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ARGUMENTATIVE KNOWLEDGE CONSTRUCTION IN HIGHER EDUCATION

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ABSTRACT (EN)

This thesis investigates the potential of Social Technologies to enhance argumentative knowledge construction processes. In particular, it focuses on the use of wikis[1], a major technology in the current Web 2.0 landscape.

The importance of argumentative knowledge construction for both Higher Education and Life Long Learning lies in its very nature: in order to engage in academic discussions, learners need to be able to argue rationally, assessing the strengths and weaknesses of other people's standpoints, and supporting their own positions with adequate grounds. These competencies are of particular value to be knowledgeable actors in the current society where knowledge is a resource of major importance and is often the result of a collaborative effort among people.

The aim of this study is twofold: on one hand, to evaluate the effectiveness of the use of wikis in collaborative processes of argumentative knowledge construction; on the other hand, to define a conceptual architecture for wiki based learning processes in the area of argumentation.

This work was developed through three experimental studies that were conducted by the candidate during a research period at the University of Manchester (UK).

The experimental outcomes confirm the potential of wikis to effectively favor the creation of a rich argumentative network and the quality of the individual argumentative acts. The experimental data also contributed to tune-up the proposed conceptual architecture (Wiki*DiA*).

[1] A wiki is a collaborative web site whose content can be edited by multiple users, hence facilitating the fast creation and elaboration of joint documents (Chao, 2007). The term 'wiki' derives from the Hawaiian phrase, wiki-wiki, which means 'quick'.

ABSTRACT (IT)

La tesi mira ad indagare le potenzialità d'uso delle tecnologie di rete (*Social Technologies*) a supporto della costruzione argomentativa di conoscenza. In particolare, si concentra sull'uso del wiki[2], uno strumento collaborativo del Web 2.0.

La costruzione di conoscenza tramite l'argomentazione è un elemento fondamentale sia nella didattica universitaria, sia in una prospettiva di apprendimento continuo: al fine di partecipare adeguatamente al dibattito scientifico, gli studenti devono essere in grado di argomentare razionalmente, valutando i punti di forza e di debolezza delle posizioni altrui, e sostenendo le proprie posizioni con dati adeguati. Tali competenze sono di particolare valore anche per operare efficacemente nella società attuale, in cui la conoscenza è una risorsa strategica e spesso il risultato di un processo di gruppo.

L'obiettivo di questo studio è duplice: da un lato, di natura valutativa, mira a verificare l'efficacia d'uso del wiki a supporto di processi collaborativi di costruzione argomentativa di conoscenza; dall'altra, assume un valore propositivo, in quanto definisce una possibile architettura concettuale per sostenere tale compito.

Il lavoro della tesi si basa su tre casi sperimentali condotti nell'ambito di un periodo di ricerca svolto dalla candidata all'Università di Manchester, UK.

I dati sperimentali confermano la potenzialità del wiki di supportare efficacemente la creazione di una rete argomentativa complessa e la qualità degli atti argomentativi individuali. I dati sperimentali hanno inoltre contribuito alla messa a punto dell' architettura concettuale proposta in questa ricerca (Wiki*DiA*).

2 Un wiki è un sito Web (o comunque una collezione di documenti ipertestuali) i cui contenuti possono essere modificati da tutti coloro che vi hanno accesso, consentendo quindi la rapida creazione di documenti/contenuti condivisi (Chao, 2007). Il termine deriva dalla lingua hawaiiana "wiki-wiki" che significa "rapido".

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Chapter 1 Introduction

1.1. Research objectives and contribution

This research study addresses the area of Computer Supported Collaborative Learning (CSCL) to facilitate argumentative knowledge construction, a subject which is relevant for both Higher Education and Life Long Learning.

Among the currently available collaborative technologies, the focus of this study is, particularly, on wikis because of the strong affinity between the participatory nature of this technology and the dialogic dimension of collaborative argumentation.

This study has a twofold objective:

- to evaluate, in terms of effectiveness and ease of use, the potential support of wiki technologies to facilitate collaborative processes of argumentative knowledge construction;
- to define a conceptual architecture apt to suitably exploit such technological environments to support the collaborative construction of argumentative knowledge in learning environments.

These two objectives were contextually pursued by organizing and developing some exploratory studies in a university setting. These studies were qualitatively analyzed with the aim to elicit participants' behaviors and situations determined by the use of wikis. They contributed to define, test and improve the mentioned conceptual architecture.

