, but what we still do not fully understand is how to construct *knowledge* technology (Roschelle & Pea, 2002). On the one hand, we suppose that knowledge is highly situational rather than general, and activity bound rather than a product to hold. This calls for specific solutions in the form of tools that support situational activities. On the other hand, collaboration is still taken as a general skill, so people can do it, or they cannot. This calls for the opposite type of solution: general, and content free tools, that can be implemented in many collaborative situations. For us as scientists, the concept of knowledge worker is interesting, because it requires us to think about how to integrate conceptions about knowledge with those of collaborative work, especially in the context of new technologies, without detaching the activities from the individuals and their situation.

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The chapters in this book all focus on collaborative learning from the perspective of the learners and their situation. The situations that we examine in our research are learning situations, which are traditionally designed for the acquisition of knowledge. In parallel with new views on knowledge, but lagging behind to different degrees, education is working on the implementation of collaborative learning, with or without the support from new technologies. Information technologies, supporting learning and instruction, as in Intelligent Tutoring Systems, computer simulations, hypertext information systems, focused on content, and the student's main task was to understand this content. New technologies, or instructional artefacts as they are currently called (e.g. Sutter, 2002), will support collaborative learning, by supporting the practice of meaning making in the context of joint activity (Stahl, 2002; Koschmann, 2002). Schools are to become communities engaged in knowledge creation by processes of inquiry and discovery, not unlike the scientific discipline (Bereiter, 2002). This implies a change of focus for studying learning, from primarily content based, to being activity or process based, and from the individual to the group learning process. The chapters in this book can be characterised as studies of learners being in the uncertain process of transition from one perspective to the other.

The transition in uncertain, as there is no clear existing notion of support for schools or students for achieving these ambitious goals. Even worse, there is no clear picture about how to understand and implement the necessary educational change. There is a need for carefully and sincerely documented practice, showing how changes can be achieved, what problems emerge during such a process, and what improvements that could lead to. As researchers within the CSCL community, we study collaborative learning with technology in various learning contexts. The extent to which such contexts display awareness about particular views on learning has a relationship with the nature of the research questions that can be asked. In the section about pedagogical scenarios of this introductory chapter, we try to elaborate a framework to describe the contributions to this volume in this respect.

We claim that the field of CSCL research is now sufficiently mature for it to be worthwhile to focus on learning from one particular type of cooperative activity: argumentation. In this book we understand the term argumentation in a very open way, as any form of cooperative activity that involves confronting cognitions and their foundations. For example, a CSCL environment designed to foster learning from argumentation, in this wide sense, could be based on requiring students to confront their individual reasoning in the form of a diagram, it could be based on stimulating and supporting a constructive debate on a particular topic, or it could involve collaborative writing of an argumentative text (with or without argumentative interaction).

The general issue that provide coherence to this volume is *the roles of argumentation with technologies supporting meaning making activities in various educational practices*. The current chapter serves as an introduction to the book, and as an attempt to combine issues from different research communities, with respect to learning from argumentation with technology in educational situations: argumentation, argumentation and learning, electronic tools, and the pedagogical context. It is not possible to present a

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complete integration of these issues, as to answer such detailed questions as "what types of argumentation should be fostered, and in what way, within a community of secondary school learners being engaged in an assignment where they collaboratively are to discuss two controversial essays about using new media for learning, to what types of knowledge and learning would that give rise, and how should their practice be changed in order to improve the depth of their argumentation?".

Instead, the chapters in this book address various perspectives on the main questions stated above, that is, how to design computer-supported collaborative learning environments that favour (1) collaborative learning interactions with representational support (chapters 2 and 7), (2) argumentative interactions with respect to scientific notions (chapters 3 and 9), (3) argumentative interactions during collaborative writing about societal issues (chapter 4), (4) argumentative activities during electronic discussions in academic practice (chapters 5 and 8), and (5) development of argumentation skills in a community (chapter 6).

One dimension on which the contributions can be aligned may be distinguished here. The perspective on educational practice can be from top-down or bottom up viewpoints. From the top, there are ideas about how learning to argue should be arranged, and participants are subjected to a task design and task sequence, which is supposed to provide ideas about how such arrangements lead to specific changes in argumentative activities. This may be accompanied by a relatively great involvement of teachers and researchers in actually getting the students to be engaged into the desired type of activities. From the bottom up, the idea is that practice is characterised in a specific manner, and the goal of the researcher is to find out how to characterise argumentative activities within that practice, supported by an electronic tool. This may involve greater responsibility for learners for engaging in learning activities. This allows a reader to take on a dynamic perspective, so that bottom-up and top-down positions can be integrated.

In the next sections, we first discuss our general notion about confronting cognitions and the role of argumentation in learning, and then discuss the approach of each individual chapter with respect to this notion. After that, we present a general discussion about electronic support of argumentation, and then discuss each individual chapter with respect to this support. Finally, we present three general pedagogical approaches with respect to collaborative learning and try to situate the contributions to this volume within these approaches. By moving from the general to the specific, we feel that perspectives from a CSCL-sub domain can provide inspiration to the CSCL field in general.

CONFRONTING COGNITIONS

This book is about learning from confronting cognitions in argumentative interactions, in situations where students use Computer-Supported Collaborative Learning (CSCL) environments. These are computer-based learning environments that are designed to be used across networks for the type of group work that is potentially favourable to collaborative learning. The book focuses on the processes and medium of collaborative learning from argumentation, in relation to its products.

Although typewritten and graphical computer-mediated communication can be viewed as an obstacle to free expression and smooth cooperation in groups (cf. Clark & Brennan, 1991), it is now becoming increasingly recognised that CSCL environments can provide new and rich opportunities for complex collaborative learning. This is because learners can access multiple distributed learning resources provided by the Web and specialised multimedia interfaces, within environments whose overall characteristics — including especially the form of interactions — can be shaped towards pedagogical ends. Thus, rather than viewing CSCL environments as group learning situations without co-presence, it is more fruitful to see them as groups of new integrated resources that can favour collaborative learning, using varied learning resources, structured interaction histories, interaction management tools and multiple representations of both problem-solving domain and interaction tasks. The advent of CSCL environments can therefore be seen as an opportunity for revitalising work in collaborative learning research on understanding the relations between types of interactions and types of learning.

For most researchers working on collaborative learning, the notion of 'confronting cognitions' is no doubt associated with research in the socio-cognitive conflict paradigm (Doise & Mugny, 1981), together with some negative results that have recently been reported with respect to it (e.g. Blaye, 1990). With a number of other researchers, we claim that insufficient attention has been given to the *processes* by which conflicts or confrontations are addressed, in complex learning situations. In other words, the roots of collaborative learning are most likely to be found in the cooperative attempt to resolve different views by argumentation, rather than in the mere incidence of conflicts (Mavarech & Light, 1991).

The aim of the book is therefore to bring together state of the art work on learning from argumentation (in our sense of the term) in CSCL environments, in order to synthesise the contribution of work in this field to research on collaborative learning with distributed technologies. Each chapter takes a firm stance on the questions of what it means to confront cognitions, or to engage in argumentation, how CSCL environments can be used to support such processes in a constructive way, and on what types of learning occur as a result. Several chapters present comparable studies of different tasks being performed with the same CSCL environments.

Before moving on to say more about what we mean by argumentation, how students might learn from engaging in it, tools for supporting this activity, and synthesising contributions of each chapter, we need to say a little more about the attractive yet enigmatic term "confronting cognitions".