1.2. Why argumentative knowledge construction matters for Higher Education and life-long learning

A fundamental aim of higher education is to develop students' critical attitudes towards knowledge and the ability to present well-ground arguments[3] (Terenzini et al., 1995; Muller Mirza & Perret-Clermont, 2009; Andrews, 2010 in press). In order to engage in academic discussions, whether in speech, writing or other modes, students need to be able to argue rationally, assessing the strengths and weaknesses of other people's standpoints, formulating their own positions and supporting them with relevant and adequate grounds (Marttunen & Laurinen, 1999). These skills are of particular value in the new network society in which people have to be able to cope with a large amount of information and select essentials from it. In this new situation, the skill in assessing information critically from different points of view is important.

Engagement in argumentative small- or large-group discussions has been found to improve conceptual understanding (Mason, 1996, 2001) and knowledge building (Leitão, 2000; Chinn & Anderson, 1998). In this context, the learner plays the role of co-author in a constructive socio-cognitive process where argumentation brings about the emergence of new understanding and the transformation of previously acquired knowledge.

In general, the importance of the social and dialogic dimension, even if not explicitly focusing on argumentation, has been stressed by many authors in the literature as essential for effective learning and cognitive development, in particular in the current knowledge society (Scardamalia and Bereiter, 2002; Tan, Hung & Scardamalia, 2006). Vygotsky (1986) highlights learning as an essentially social process in which knowledge is built by a collaborative effort among students. Bruner (1998, p. 68) points out that "the cultural contexts that favor mental development are principally and inevitably interpersonal". Drawing from Bakhtin (1981) and Wertsch's (1985) ideas of converging, complementary

3 'Argument' and 'Argumentation' are usually used interchangeably. In this work following Andrews (in press), a distinction is made between argument (the product of argumentation, eg. an essay, a debate, a dissertation, etc.) and argumentation (the process, sequence or exchange of arguments in a specific context, eg. education, policy, etc.). Argumentation in higher education mainly refers to how arguments occur in university settings, and how best to nurture it. The expression of argumentative knowledge construction will be used to indicate the process of constructing knowledge by means of argumentation, which is central to this work.

arguments, Pontecorvo (2000) points out that any thinking activity should necessarily be ground in a dialogic dimension.

The importance of argumentative knowledge construction in higher education pedagogy lies in its very nature: the study of subjects and disciplines at higher education level implies students' ability to research complex connections among knowledge. Indeed, exploring connections among knowledge, together with acquiring discipline-specific knowledge and inquiry methods can be defined as three distinctive characteristics of higher education pedagogy. These characteristics can also be seen as three forms of argumentative knowledge construction. Therefore, fostering advancements in higher education pedagogy necessarily implies offering students more opportunities to master the argumentative discourse structure.

Argumentation is therefore of interest of the educational research for being a conceptual tool apt to promote learning, knowledge building and cognitive growth.

Although argumentation skills appear to be so much necessary, university students seldom know how to argue effectively, as documented by several research studies: not only have they difficulties producing relevant evidence to support their positions (Kuhn, 1991), but also they are often guided by beliefs and bias when evaluating arguments (Klaczynski, 2000). Moreover, Stein and Albro (2001) demonstrate that the affective dimension has a strong influence on students' effective engagement in argumentation: college students tend to avoid to get involved in argumentative discussions for the fear that this might disrupt interpersonal relations with their peers. A further difficulty is introduced by the fact that only generic skills can be used across fields, as argumentation skills are mostly subject-dependent. Hence, it is important for university students to practice argumentation on all subjects of their interest, on which they have command of discipline-specific knowledge and discourse (Mitchell & Andrews, 2000; Riddle, 1997), as well as to be introduced to effective argumentation by means of suitable methods and tools.

1.3. CSCL and its potential to support higher education pedagogy

If paired with a sound methodology of use, ICT (information and communication technologies), and in particular social technology[4], has a good potential to support learning and knowledge building in higher education (Hamid, 2009; Hemmi et al., 2009; Hughes, 2009; Scardamalia & Bereiter, 2002).

As concerns the topic of interest for this thesis, Steinberg (1992) points out that the key feature of ICT with respect to practicing argumentation and critical thinking is its potential support to the focused discussion of alternative points of views between participants. Students in social digital environments are not affected by some factors typical of face-to-face settings that may inhibit discussion (such as gender, age, ethnicity, performance skills). Furthermore, studying through ICT consists mainly of text-based contributions to the topics under consideration. As Henri (1992) puts it, a written text demands exactness, careful consideration, and explicit expression of thoughts. These qualities are important in argumentative dialogues and debates in which the goal is to assess the strengths and weaknesses of others' contributions. Many studies (e.g., Littlefield, 1995; Marttunen, 1997) also suggest that learning environments in which students are engaged in active interaction and debates with each other are beneficial when the aim is to promote argumentation skills.

Among the existing ICT tools for social collaboration, this study focuses in particular on wiki-technology[5] that, as previously pointed out, can enable broad participation in knowledge production (including argumentative knowledge).

Wikis facilitates the collaborative generation of knowledge by supporting joint creation and editing of documents (Fuchs-Kittowski & Köhler, 2005; Köhler & Fuchs-Kittowski, 2005). Wikis' potential for collaborative learning lies in their ability to allow for debate-based learning experiences (Chong & Yamamoto, 2006) or to facilitate shaping of knowledge (Reinhold, 2006), collaboration (Kim et al., 2006), design-based learning

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4 Essentially, social technology tools are Web 2.0 software (eg. wiki, blogs, podcasting, etc.) that supports group interaction and collaboration.

5 Wikis are compilations of web pages that enable users to easily create content, hyperlinks it with other content, add, delete and change any part of the text as they please. The potential of wikis for collaborative learning is addressed in Chapter 2.

(Rick and Guzdial, 2006), inventiveness (Guzdial et al., 2001), as well as inquiry learning and the co-construction of knowledge (Yukawa, 2006). Overall, wikis can be considered to support social constructivist learning in general (Bruns and Humphreys, 2005).

Among the applications in Higher education, the literature reports positive experiences as concerns co-writing (Weng et al., 2004; Hampel et al., 2005; Schaffert et al, 2006; Trentin, 2006, 2009; Swan et al., 2006), collaborative learning (Parker & Chao, 2007; Notari 2006; Wheeler et al, 2008; Ebner et al., 2008), and content creation and development by groups of students (Guzdial, 2001; Tonkin, 2005; Naish, 2006; Chao, 2007). A wide bibliographical search in this respect provided a good number of wiki application in education. None of them, however, explicitly focuses on using wiki to support argumentative knowledge construction.

Discussing how to exploit wiki technology to this purpose is therefore the original contribution of this study, which examines the main factors contributing to successful argumentative knowledge construction in higher education pedagogy[6].

6 As pointed out by Andrews (2007), in European educational context and literature didactics and pedagogy have well-defined and very different meanings: pedagogy is a broad and inclusive concept that transcends subject boundaries but acknowledges general theories of teaching and learning. Pedagogy includes didactics, which comprise strategies and approaches to subject teaching and learning, including also consideration on the sequencing of ideas and its coherence. Didactics also acknowledge theories of teaching and learning but from the discipline-specific perspective. The English language has no word for the general concept, as the word "pedagogy" is to be used for what in the European context is described as 'didactics' (cfr. Andrews P., 2007, Conditions for learning: a footnote on pedagogy and didactics, http://www.atm.org.uk/journal/archive/mt204files/ATM-MT204-22-22.pdf (26 Nov2009). In this study, the term 'pedagogy' is also used with the meaning of the Italian term 'didattica'.

1.4. Research field addressed

The subject of this thesis is rooted in two different research fields: CSCL and Argumentation (as depicted in Fig. 1).

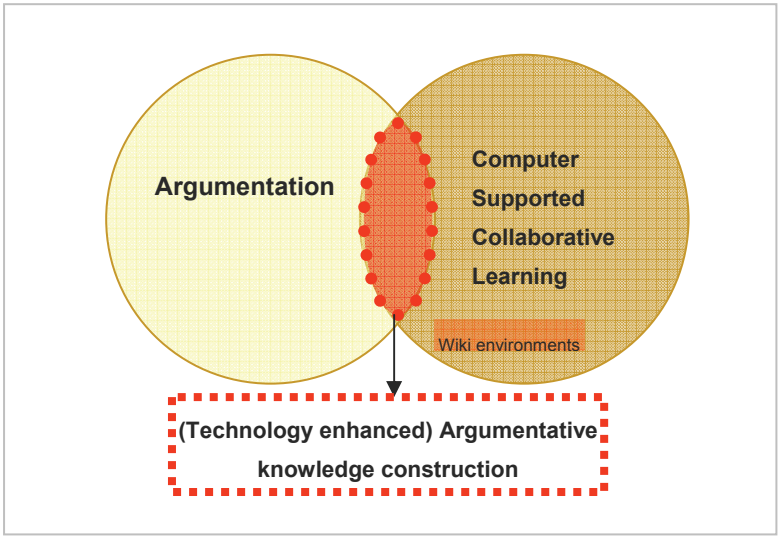

Fig. 1 - The topic addressed in this thesis belongs to the intersection of two research fields: Argumentation and CSCL