If cognitions are viewed as representations in the mind, or as structures in the brain, then of course they cannot be "confronted" in any direct sense of the word. What can be confronted are expressed statements, claims, points of view and … arguments. Although it might be tempting, therefore, to see argumentation as essentially a language-based activity, we take a wider view, which is that it is both *semiotic* and *epistemic*. It is a semiotic activity to the extent that views and arguments can be expressed in a variety of sign-systems, such as formal languages and diagrams (see e.g. Suthers, this volume); it

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is an epistemic activity since it involves expressing knowledge (at least from the point of view of the people involved), and more specifically, relations between 'pieces' of knowledge. In fact, 'knowledge' in this sense corresponds to the original meaning of the term 'cognition' (the faculty or object of knowing — latin *cognitio*). Finally, by 'confronting' we simply mean mutually apprehending or considering.

In sum, therefore, when we say that students confront their cognitions, we just mean that they produce and mutually apprehend a variety of semiotic representations in a relation to a specific knowledge domain. As we discuss below, confronting does not only mean that cognitions are viewed as opposed, but also that students deliberate as to which is most acceptable, by examining arguments for and against each. The process of confronting cognitions will be viewed as leading to learning in the case where the semiotic representations the students produce are improved (according to some norm) across new situations, in a relatively stable form.

THE VARIETY OF UNDERSTANDINGS OF ARGUMENT(ATION)

As is well-known, researchers working on 'argument' and 'argumentation' over around the last three thousand years have given quite different meanings to these terms (see e.g. van Eemeren, Grootendorst & Snoeck-Henkemans, 1996). Without claiming to review the whole field, nor attempting to propose a single unified approach, it is worth saying something here about the variety of approaches as a basis for understanding how argumentation relates to learning.

If asked what argument or argumentation is, most researchers would probably give one or both of the three following replies: "it's about giving reasons", "it's about trying to convince" and "it's about demonstrating a point of view". Whilst these replies are adequate as far as they go, for our purposes here — understanding argumentation and collaborative learning with technical artefacts — they are each too restrictive. Firstly, 'having an argument' is not just about giving reasons, since people also often examine coherence between them (for example "if you already claim x then you can't also claim y, you're contradicting yourself"). Secondly, people also sometimes argue when they have no genuine hope of convincing their audience: they simply want to show that their point of view is at least defendable or worthy of consideration. Finally, the idea of argumentation as demonstration restricts the type of reasoning involved to the mathematico-logical kind, associated with proof and validity: not all ('valid') reason and argument is of this kind.

Before sketching a wider view of argument(ation), let us briefly deal with the two terms "argument" and "argumentation" (as well as, in passing, the term "reasoning"). In the English language, the terms "argument" and "argumentation" can both be used interchangeably to describe a more or less heated discussion or debate involving several parties. But more restricted meanings of each restrict the term "argument" to a "reason advanced" and the term "argumentation" to a "methodological (line of) reasoning". Clearly, it is not reasonable to make prescriptions in these matters; but we think it is useful here to use these more restricted meanings. Thus "an argument" (singular) is a

meaningful expression (e.g. an utterance), that is meant to *support* another (and the converse with a "counter-argument"). What "support" means depends on the situation in which the expression is produced — it could mean "prove to be true", or "defend from attack", or "render more acceptable, believable, plausible", and so on. An "argumentation" then, is simply a series, set or chain of arguments, linked by theme or reasoning, materialised, for example, in the form of a text or a dialogue. "Reasoning" is the process by which arguments are generated (as opposed to retrieved from memory). These proposed definitions, whilst requiring further fleshing out, are not so anodyne as they may seem: they have analytical consequences. For example, an interaction in which doubt is expressed, and a single argument is produced, would not be termed an argumentation, since no further inter-linked arguments have been produced. In general, argumentation situations require some kind of *diversity* — of claims and/or of arguments for and against them —, as well as some kind of situational *constraint* that pushes participants to deliberate or choose with respect to them (otherwise, they could simply let the matter drop).

Let us now return to our general characterisation of argumentation situations. We propose that types of argument and argumentation can be characterised in terms of five main factors: *object*, *reasoning*, *medium, activity* and *goal*.

The *object* of argumentation is what it is about, what it bears upon. For example, one argumentation could be about the acceptability of authorising experiments on genetically modified organisms in nature, another could be about the possible causes of meanders in rivers, and yet another about the validity of a mathematical proof. Although such objects can be conceived in disciplinary terms — e.g. argumentation in mathematics, science, religious studies, history, and so on — it is likely that different types of argumentation, in this sense, can occur within each discipline, from a more abstract or trans-disciplinary point of view. For example, argumentation about factual statements, that could be (in)validated by recourse to experience, can be distinguished from axiological (concerning judgements), doxastic (concerning commonly held beliefs) and deontic (concerning rights and obligations) argumentation. The object of argumentation can make a great deal of difference with respect to how the latter does and can take place, since statements are, by their nature, more or less *debatable* (c.f. Golder, 1996). For example, a factual claim such as "metals are colder than wood" could be invalidated by the appeal to common experience "but you don't want to sit on the corrugated bike-shed roof when it's been in the sun in August, it's much hotter than the wooden fence!". However, an argumentation concerning the ethics of capital punishment, whilst perhaps making appeal to factual arguments, could also reach a stalemate when participants' simply oppose their entrenched personal points of view.

The *reasoning* involved in argumentation should naturally be appropriate to its object. As discussed above, given objects will nevertheless often involve different types of reasoning. For example, in defending a particular mathematical proof, it would be possible to use *analogical* reasoning with respect to a similar problem, *plausible* reasoning by stating that the result is approximately of the right order of magnitude, or that it is an even number (which is surely what the teacher would have intended) and of

course, mathematical (deductive, inductive, etc.) reasoning for checking stages of the proof. Traditional categories of types of arguments are commonly based on types of reasoning (e.g. by analogy, by cause), as are types of fallacies.

Argumentation can take place in different *media*, by which term we here combine both physical means of expression (speech, writing, television, Internet, telephone) and types of semiotic representations (linguistic, symbolic, diagrammatic, pictural, etc.). Clearly, such factors can greatly influence the degree of determinateness and 'sharpness' of a cognitive confrontation — for example, an argumentation based on diagrams or logical formulæ could be quite different from one expressed in relatively vague and evanescent spoken language. Isolating this feature of argumentation, in learning situations, reveals an interesting connection to be explored, with research on the cognitive properties of multiple external representations (Van Someren, Reimann, Boshuizen, & de Jong, 1998).

By the *activity* associated with argumentation, we mean quite simply the overall social situation in which it is produced, including the person or persons involved, the extent to which they can or can not interact in co-presence, and the problem-solving task (if any) in which they are engaged. Clearly, an argumentation produced in a school problem-solving setting is likely to be different in important ways from one where an important decision needs to be made, with much at stake, or from one in everyday conversation where the interpersonal relation is likely to be primary. Written argumentation, or spoken monologue with little feedback from the audience, is likely to be more orderly than argumentation produced in a largely unpredictable interaction, in which speakers have to both present their own points of view and criticise their partners'. The activity is relatively independent of the medium since, for example, a given problem could be solved interactively either by face-to-face speech or across another medium such as Internet.