CSCL studies the support granted and dynamics induced by technological means used to mediate collaborative learning processes.

Research on Argumentation, on the other hand, investigates how to formally structure and sequence the argumentative discourse. This is an interdisciplinary research field involving contributions from several domains, such as logic, linguistics, philosophy, etc.

The strongly social nature of both fields suggest a potential synergy between them and determined the interest of this research for investigating the possible contribution of new technologies (wikis) to a traditional research field (argumentation).

1.5. Why focusing on wikis

Computer mediated communication environments have provided multiple ways to interact and exchange information among groups of users in the form of messages or files: emails, forums, discussion boards, blogs, instant messaging, social spaces, learning management systems.

Among them, wiki environments offer a unique feature, that is, the possibility to jointly modify a common file. Hence, wikis offer a new logic of "shared editing/creation" where individual contribution naturally merge in one document (see Fig. 2).

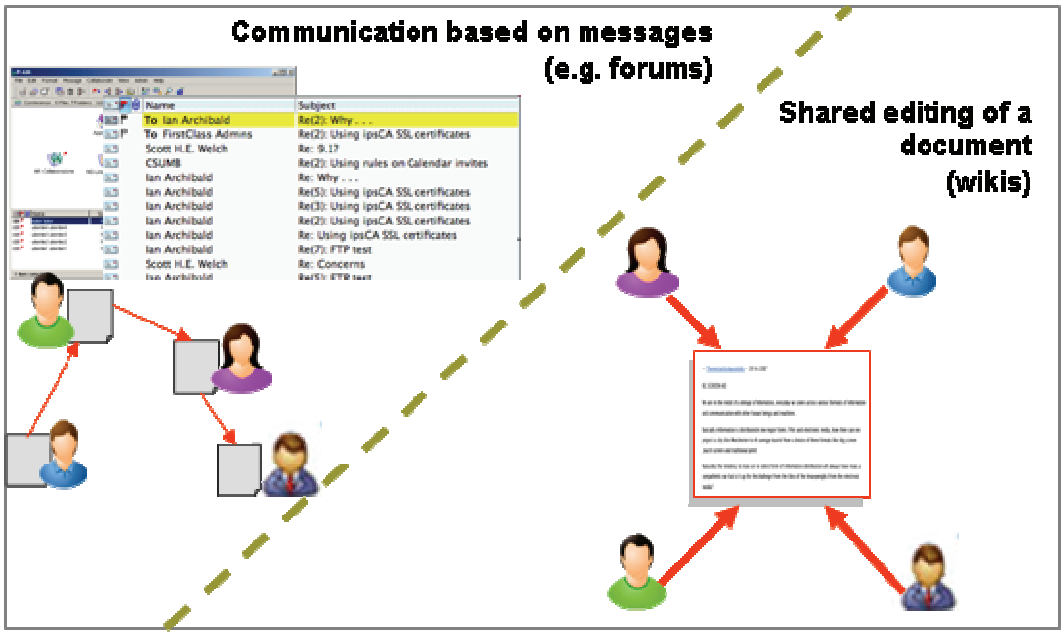

Fig. 2 - CSCL environments: communication models

While the educational application of more 'traditional' interaction environments (like forums, etc.) has been largely explored and discussed in literature during the last ten years, the logic of communication supported by wikis is still to be fully explored and this thesis aims to contribute to the understanding of wiki's potentials in education.

In particular, the participatory features of wikis make it appear a particularly suitable support for collaborative argumentations because in such activities all participants need to contribute to the construction of a joint argument rather than collect different points of view.

1.6. Hypothesis

To address the aims pointed out above, three experimental situations were defined in which learning and knowledge building can be observed. These case studies also offered the opportunity to test the hypothesis that appropriate conceptual architecture and wiki tools can facilitate argumentative knowledge construction in the way described by Scardamalia & Bereiter: wikis are assumed to support both individual argument construction, and collective knowledge building.

The assumption is made that wiki technology significantly influences argument construction as described above, by triggering both the structure of individual arguments (microstructure) and the arguments' sequence (macro-structure). Furthermore, a simplified model of argument, such as Toulmin's layout, can facilitate students' learning on argumentation. The social intrinsic nature of wikis is also assumed to stimulate students' engagement in rebuttals and counter-arguments.

These considerations led to formulate the following two hypotheses:

H1: The use of wikis can promote the creation of learning environments conducive to argumentative knowledge construction. In particular:

- Wikis can effectively support collaboration and decision making processes
- Wikis help to structure argumentative discourse at both micro- and macro-level.

H2. Learners respond (in terms of rebuttals/counterarguments) more to peers via mediated communication than in face to face discussions.

1.7. Thesis structure

Chapter Two presents a review of the literature on computer supported collaborative learning and argumentative knowledge construction. It also discusses Toulmin's model of argument which has been used in two of the three case studies as a base for argument construction. The chapter provides the theoretical rational for the present study.

Chapter Three presents and discusses the research methodology adopted in this study. It roots the decision for the adoption of a case study methodology in the complexity and nature of the phenomenon under investigation.

Chapter Four describes Case Study 1, providing information on the task, procedure and technology used, context and participants, outcomes.

Chapter Five presents Case Study 2. It describes the activities, tasks, and roles adopted. It outlines the workflows and mechanisms enabling the collective creation of dialogic argumentation, and highlights the features of wiki technologies that support the foregoing.

Chapter Six presents Case Study 3, a controlled experiment designed to test the hypothesis that social text stimulates a greater number of student rebuttals. The aim of this case study was to perform a comparison between participant engagements in face-to-face discussion *vs*. Mediated Communication debate.

Chapter Seven discusses the findings of this study. The discussion is presented in three primary sections. Additionally, the conceptual architecture for supporting the collaborative construction of argumentative knowledge in wiki-based environments is described.

Finally, Chapter Eight summarizes what can be learned from this study, and provides directions for future work.

Chapter 2 Literature Review

2.1. Introduction

This chapter presents the conceptual framework for the present study, which is grounded in the relevant literature pertaining to the fields of Computer Supported Collaborative Learning (CSCL) and Argumentation. Specific attention is then given to the specific field of interest, argumentative knowledge construction. The chapter is structured in five sections.

Section 2.2, *Computer Supported Collaborative Learning* (CSCL), provides an overview of the development of this research field. It focuses in particular on those aspects in which is framed this research: collaborative learning strategies and group cognition. Potentials of wiki technologies in higher education pedagogy is also explored, in particular to support collaborative construction of knowledge.

Section 2.3, *Argumentation* presents commonly accepted definitions of argumentative process and dialogic argumentation with the aim to help understanding the nature of the considered problem. Particular attention is given to Toulmin's argumentation model that plays an important role in this study. This model provides a common focus for analytic methods and pedagogical approaches designed to foster argumentation. Against this background, Leitão's (2000) model of argumentation sequences is then discussed, which together with Toulmin's model contributed to shape the proposed conceptual architecture.

Section 2.4, *Argumentative knowledge construction* analyses different analytical frameworks focusing on formal argumentation structure, nature and function of contributions within the dialogue, argumentation sequences and interaction patterns. The section proceeds by exploring teaching and learning approaches for supporting computer-mediated collaborative argumentation. Against this background, experiences with technologies aimed at scaffolding development of students' argumentation skills are also presented.

Section 2.5, *Specific theoretical perspectives used in this study*, discusses more in details some theories related to learning with knowledge building and collaborative argumentation which inspired the methodological and epistemological design of this study.

2.2. Computer Supported Collaborative Learning: general overview

Computer-supported collaborative learning (CSCL) is an emerging branch of the learning sciences concerned with studying how people can learn together with the help of computers (Stahl et al.2006). According to Lehtinen et al. (1999) two research traditions have strongly contributed to the development of the ideas in computer-supported collaborative learning. The first source is cooperative learning, which can be considered as one of the greatest success stories in the history of educational research (Slavin,1997). The amount and quality of this research field greatly accelerated in the early 1970's and is currently one of the most expanding topics in educational research (see also Damon & Phelps, 1989). The other source of inspiration for the CSCL field originates from the research on Computer-Supported Collaborative/ Cooperative Work (CSCW). This research shed lights on the cooperative nature of work in the networked work context (Baskerville & al.1995; Tuomisto, 1994). Based on the organization theory, CSCW defines collaboration as the process of shared creation: two or more individuals with complementary skills interacting to create a shared understanding" (Schrage, 1990 p. 40).