Finally, the *goal* of argumentation is usually closely related to the activity within which it is produced, and yet can be distinct from it. Thus, the goal of the argumentation can be quite simply to contribute to solving a common problem — for example, cooperatively searching for the most adequate solution. But on an *intersubjective* level, goals can include *convincing* one's partner that one's own position is to be accepted, *refuting* one's partner's position, demonstrating the *defensibility* of one's position, and so on. On an *interpersonal* level, goals can relate to facework, and include demonstrating personal superiority in different respects. Walton (1989) has produced a useful classification of types of (argumentation) dialogue in terms of their situations (c.f. "activity", above), methods (c.f. "reasoning" above) and goals, that is useful in characterising the research described in this book (reproduced below in Table 1).

Table 1. Types of argumentation dialogue (Walton, 1989, p. 10).

Dialogue	Initial Situation	Method	Goal
Quarrel	Emotional disquiet	Personal attack	"Hit" out at other
Debate	Forensic contest	Verbal victory	Impress audience

Persuasion (critical discussion)	Difference of opinion	Internal and external proof	Persuade other
Inquiry	Lack of proof	Knowledge-based argumentation	Establish proof
Negotiation	Difference of interests	Bargaining	Personal gain
Information-seeking	Lacking information	Questioning	Find information
Action-seeking	Need for action	Issue imperatives	Produce action
Educational	Ignorance	Teaching	Imparting knowledge

We think it likely that the situations described in this book will contain all of these types of dialogue to a greater or lesser extent, despite the fact that the objective is usually to emphasise knowledge-based argumentation, debate, critical inquiry and even (peer) teaching.

In summary, argumentation involves producing and comparing arguments using a variety of types of reasoning. The nature of what is being argued about, the media of expression, the wider situation and activity, as well as local goals of argumentation, all have determining influences on the overall form it takes. Such a general analysis provides a means by which readers can situate the different contributions in this book.

The objects of argumentation dealt with here are quite varied, not least in the way in which they are defined by authors and the importance attributed to choice of the topic. Thus, chapters by Baker, by Schwarz and Glassner and by Suthers focus on argumentation about scientific problems or scientific controversies (the nuance is important), chapters by Jermann and Dillenbourg, and by Veerman study argumentation about the relations between educational theories and technologies at university level, and chapters by Andriessen, Erkens, van de Laak, Peters and Coirier, and by Pilkington and Walker address societal questions that are or should be motivating to students (labour policy, existence of aliens, roles of men and women in the family, etc.). Van Bruggen and Kirschner discuss argumentation about a general class of so-called "wicked" problems, such as design of cars. The media of argumentation considered are quite varied, including CHAT or classroom discussion, individual or collective text writing, and individual or collective drawing of argumentative graphs. Whilst some authors deal with a single medium such as CHAT, structured or otherwise, others focus precisely on argumentation as a multisemiotic or multirepresentational activity, where, for example, argument graphs are considered as both a means of expressing arguments and as a focus for argumentative discussion. Finally, it is perhaps instructive to compare the variety of ways in which the authors of each chapter in this volume theorise the general process or activity of argumentation, in relation to the type of reasoning involved and its goals:

— argumentation as a form of negotiation about content of a common argumentative text (Andriessen, Erkens, van de Laak, Peters and Coirier);
— argumentation as interlocutionary problem-solving (Baker);

— argumentation as justification or explanation for individuals' answers to a question, and as argumentative discussion of arguments (Jermann and Dillenbourg);
— argumentation as a chain of varied individual and cooperative dialectical activities (Schwarz and Glassner);
— argumentation as a set of speech acts that aim to convince (Pilkington and Walker);
— argumentation as expressing and discussing evidential relations between data and hypotheses (Suthers);
— argumentation as a multi-representational activity oriented towards solving open-ended problems (Van Bruggen and Kirschner);
— argumentation as a type of constructive and multi-representational exchange (Veerman).

ARGUMENTATION AND LEARNING

As we have discussed, argumentation is a complex activity. Before discussing how learning might take place as a result of it, we briefly discuss *what* can be learned, focussing on the case of *debate* (interactive argumentation produced in a rule-governed situation). Similar reflexions apply to other forms of argumentation.

We term the first type of learning **learning *from* the debate**. By this we mean deepening understanding about the topic debated, and concepts associated with it. For example, in debating the desirability of cloning human beings, debaters could gain deeper understanding of the concept of a "person", and perhaps better understanding of cellular biology.

The second type of learning is **learning *about* the debate**, which basically means becoming better acquainted with the full diversity of points of view and common types of arguments with respect to a topic. For example, suppose a student is firmly against allowing cars in city centres on grounds relating to public health. As a result of debating the topic, the student might become better acquainted with an economic point of view on the question, with its associated arguments.

Finally, although children already possess argumentation skills from a quite early age (around three years — Stein & Bernas, 1999), many situations also provide opportunities for **learning *to* debate**, with respect to specific topics. As with any type of learning, learning to argue is closely associated with learning a technical vocabulary or language (symbolic or graphical). Whilst learning a language of argumentation (e.g. of connectors in texts, of types of arguments, claims and so on; see Suthers, this volume) can be seen as an impediment to learning from argumentation over a relatively short period of time, in the long term, such an acquisition can be seen as essential to learning to argue.

The chapters in this book consider a variety of pedagogical goals associated with argumentation, including understanding scientific concepts (Baker; Schwarz and Glassner; Suthers), learning general literacy skills (Pilkington and Walker; Schwarz and Glassner; Suthers), learning to reason in science (Schwarz and Glassner; Suthers) and in education (Jermann & Dillenbourg; Veerman), learning to solve open-ended problems in

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general (Van Bruggen and Kirschner) and learning domain concepts in general (Andriessen, Erkens, van de Laak, Peters and Coirier).

But *how* might students learn in argumentation situations, thus broadly defined? The first possible mechanism relates to the *production of (counter-)arguments* in an interactive context. In a manner analogous to the mechanisms underlying the "self-explanation effect" (Chi et al., 1989), the expression of arguments could itself lead to reflexion and knowledge restructuring. More generally, the expression of views under criticism could lead the speaker to elaborate a more coherent discourse on the topic being discussed (c.f. Crook, 1994). However, evidence from analyses of argumentative interactions now suggests that students do not always express the knowledge that genuinely underlies their views, but rather reconstruct appropriate arguments in a way that is situated within their argumentative goals (Baker, 1996, 1999). Learning from expression of arguments can take place in both spoken and written dialogues via computer-mediated communication. In the latter case, synchronous CHAT argumentative interactions could inherit learning mechanisms from both dialogue and writing (c.f. Alamargot & Andriessen, *in press*).

Secondly, within a rhetorical point of view on argumentation, arguments are generally produced with a view to modifying underlying attitudes, such as beliefs, comittments, and so on. Thus the acquisition or 'removal' of beliefs as a result of argumentation could correspond to a type of learning. Whilst the most obvious case would be dropping an erroneous belief in a thesis that is refuted, more subtle changes can occur, such as adopting less rigid or certain attitudes with respect to a question, as a result of discussing it (c.f. Nonnon, 1996). It has been found that in general, students' beliefs are weakened as a result of argumentation, which functions as a means of eliminating 'flawed' claims, rather than as a way of convincing partners to accept views (Baker, 1999).

Thirdly, new knowledge and understanding can be co-constructed in argumentation, especially as a means of achieving a compromise between divergent views. In addition, the interpersonal 'pressure' imposed by disagreement (especially in face-to-face situations) can lead students to refine meanings of key concepts that are being discussed. Similarly, argumentation can lead to dissociating concepts from one-another (c.f. Perelman & Olbrechts-Tyteca, 1958/1988). Most chapters in this book emphasise all three of these learning mechanisms in collaborative argumentative interactions.