Stahl (2006) identifies a number of relevant sources which significantly impacted on the historical evolution of CSCL research and theory:

- *Mediated Cognition*: Vygotsky's work from the 1920's and 1930's only became available in English 50 years later, when it proposed a radically different view of cognition and learning as socially and collaboratively mediated.
- *Distributed Cognition*: This alternative developed by a number of writers (e.g., Suchman, Winograd, Pea, Hutchins) also stressed the importance of not viewing the mind as isolated from artifacts and other people.
- *Situated Learning*: Lave's work applied the situated perspective to learning, showing how learning can be viewed as a community process.
- *Knowledge building*: Scardamalia and Bereiter developed the notion of community learning with a model of collaborative knowledge building in computer-supported classrooms.
- *Meaning making*: Koschmann argued for re-conceptualizing knowledge building as meaning making, drawing upon theories of conversation analysis and ethnomethodology.
- *Group Cognition*: the theory of group, developed by Stahl, argues that, in small-group collaboration, the meaning is created across the utterances of

> different people. That is, the meaning that is created is not a cognitive property of individual minds, but a characteristic of the group dialog.

It was particularly the omission of social interaction in computer-based learning environments which worried many educators in the first phase of CSCL evolution (Baker, 1985; Cuban, 1986; Hawkins, Sheingold, Gearhart & Berger, 1982; Isenberg, 1992; Kreuger, Karger & Barwick, 1989; Turkle, 1984). In general, solo-learner models pervaded even within constructivist paradigms (Crook, 1994). Learners' individual benefits of working in groups such as more achievement, higher productivity; and increased factual information were reported (Johnson et al.1986).

During the second phase, 1995-2005, expertise in the design of CSCL systems and activities was accrued (Dillenbourg et al.2008). The emphasis shifted from investigating individuals to examining groups and their social interactions. The interaction paradigm emerged (Baker et al.2007; Dillenbourg & Traum, 1996) The focus of the research was to investigate collaborative processes to identify the interactions that took place, their pattern of occurrence, and how these triggered certain cognitive effects (Dillenbourg2000). The development of specific CSCL applications aimed at supporting critical enquiry skills and knowledge building such as Belvedere (Suthers & Jones, 1997), CoVis (Edelson et al.1996), or CSILE (Scardamalia & Bereiter, 1996) proliferated. Studies with generic tools like forums, emails or chats also took place (Dillenbourg & Fischer,2007). The third phase, 2005 to present, is dominated by the outlook of the disappearance of CSCL as a distinct approach. The field is moving towards a broader conceptualization of CSCL. This is underpinned by the notion of integrated learning which is characterized by scenarios and episodes where the differentiation between activities with or without technology has became trivial (Dillenbourg & Fischer,2007).

In an attempt to distinguish the CSCL and CSCW approaches authors (Dillenbourg,1999; Roschelle & Teasley, 1995; Stahl et al.2006) have argued that the difference resides in how the work is divided and executed by the members of a group. In cooperative scenarios, the work is divided in subtasks which are performed by different members and assembled at the end to obtain the group's output. In collaborative activities, the members of a group work together in a collective effort to complete the tasks. On the one hand, Johnson & Johnson (1999) define cooperative learning as a structured situation in which learners work together towards the achievement of shared goals. They seek mutually beneficial results and help each other to understand by discussing their work. Performance of individual members of the group is checked in order to ensure everyone is contributing and learning (p. 68). On the other hand, Schrage (1990) defines collaboration

as shared creation of understanding involving two or more people with complementary skills (p.40). Furthermore, Roschelle & Teasley (1995, p. 70) sustain that:

> *"Collaboration is a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem"*

These definitions highlight core elements of collaborative scenarios. For instance, Johnson & Johnson specify the need to structure the situation. Putting learners together to perform a collaborative task may not be enough to achieve collaborative learning (Weinberger et al.2008). Though in so doing, spontaneous collaboration leading to learning episodes may take place. Unplanned 'collaborative' activities leave students to flounder, waste time, and fail to yield learning benefits from interaction (Barkley et al.2005). They defeat the purpose of the practice since successful collaborative leaning rests upon effective interactions among learners (Kobbe et al., 2007). The pursuit of a shared goal creates interdependences and group cohesiveness triggering greater personal and group accountability and more commitment towards the fulfillment of the task (Johnson & Johnson2005). Checking performance, similarly to informing the group of the need for homogenous participation reduces social loafing and free riding (Kerr, 1983). The construction of shared understanding invokes the need for effective communication (Meier et al.2007) to reach a common ground in relation to ideas, assumptions and expectations (Clark, 1996). This is an interactive processes that involves the transition from divergent individual perspectives to collaborative knowledge building (Puntambekar, 2006). To this end, three main categories of interactions are said to facilitate learning: explanation, argumentation/negotiation and mutual regulation (Dillenbourg et al.2008). Complementary skills suggest some level of asymmetry of knowledge among people and echo the notion of the Zone of Proximal Development (ZPD). Thus, the difference between what one can do alone and with the help of a more knowledgeable one (Vygotsky, 1978). In sum, the definitions indicate that:

> *"Collaborative learning describes a situation in which particular forms of interaction among people are expected to occur, which would trigger learning mechanisms, but there is no guarantee that the expected interactions will actually occur. Hence a general concern is to develop ways to increase the probability that some types of interaction occur" (Dillenbourg, 1999, p. 7)*

Against this background, Koschamann argues that CSCL investigates collective meaning making, its practices, and how these are mediated by artifacts (2000, p. 18). However, technology by itself, no matter how sophisticated or cleverly designed, cannot change the practices of meaning making (Stahl et al.2006). Research has consistently

demonstrated that technology alone is not an effective teaching and learning tool (Kulik et al.1985). Its function, within the context of learning as a shared construction of understanding, is to mediate collaboration and disambiguate language (Roschelle & Teasley, 1995). It enables the creation of frameworks within which communication takes place in relation to points of shared reference (Crook, 1994), and it provides additional communication channels with which actions as well as verbal interactions constitute communication acts (Roschelle & Teasley, 1995).

Most of the recent research on the use of information and communication technology in education is explicitly considering technology's possibilities to facilitate social interaction between teacher and students, and among students (Calvani & Rotta, 2000; Calvani, 2001, 2004; Calvani et al. 2004). Collaboration and communication is certainly a main idea in network-based learning environments (Trentin, 2006, 2008), but social interaction has also been more and more taken into consideration. In particular, many author point out the fundamental role of a careful planning. Successful implementation of collaboration technologies require both a careful assessment of the fit of the technology to the organization and a well-designed training program to introduce this new technology and its potential to the organization members (Vandenbosch & Ginzberg, 1997; Trentin, 2007).

Brown and Duguid (2000) note that online communities or 'networks of practice' allow for efficient communication of information relating to a shared practice to large numbers of members, however there is little reciprocity; while information is passed on, there is little chance of action being taken or knowledge being produced as a consequence of the existence of the network. The field of distributed/socially shared cognition, like the fields of learning communities and communities of practice, takes the view that knowledge (and learning) is commonly socially constructed, through collaborative efforts toward shared objectives or by dialogues and challenges brought about by difference in persons' perspectives (Midoro, 2000, 2002; Trentin, 2001, 2008). The fields of distributed cognition and socially shared cognition have, as their foundation, the constructivist approach to learning (Resnick, 1991; Salomon, 1993). A constructivist view of learning holds that learning cannot be taught, but must be constructed by the learner. The learner, in making sense of experiences, tests previously held values and attitudes against those of others (opportunities for which are enhanced in a learning community).

CSCL, hence, encompasses a wide spectrum of situations ranging from asynchronous to synchronous and from distance to face-to-face (Stahl et al.2006). As technology develops and more artifacts are being designed for multiple users, the notion of personal computer is fading away and the idea of interpersonal computers is emerging

(Dillenbourg et al.2008). CSCL scenarios are transitioning from computers to the real world and they co-exist in both. In this increasingly varied and changeable context, CSCL scripts emerge as an approach to set up and facilitate effective collaborative learning across virtual and real worlds (Weinberger et al.2008). Scripts attempt to increase the probabilities of knowledge generative interactions, such as explanation or mutual regulation, taking place during collaboration (Dillenbourg & Tchounikine, 2007). They are underpinned by the idea that collaborative learning by itself is neither effective or ineffective (Dillenbourg & Traum,1996). It works under certain conditions which regard a extensive set of factors such as the CSCL tools, the pedagogical scenarios (Dillenbourg 2000), and the emotional plane (De Jong et al.2005). The following section of the literature explores factors at play in collaborative learning situations.