Fourthly, learning can occur as a result of expression of argumentation using different types of (graphical, textual) representations, and in making transitions between them (see notably chapters by Suthers and by Van Bruggen and Kirschner, this volume).

Finally, given that these learning mechanisms have been described primarily for face-to-face interactions, the question arises as to how the kinds of argumentation that take place in CSCL environments will lead to different kinds of learning mechanisms. For example, whilst working at a distance over the network should lead students to be less inhibited in expressing disagreement, this lowered social pressure might also mean that they will expend less effort in resolving the disagreement. Similarly, whilst a slowed-down typewritten interaction allows more time for reflexion and argument

generation, the higher cognitive-motor costs of utterance production would make co-constructing meanings and knowledge more difficult. We hope that the chapters in this book go some way to answering this new as yet unsolved research problem.

TOOLS FOR SUPPORTING LEARNING IN RELATION TO ARGUMENTATION

When considering how computers and associated technologies can support "arguing to learn," we must first consider the properties of the technology as a communication channel, for without communication no argumentation would be possible. Yet, computational media are not limited to being means of communication. They also present opportunities to aid and guide argumentation and learning through their dynamic and representational properties. We will therefore also consider some of the other ways in which CSCL tools can help facilitate argumentative communication.

Computer Mediated Communication

The study of computer-mediated communication (CMC) has demonstrated, among other things, that problems arise from the limitations placed on communication in the computer medium (Clark & Brennan, 1993). The loss of nonverbal cues (such as intonation, facial expressions and gesture) and the increased cost of utterance production (such as when using a keyboard) can make any discourse, including argumentation, more difficult. However, other advantages may be realized in comparison to face-to-face discourse. For example, persons who are inhibited from participating in face-to-face discussion have greater opportunities online. As another example, it is possible to review the written record of discourse in CMC, which is not possible without recording face-to-face conversations. Learners can use this record as a learning resource.

CMC is generally used when face-to-face communication is not possible due to spatial or temporal separation of the interlocutors. *Synchronous* CMC tools address spatial separation, and *asynchronous* tools address temporal (and possibly spatial) separation. Synchronous interaction such as "chat" tends to be fast paced with short utterances, like a verbal conversation. The immediacy of synchronous interaction has social advantages: participants may be more motivated to engage, and interpersonal negotiations are easier to carry out in synchronous media. With appropriate scaffolding, chat can support productive argumentation (Pilkington & Walker, this volume). Yet the fast pace of chat is also a disadvantage. Asynchronous communication encourages more reflective dialogue, as there is time to think through and compose a considered response, unlike in either face-to-face communication or synchronous CMC.

Face-to-face discourse – whether argumentation or not – often involves reference to and manipulation of artifacts such as pictures, figures, diagrams, and textual documents under discussion. Many CMC tools provide poor or no support for discourse about artifacts other than the text of the messages themselves. Artifacts attached to email or other messages exist only with in the context of the message. In many applications, this

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dependency should be reversed: artifacts should exist independently as part of the context of the ongoing discussion, with messages attached to the appropriate artifacts. Solutions to this problem include document annotation systems in which messages and threads are associated with documents or parts of documents (e.g., Buckingham-Shum & Sumner, 2001). Designers of argumentation tools are advised to carefully consider the relationship between the organization of the artifacts referenced in support of the argumentation and the structure of the argumentation itself.

Structuring Interactions

If messages (synchronous or asynchronous) are simply listed in the order they are contributed, it may be difficult to keep track of the different threads of conversation that emerge as multiple participants reply to each others' messages. Two contiguous messages may not have any thing to do with each other, violating a basic assumption behind the coherence of spoken dialogue (Herring, 1999). This problem is typically addressed by enabling contributors to indicate the message to which they are responding, and displaying the messages according to the resulting reply structure. Yet, such "threaded" discussions present other problems. They are notorious for their lack of convergence, a situation that has been blamed on the fact that the reply relations build an inherently divergent representation: a tree (Hewitt, 1997). Furthermore, the representation is based on the historical development of the discussion rather than its conceptual content (Turoff et al., 1999) making it difficult to quickly grasp and assess the status of the discourse and hence to make contributions that move it forward. Argumentation tools may require representations that capture the conceptual structure of argumentation, a topic to which we return shortly.

Some tool designers address problems of coherence and convergence by tracking and constraining the learners' interactions. A common approach is to provide and require the use of a usually fixed set of classifications for messages, whether synchronous or asynchronous. In synchronous environments, these classifications often take the form of communicative acts (Baker, this volume) or of sentence openers (McManus & Aiken, 1995). In asynchronous environments, messages may be classified as posing a question, providing information, offering a theory, etc. Proponents claim that utterance classifiers and sentence openers (1) increase the efficiency of online communications by reducing cost of message production (saving typing); (2) guide interlocutors into argumentation by prompting them with an appropriate set of argument moves; (3) increase refection on the part of interlocutors by requiring that they identify the intent of their communications; and thereby (4) increase the success of online communications by making intentions more explicit. Results of studies are mixed. If not sufficiently trained and motivated, users of such systems may form the habit of using the most convenient (e.g., first item in the menu) or most generic ("I think …") markers (Robertson et al, 1998). On the other hand, some work has shown that structured interfaces can lead to a greater percentage of task-oriented (if not argumentative) communications (Baker, this volume). Other benefits may accrue from automated guidance enabled by tracking the dialogue. Yet, given that the choice of communicative acts imposes an additional

cognitive burden on the users, designers might ask whether their users perceive direct benefits for making these choices.

Argument Representations

We have just discussed ways to structure the argumentation *process*. Another approach is to structure argument *products*, including intermediate forms. Software is provided that enables interlocutors to construct a map of one or more beliefs and the argumentation about these beliefs in some usually pre-determined notation. Externalization of beliefs and arguments in visual knowledge representations has several potential advantages.

Every notation has its representational biases, which may be exploited to guide the direction of argumentation. Chapters by Suthers and van Bruggen & Kirschner discuss possible mechanisms by which representational tools can influence the content of learners' argumentation, and chapters by Suthers, Jermann & Dillenbourg, and Veerman summarize empirical studies of the influence of tool on argumentation. This influence begins before learners construct a representation: the notation's ontology influences learners' conceptualization of the problem. A partially constructed representation may prompt for particular constructive activities, such as linking new claims to an existing argument graph or filling in cells of a table. Once beliefs and the argumentation underlying those beliefs are externalized in a visual representation, it becomes easier for interlocutors to share and compare their conceptualizations, and thereby to recognize potential points of conflict for further discussion. The ease with which this comparison can be done depends on the properties of the representational notation used.

The concepts of epistemological and heuristic adequacy, which we borrow from the artificial intelligence literature, can clarify the importance of well-considered representation design in CSCL tools. A representation is epistemologically adequate if it captures the distinctions (e.g., between types of entities and relationships between them) needed to expose differences to be worked out via argumentation. A representation is heuristically adequate if the important differences are immediately salient to the interlocutors (rather than requiring some effort to recover from the notation). For example, natural language text has high epistemological adequacy (it can express virtually any concept) but low heuristic adequacy (we cannot tell at a glance, or sometimes even after a quick read, the argumentative structure of a text or the points of conflict between two texts). As an example of the other extreme, evidence mapping notations such as used in Belvedere (Suthers, this volume) have low epistemological adequacy (they do not capture many of the nuances of argumentation we might need) but high heuristic adequacy *within the scope of their epistemological adequacy* (it is easy to assess and compare the content of evidence maps). These examples suggest the possibility of a fundamental tradeoff in the design of representational tools, termed the "techno-cognitive paradox" by Baker (this volume): epistemological adequacy seems to come at the cost of heuristic adequacy, and vice-versa. If we want our guidance we apparently must pay for it with our freedom of expression.

Representational tools play other roles in addition to prompting users for certain ideas and enabling assessment and comparison of expressions of those ideas. The very act of constructing a representation together changes the interaction. Interlocutors acting on a shared representation may feel some level of obligation to obtain agreement or permission from one's group members, leading to explication and negotiation of representational acts in advance of their commission. Thus, the creative acts afforded by a given representational notation may affect which negotiations of meaning and belief take place. The components of a collaboratively constructed representation, having arisen from these negotiations, evoke in the minds of the participants rich meanings, and therefore can serve as an easy way to refer to ideas previously developed through deixis rather than complex verbal descriptions (Clark & Brennan, 1993). In this manner, collaboratively constructed external representations facilitate subsequent negotiations; increasing the conceptual complexity that can be handled in group interactions and facilitating elaboration on previously represented information. The shared representation also serves as a group memory, reminding the participants of previous ideas (encouraging elaboration on them) and possibly serving as an agenda for further work. Representational guidance pervades these roles: the utility of a representation with respect to constructing and comparing arguments depends on its biases.

Active Guidance of Argumentation

To this point, we have discussed only passive forms of support for argumentation as a learning process. Drawing upon the field of intelligent tutoring systems (or, more generally, artificial intelligence in education), tool designers may elect to build in active guidance of the argumentation process. Although there has been much work on coaching individual problem solving, coaching of collaboration is more rare. Approaches can be classified according to whether they are based on dialogue models or actions in the workspace (Muehlenbrock, 2000). An example of a dialogue-based approach is the Group Leader Tutor (McManus & Aiken, 1995). Students' use of sentence openers is tracked and compared to an ideal model of interaction to generate a tutoring plan, applied when students ask for suggestions or when they do not use the sentence openers properly. An example of a workspace-based approach is COLER (Constantino-Gonzales, 2000). After constructing individual solutions to a database modeling problem, students construct a group solution. COLER compares each individual's workspace to the group workspace and encourages students to address differences they may have with the group solution.

COLER was designed with a particular activity sequence in mind: differences between individual problem solutions provide the basis for argumentation in the group phase. This dependency of tool on activity illustrates an important point: one cannot expect too much of the tool alone. Several chapters of this volume attest to the importance of designing appropriate activities and indeed environments for argumentation (see for example the chapters by Andriessen et al.; Baker; and Schwartz & Glassner), a topic to which we now turn.

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PEDAGOGICAL SCENARII

From a pedagogical perspective, collaborative tasks may serve different roles in educational practice. It seems reasonable to suppose that in this practice, the stakeholders' assumptions about learning and knowledge will reciprocally interact with the design of learning environments and how one participates in those environments (Barab & Duffy, 2000). What people think knowing something entails affects the likelihood of accepting new knowledge, belief revision or conceptual change (Kuhn, 2001). The discussion of confronting cognitions and instructional technologies cannot be detached from discussing classroom or work practices of which they are a part. Because of the wide range of options available to participants in a collaborative learning task, a range that is necessary for personal beliefs and knowledge to be at stake, in order for learning by argumentation to take place, it is crucial to consider the role of the educational context. This is the purpose of this section.

The educational contexts under which specific learning goals are to be realized can be captured in the form of pedagogical scenarios. Scenarios stand for educational arrangements, that is a designed combination of tasks or task sequences, instructions, and tools that enable learner activities, serving the attainment of specific learning goals. Andriessen & Sandberg (1999) proposed three prototypical scenarios, covering most educational practices, that can be distinguished on the basis of underlying assumptions about learning, goals typically associated with learning assignments, types of learning activities involved and the associated roles of the participants in the learning situation. While most learning situations involve a blend of scenario ingredients, a more abstract approach to characterise these practices helps clarifying the relationships between argumentation and its educational context, specifically with respect to epistemology and pedagogy.

Transmission scenarios

The first prototypical pedagogical scenario was called *transmission*. In transmission, knowledge is supposed to be an object to be imparted into the minds of learners. The goal of education is the transmission of domain knowledge from the expert to the learner. Learners have to understand what experts mean, and their lack of personal understanding is treated as misconceptions that have to be repaired. Transmission based teaching, which characterizes most formal education, centres on the acquisition of declarative or statable knowledge and a limited number of critical skills, by a system of lectures, textbooks, and testing. Transmission scenarios favour closed assignments with criteria determined by the instructor. Learning by being taught, by examples and demonstrations, by drill and practice, or by discovery all should lead to the attainment of fixed learning goals. The ideal transmission-based learning environment is one with an inspiring tutor teaching with clear demonstrations, expositions, narratives, arguments and examples. In transmission, collaboration may support participants in trying to understand ideas, by explanation and comprehension processes. The success of the

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collaboration in transmission depends on the (effective and efficient) attainment of domain-specific knowledge.

In transmission, argumentation is mainly considered as a reasoning process, in which learners try to articulate strong and relevant arguments to arrive at an approved conclusion. The situational constraint that drives the argumentation in the first place is the teacher (who has the roles of domain expert, discussion moderator and evaluator at the same time), not the interests or personal goals of the participants themselves. Hence, what is being confronted during argumentation between two students concerns not only their personal representations, but also those of experts, represented in the teacher's words or the textbook contents. In other words, for the participants the issue at stake during argumentation in knowledge transmission is: is this information *correct*? Ideally, this would require on-line expert feedback and prompting, originally one of the main goals of Intelligent Tutoring Systems (Andriessen & Sandberg, 1999).

If correctness of knowledge is the principal issue, participants in a discussion will be constrained to the extent of their lack of confidence in the strength and relevance of their personal knowledge. The paradox of transmission with respect to the role of argumentation as a learning tool is that the less knowledge you have, and so the more you can benefit from argumentative discussion, the less inclined you may be to deeply engage in such a discussion. As a consequence, participants do not tend to bring in more than facts and opinions they feel relatively certain about, resulting in less understanding (especially less refinement of goals and concepts) than would have been possible. In other words, in transmission, the learners' argumentative *goals* do not match those required for constructive debate, from a learning perspective.

Another characteristic of transmission scenarios is their focus on *individual learning* or *personal understanding*. Individual conflict is a driving force of knowledge transmission, not interpersonal disagreement. Obviously, handling interpersonal conflict during confrontation of cognitions involves a social component as well, which is tightly interwoven with the cognitive aspects of the collaborative situation. However, learners' social skills for handling conflicts are not linked to school tasks, but to their personal interactions outside the context of school assignments. When students collaborate they are used to distributing tasks, as in writing a paper where each writer produces a section of the text, after which all sections are assembled. The social skills of students necessary to handle socio-cognitive conflicts in constructive epistemic discussions are not developed in this way. This relates to what Baker (this volume) calls the *socio-cognitive paradox*: if the dialogue is to have any point, then students must, to some extent, address cognitive conflicts as they arise; but the more they go deeper into cognitive disagreement, the greater the threat to their interpersonal relationship.

Furthermore, due to the focus on individual knowledge in transmission, students involved in a collaborative discussion do not have great interest in sharing ideas. It is more likely an act of benevolence when a student with more understanding of some aspect of the domain explains this understanding to another student. The receiver of this information would better not try to challenge this gift too much. As a consequence,

conflicts may not be sought as often as they potentially could be, from a learning perspective.

A number of findings reported by authors in this book (e.g. Baker, Veerman, Andriessen et al.) may be (at least partly) explained by the role of user expectations in a transmission scenario. Some of the common findings addressed in these chapters are that (1) students tend to focus on solutions, rather than processes, even if the problems to be solved are open and complex, (2) students tend to divide subtasks between them, rather than working together, (3) students feel stuck by constraints, rather than trying to overcome them, (4) students use provided information and task structure as given, not as negotiable or discussible, and (5) because of their inflexibility, users are extremely sensitive to specific design features of the computer environment. In addition, concerning argumentation, (6) students depend on explanations to guide their knowing rather than on evidence (Baker, 2002; Kuhn, 2001).

It would be easy to raise more issues concerning problems with most current educational contexts, which have been described as 19th century Tayloristic, based on the wrong ideas about what knowledge is, and lacking in authenticity with respect to real life tasks (e.g. Resnick, 1987; Harasim, 1997; Petraglia, 1998; Bereiter, in press). As a consequence, the effectiveness of argumentation as an educational activity in such contexts is limited to the extent that the participants in this activity are truly committed to knowledge improvement. This is not very likely to happen in transmission scenarios, and only with enigmatic teachers and socially highly skilled and motivated students.

Studio scenarios

The second educational scenario distinguished by Andriessen and Sandberg (1999) was called *studio*. Instead of focusing on personal understanding of normative information as in transmission, the studio scenario concerns the acquisition of metacognitive skills and learning to learn. The learning environment is explicitly considered, as it is seen as a collection of tools and tasks to be used by learners to adapt their learning to their needs and goals. Collaborative learning is one of the skills that learners are supposed to master. Instead of collaboration being acquired as a by-product of knowledge acquisition, now it is addressed in a number of different tasks in which different functions of collaboration and roles of participants are the focus of attention. While studio scenarios presuppose that learners have the ability to understand given information, the new focus is now on their individual roles as learners and collaborators that have to apply and extend their understanding to different tasks. Typically, the tasks are open, with no fixed solutions or solution paths, and allow adaptation to specific individual knowledge and skills. In studio, learners are learning to arrive at *shared understanding*, by dialogue and communication of information and knowledge through the use of various tools available in the environment. This involves, among other things, discussing different viewpoints, and integrating personal beliefs, other peoples' ideas and information from different sources in a process of argumentative learning (Stahl, 2000).

The general reason why argumentation is supposed to involve more committed users in studio than in transmission is that in studio collaboration is an integral part of the curriculum and a skill explicitly to be acquired during the learning process. In studio, context is ripe for the development and use of CSCL environments that (1) adequately *support* (as opposed to enable) collaborative (and argumentative) learning, (2) allow using *generic tools* that are not task- and domain-specific as in transmission, and (3) do not treat collaboration as a single type of activity, but instead allow attention for *development* of users, differentiation of user *roles* and distinction of different *phases* in task-based discussions.

Although an implementation of a studio scenario according to the criteria we described here is not known to us, there are many attempts to create studio-type CSCL environments. In this book, the chapter by van Bruggen & Kirschner addresses issues for the development of tools that support several types of argumentation in the context of complex open problems, such as design and investigation. Their chapter offers interesting and important suggestions for a framework for designing external representations for studio-type CSCL environments, and more specifically for representation and support for argumentation in such environments. One of their main points is that the richer the ontology the representational system offers to the users, the harder it would be to use the representation, at least for beginners.

This assumption is also derived from results reported in the chapter by Suthers (this volume) in which it was found that in the case of constructing graphical representations to map scientific debate, the labels of categories on the buttons led students to trying to classify their contributions in terms of these labels, rather than developing their own thinking and reasoning. Similarly, Veerman (this volume) found that the limitations of the linear interface that supported electronic communication during open problem solving were a greater obstacle for students that focused on concepts and their meaning than for students that had a more product oriented goal. In terms of the pedagogic scenarios one would be tempted to examine such results in terms of differences in flexibility of learners in different scenarios.

The contribution by Jermann & Dillenbourg (this volume) also addresses the interface issue. They report a study situated in actual teaching practice that explicitly attempts to foster active interaction between students in an electronic environment, called the TECFA virtual campus. The scenario, serving to promote the acquisition of declarative knowledge about design principles for computer support in education, includes making students' ideas available for discussion by graphically representing them as a collective output. What the authors try to show is that when the computer tool (by its design) orients the students towards expressing differences in opinion, students abandon their usual 'standing pat' attitude (Baker, 1994), an attitude that was discussed above as a characteristic of behaviour in a transmission scenario. Certain tool features served to perceive the task in a different way, which worked out in the context of the studio-type scenario designed by Jermann & Dillenbourg.

The chapter by Schwarz & Glassner (this volume) discusses the Kishurim project, an impressive and well-founded attempt to integrate argumentation-based activity in

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classroom practice. Although it is not explicitly described as such, the project can be taken (among other things) as an attempt to establish the transition from transmission to studio, and beyond, in educational practice. By discussing the role of argumentation in education the authors note the lack of adequate learning environments for students, leading them not to engage in argumentation. This is because (1) the students do not know how to link many natural arguments to personal knowledge and beliefs, and (2) the students tend to take scientific arguments as true rather than challenging them, in other words, they are blind (1) and paralytic (2) with respect to argumentative activities. Schwarz & Glassner go on to discuss several principles, at the level of educational design, with and without technology, to develop a goal-directed program in which students learn and experience argumentation in several forms, and during which students can have different roles.

The role of argumentation is taken much more seriously in studio than in knowledge transmission. Although the focus is still on individual learning, the need for a collaborative context for a learner to be engaged in several forms of meaningful learning is acknowledged. Three chapters in this book explicitly address important issues related to the studio scenario, at the level of design of representations in the CSCL environment (van Bruggen & Kirschner), at the level of task design (Jermann & Dillenbourg), and at the level of educational design (Schwarz & Glassner). Although there is not much evidence to support this, it is expected that argumentation may help to realize more and more versatile learning goals in studio than in transmission. However, in order for such learning to be realized in a collaborative task, a relatively high degree of mutual understanding (grounding) between collaborators has to be established, at the pragmatic level (learning to collaborate, play roles, in different tasks) to arrive at meaning making at the semantic level (Baker, Hansen, Joiner & Traum, 2000). Hence, the focus in studio is on the *pragmatics* of collaborative argumentation (when, why, and how to argue, and for what purpose?) with the aim of (1) reducing the space of misunderstanding during collaborative learning (Dillenbourg, 2000), (2) increasing metacognitive awareness of learning, collaboration and the role of argumentation (e.g. Kuhn, Shaw & Felton, 1997), and (3) preparing learners for the practice of group work and knowledge building discourse (e.g. Bereiter, in press).

Negotiation scenarios

The third (and final) prototypical scenario distinguished by Andriessen & Sandberg (1999) is called the *negotiation* scenario. Negotiating implies individuals communicating and debating points of view in order to reach agreement or understanding. The goal of education in this scenario is to establish learning groups (within and between schools) engaged in knowledge building: creating new knowledge by sharing and negotiating content. All professional practices have found their current shape by long-term interaction and negotiation processes (Saljo, 1996). Participating in professional groups implies the ability to understand the important debates and problems and to use the right language to examine and influence ongoing discussion. Learning in the negotiation scenario is to a large extent learning to produce and comprehend the discourse of the

community (Lemke, 1987; Pea, 1993). The idea that learning may be negotiated is not, of course, new. It closely relates to what Bennett (1976) termed the "progressive approach" to teaching, which Bruner (1986) described a decade later as follows:

> "... induction into the culture through education, if it is to prepare the young for life as lived, should also partake of the spirit of a forum, of negotiation, of the recreating of meaning. But this conclusion runs counter to traditions of pedagogy that derive from another time, another interpretation of culture, another conception of authority - one that looked at the process of education as a transmission of knowledge and values." (Bruner 1986, p. 123)

While in studio, learners' activities focus on arriving at shared understanding through multiple forms of collaboration, in the negotiation scenario, learners focus on the process of creating new knowledge on the basis of what is shared (which does not necessarily imply *agreed*). This scenario is about arriving at and building on meaning making practices, making ideas the focus of inquiry and the product an achievement that represents the best of a collaborative effort (compare Scardamalia, 1997).

The chapter by Andriessen et al. (this volume) discusses the process of *knowledge negotiation* in collaborative writing, which they describe as discussion for agreement about the meaning of concepts and their interpretations in the context of a learning task. Negotiation may be about problem solutions, meanings of concepts, and other things. Argumentation is one of the forms that dialogues in negotiation may take (Baker, 1994; Dillenbourg and Baker, 1996). The extent to which negotiation fosters individual learning depends on specific meaningful exchanges between individual participants. The chapter by Andriessen et al. shows that university students that collaboratively produce an argumentative text through electronic communication do not tend to negotiate each item of content extensively. When they do, as in elaborate argumentation, this immediately increases the variety of arguments in the discussion, in terms of their orientation, pro- and counter the main position of the text. In addition, much of this information discussed as elaborate argumentation is immediately entered into the text under construction. However, in most of the discussion, participants are all too eager to accept ideas put forward by the other. It seems straightforward to attribute this behaviour to the context of transmission-based university education.

The negotiation *scenario*, however, is not merely about individual learning, it is about getting the best out of groups. Knowledge is seen as a (by-) product of group activities, displayed by their discursive practice (Gergen, 1995). In order to construct negotiation scenarios, educational designers must be able to understand concepts such as collective thinking (Allwood, 1997), collaborative knowledge building (Brown & Campione, 1994; Stahl, 2000; Bereiter, in press), communities of practice (Wenger, 1998), and knowledge management (Brown & Duguid, 2001). Research in this area is in its exploratory phases, and frequently involves case-studies in business contexts, which are beyond the scope of this chapter. The chapter by Pilkington & Walker (this volume), however, can be taken as an attempt to study the role of electronic communication in the development of a learning community which can be linked with characteristics of a negotiation scenario.

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Pilkington & Walker reason that in order for young students to develop argumentation skills it is first necessary to develop a culture of interaction in which constructive debate is possible. They study this development in a setting outside the school context, a community centre that provides an environment for disadvantaged children (10-15 years old) that need extra support to develop their literacy skills (among other things). The medium is synchronous text-based chat, which was supposed to facilitate communication by reducing writing apprehension and inequality. One of their research questions was whether it is possible to learn children to engage in debate-style 'substantive conflict' (explicit disagreement, considering alternatives) through the use of this medium, to engage in better argumentation, and to produce better individually written compositions. Characteristic for their approach is the study of developments over a long period, using different media, tasks and specific task goals, implementing different teacher roles and a variation of individual and collaborative phases. Note that the study by Schwarz & Glassner (this volume) explicitly states a similar approach in these respects. Both studies involve the goal of 'learning to argue', which is not taken as the mastery of argumentative schemas, but as a form of practice in a social and educational context, to be exercised in open and complex domains such as scientific reasoning or written text production.

The differences between the two studies relate to the context of the research (community centre and classroom) and the balance between top-down (teacher or researcher-designed) and bottom-up (student choices and responsibility) goals set during the experiments. Hence, argumentation in the Schwarz & Glassner study concerned bridging the gap between scientific reasoning and the students' personal reasoning. This requires for their students quite precise reflections on the content and formulation of arguments. In contrast, in the Pilkington & Walker study, the development of argumentation skills served to improve literacy in different contexts. This is studied in a context in which interpersonal communication is at least as important as the content of the arguments put forward during this communication.

Confronting cognitions in different scenarii

Arguing to learn serves different goals in the different pedagogic scenarios. Different goals affect the argumentative activities users are engaged in, which is directly related to the learning outcomes of these activities. Scenarios focusing on meaning making practice rather than on the product, and on collaboration and group processes rather than individual knowledge were considered as better test-beds for the study of learning from argumentation. All chapters in this book address issues that are relevant to these distinctions. However, educational practice seems to be lagging behind in may respects. A fundamental problem is thus to understand how to help teachers to provide help to learners to better exploit the co-constructive potential of their argumentative interactions.

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CONCLUDING REMARKS

In conclusion, we restrict ourselves to two brief remarks that may be worth reflecting upon when reading this book.

Firstly, for a book on the apparently restrictive topic of confronting cognitions in argumentation-based CSCL environments, the chapters describe a surprisingly varied ensemble of situations and complex sequences of pedagogical tasks, activities, and scenarii, with their associated sets of tools. But this is perhaps not so surprising if one accepts that knowledge-based argumentation is one of the most complex cognitive, linguistic and communicative tasks required of human beings, who not only have to generate cognitions, but also refine them by examination of their foundations, in confrontation with others people's cognitions. Pedagogical activities for argumentation-based learning will thus have to be correspondingly knowledge-rich and complex.

Secondly, although this book concentrates on argumentation, in a very wide sense of the term, we do not wish to suggest that everything could or should be learned in this way. There are surely limits to learning from confronting cognitions in CSCL environments, however well situations are designed in terms of collaborating partners, communication tools, associated information and pedagogical scenarii. What are those limits? We can only hope that this book contributes not to answering that question, but rather to laying foundations for … a constructive debate.

REFERENCES

Alamargot, D. & Andriessen, J. (*in press*). The "power" of text production activity in collaborative modeling: Nine recommendations to make a Computer Supported situation work. In P. Brna, M. Baker, K. Stenning & A. Tiberghien (Eds.), *The Role of Communication in Learning to Model.* Mahwah, New Jersey: Lawrence Erlbaum Associates.

Alwood, J. (1997). Dialog as collective thinking. In Pylkkänen, P., Pylkkö, P. & Hautamäki, A. (Eds.). & *Brain, Mind and Physics,* Amsterdam, IOS Press.

Andriessen, J. E. B. & Sandberg, J. A. C. (1999). Where is Education heading and how about AI? *International Journal of Artificial Intelligence in Education* 10, 2, 130-150.

Baker, M.J. (1994). A Model for Negotiation in Teaching-Learning Dialogues. *Journal of Artificial Intelligence in Education*, 5(2), 199-254.

Baker, M. J. (1996). Argumentation et co-construction des connaissances. *Interaction et Cognitions* 2 (3), 157-191.

Baker, M. J. (1999). Argumentation and Constructive Interaction. In G. Rijlaarsdam & E. Espéret (Series Eds.) & J. Andriessen and P. Coirier (Vol. Eds.) Studies in Writing: Vol. 5. *Foundations of Argumentative Text Processing*, (pp. 179 – 202). Amsterdam: University of Amsterdam Press.

Baker, M. J. (2002).

Baker, M., Hansen, T., Joiner, R. & Traum, D. (1999). The role of grounding in collaborative learning tasks. In P. Dillenbourg (Ed.), *Collaborative Learning: cognitive and computational approaches* (pp. 31-63). Oxford: Pergamon.

Barab, S. A. & Duffy, T. M. (2000). From practice fields to communities of practice. In: D. Jonassen & S. M. Land (Eds.), *Theoretical foundations of learning environments*, (pp. 25-56). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Bennett, N. (1976). *Teaching Styles and Pupil Progres*s. London : Open Books.

Bereiter, C. (in press). *Education and mind in the Knowledge age.* Mahwah, New Jersey: Lawrence Erlbaum Associates.

Blaye, A. (1990). Peer Interaction in Solving a Binary Matrix Problem: Possible Mechanisms Causing Individual Progress. In H. Mandl, E. De Corte, N.Bennett & H.F. Friedrich (Eds.) *Learning and Instruction* Vol 2,1. London: Pergamon Press.

Brown, J. S. & Duguid, P.

Bruner, J.S. (1986). *Actual Minds, Possible Worlds.* London : Harvard University Press.

Buckingham Shum, S. & Sumner, T (2001). JIME: An Interactive Journal for Interactive Media. *First Monday*, 6, (2), Feb. 2001. [http://firstmonday.org/issues/issue6_2/buckingham_shum/]. To be reprinted in Learned Publishing, 2001. PrePrint (with high resolution screens images) available as a PDF: Technical Report KMI-TR-99, Knowledge Media Institute, Open University, UK (2001) [http://kmi.open.ac.uk/tr/abstracts/kmi-tr-99.html].

Chi, M.T.H., Bassok, M., Lewis, M.W., Reimann, P. & Glaser, R. (1989). Self-Explanations: How Students Study and Use Examples in Learning to Solve Problems. *Cognitive Science* , 13 (2), 145-182.

Clark, H. H. & Brennan, S. E. (1993). Grounding in Communication. In R. M. Baecker (Ed.), Readings in Groupware and Computer-Supported Cooperative Work. San Mateo, CA: Morgan Kaufmann Publishers.

Constantino-González, M. A. (2000). *A Computer Coach to Support Collaboration in a Web-based Synchronous Collaborative Learning Environment*. Unpublished dissertation, ITESM (Instituto Tecnológico y de Estudios Superiores de Monterrey), México.

Crook, C. (1994). *Computers and the Collaborative Experience of Learning.* London : Routledge.

Dillenbourg, P. (1999) Introduction: What do you mean by 'collaborative learning'? In: P.Dillenbourg (ed.) *Collaborative learning, cognitive and computational approaches,* (pp. 1-19). Oxford: Pergamon.

Doise, W. & Mugny, G. (1981). *Le développement social de l'intelligence*. Paris : InterÉditions.

Gergen, K. (1995). The social constructionist movement in modern psychology. *American Psychologist,* 40(3), 266-275.

Golder, C. (1996). *Le developpement des discours argumentatifs.* Lausanne: Delachaux & Niestle.

Harasim, L. (1997, march). Network learning: what have we learned and what does it mean? Presented at the AERA annual meeting, Chicago, Il.

Herring, S.C. (1999, January). Interactive coherence in CMC. In *Proceedings of the 32nd Hawai`i International Conference on the System Sciences (HICSS 32).* (CD-ROM). Maui, Hawai`i: Institute of Electrical and Electronics Engineers, Inc. (IEEE).

Hewitt, J. (1997). Beyond threaded discourse. Paper presented at WebNet'97. Available: http://csile.oise.utoronto.ca/abstracts/ThreadedDiscourse.html

Koschmann, T. (2002). Dewey's contribution to the foundations of CSCL Research. In G. Stahl (ed.), *Computer Support for Collaborative Learning*. Proceedings of CSCL 2002, (pp. 17-22). Boulder, Colorado.

Kuhn, D. (2001). How do people know? *Psychological Science, 12 (1), 1-8.*

Kuhn, D., Shaw, V. & Felton, M. (1997). Effects of dyadic interaction on argumentative reasoning. *Cognition and Instruction, 15(3),* 287-315.

Lemke, J.L. (1989). *Using language in the classroom.* Oxford: Oxford University Press.

McManus, M.M. and Aiken, R.M. (1995). Monitoring Computer Based Collaborative Problem Solving. *Journal of Artificial Intelligence in Education* , 6(4) , 308-336.

Muehlenbrock, M. (2000). Action-based collaboration analysis for group learning. Ph.D. thesis, Department of Mathematics/Computer Science, University of Duisburg.

Nonnon, E. (1996). Activités argumentatives et élaboration de connaissances nouvelles: le dialogue comme espace d'exploration. *Langue Française, 112*, 67-87.

Pea, R.D. (1993). Learning scientific concepts through material and social activities: Conversational analysis meets conceptual change. *Educational Psychologist, 28* (3), 265-277.

Perelman, C. & Olbrechts-Tyteca, L. (1958/1988). *Traité de l'argumentation. La nouvelle rhétorique*. Bruxelles: Editions de l'Université de Bruxelles.

Petraglia, J. (1998). *Reality by Design: The rhetoric and technology of authenticity in education*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Resnick, L. B. (1987). Constructing knowledge in school. In L. S. Liben (ed.), *Development and learning: Conflict or congruence?* (pp. 19-50). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Robertson, J.,Good, J., & Pain, H. (1998). BetterBlether: The design and evaluation of discussion tool for education. *International Journal of Artificial Intelligence in Education*, 9.

Roschelle, J. & Pea, R. (2002, January). A Walk on the WILD side: How wireless Handhelds may change CSCL. In G. Stahl (ed.), *Computer Support for Collaborative Learning*. Proceedings of CSCL 2002, (pp. 51-60). Boulder, Colorado.

Scardamalia, M. (1997, march). *Networked Communities Focused on Knowledge Advancement*. Presented at the AERA annual meeting, Chicago, Il.

Stahl, G. (2000). A model of collaborative knowledge-building, In: *Proceedings of the Fourth International Conference of the Learning Sciences* (ICLS 2000), (pp. 70-77). Ann Arbor, MI.

Stahl, G. (2002, january). Introduction, Foundations for a CSCL community. In G. Stahl (ed.), *Computer Support for Collaborative Learning*. Proceedings of CSCL 2002, (pp. 1-2). Boulder, Colorado.

Stein, N. L. & Bernas, R. (1999). The Early Emergence of Argumentative Knowledge and Skill. In G. Rijlaarsdam and E. Espéret (Series Eds.) & J. Andriessen and P. Coirier (Vol. Eds.) Studies in Writing: Vol. 5. *Foundations of Argumentative Text Processing*, (pp. 97–116). Amsterdam: University of Amsterdam Press.

Sutter, B. (2002, January). Instructional Artifacts. In G. Stahl (ed.), *Computer Support for Collaborative Learning*. Proceedings of CSCL 2002, (pp. 33-42). Boulder, Colorado.

Turoff, M., Hiltz, S. R., Bieber, M., Fjermestad, J., & Rana, A. (1999). Collaborative discourse structures in computer mediated group communications. *Journal of Computer Mediated Communication, 4*(4). Online: http://jcmc.huji.ac.il/

van Eemeren, F. H., Grootendorst, R. & Snoeck-Henkemans, F. (1996). *Fundamentals of Argumentation Theory: A Handbook of Historical Backgrounds and Contemporary Developments*. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Van Someren, M. W., Reimann, P., Boshuizen, H. P. A., & de Jong, T. (1998). Learning with Multiple Representations. Amsterdam: Elsevier Science, Ltd.

Walton, D.N. (1989). *Informal Logic: a handbook for critical argumentation*. Cambridge: Cambridge University Press.

Wenger, E. (1998). *Communities of practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press.