2.2.1. Collaborative learning settings

Collaborative or group learning refers to instructional methods whereby students are encouraged or required to work together on learning tasks. Recent research on the role of collaboration in learning has tried to find deeper theoretical frameworks that could better guide the developing of technology-aided learning environments. A distinction between cooperation and collaboration is conceptually central. This distinction is based on different ideas of the role and participation of individual members in the activity. Cooperative work is accomplished by the division of labor among participants. It is an activity where each person is responsible for a portion of the problem solving, whereas collaboration involves the mutual engagement of participants in a coordinated effort to solve the problem together.

Recent work in CSCL and the learning sciences indicates that learning takes place differently in small groups than when students are working on their own (e.g., Barron, 2003; Cohen et al., 2002; Schwartz, 1995). In the theory of Group Cognition, Stahl (2006) explores the technological and social reconfigurations that are needed to achieve computer supported collaborative knowledge building--group cognition that transcends the limits of individual cognition. Stahl's empirical analysis shows how, in small-group collaborations, the group constructs inter-subjective knowledge that emerges from and appears in the discourse itself. This discovery of group meaning becomes the springboard for Stahl's outline of a social theory of collaborative knowing. The term “building collaborative knowing,” (Stahal, 2006) is derived from the work of Scardamalia and Bereiter (1996), who did much to found the field of CSCL. the phrase is intended to point to a core process in collaboration: a particular way in which a group may construct a new degree of understanding about the topic that they are investigating. This new knowing is something

that the group creates that cannot be attributed to the mental processes of any one individual. As Bereiter (2002) says,

> *The mark of a really successful design or problem-solving meeting is that something brilliant comes out of it that cannot be attributed to an individual or to a combination of individual contributions. It is an emergent, which means that if you look at a transcript of the meeting you can see the conceptual object taking shape but you cannot find it in the bits and pieces making up the discourse. There are, of course, instances where the design or solution does come from one person, but then you have a different kind of meeting, one that is devoted to grasping, accepting and elaborating an idea. The result is still a social product, no matter how much it may bear the stamp of an individual. (p. 283)*

This emergent group phenomenon is of particular interest to a theory of collaboration (Stahl, 2006). The underlined hypothesis is that the building of knowledge, understanding and meaning—learning, broadly speaking—within a group is central to the activity of both cooperative work and collaborative learning. Thus, it is a core phenomenon for the study of computer-supported small-group collaboration, including both CSCW and CSCL. In the following, three specific dimensions will be considered: *group meaning, socio-relational and affective dimensions and, shared objectives.*

2.2.1.1 Group meaning

According to Stahl (op. cit) in small-group collaboration, meaning is created across the utterances of different people: is an essential collective effort that cannot be reduced to the sum of independent individual contributions. In fact, a given utterance in a collaborative knowledge-building discourse refers back and responds to previous utterances, as well as anticipating, projecting and calling future responses (Sfard & McClain, 2003, p. 355). Thus, every contribution to the discourse is a group accomplishment and its meaning is a group construct.. This view implies the importance of how artifacts like groupware are designed.

In order to assess degree of collaborative interaction in group discourse, Sfard (2002, pp. 39-41) developed an “interactivity flowchart” that represents which utterances respond to other utterances or invite a response. Arrows show the interrelations among the utterances, with separate representations of each individual’s “personal channel” and the overall group interaction. Of course, such a diagram only summarizes the primary thrust of each utterance, and cannot show the detailed web of connotations, terminological references or shared indexing that can be brought out by conversational micro-analysis.

The process by which groups construct meaning evolves in terms of Vygotsky's (1978; 1986) *Internalization and Externalization. Internalization* is the generation of cognitive artifacts (Hutchins, 1999; Norman, 1991). Externalization embodies meaning in artifacts. Accordingly, meanings are generally internalized first—from some external, inter-personal, group or social form,- before they can be (re-)externalized. So, external meaning generally precedes internal (Hutchins, 1996), rather than the reverse, which is traditionally assumed.

> *Collaborative learning—as the extending of group knowing—is constructed in social interactions, such as discourse. It is not a matter of accepting fixed facts, but is the dynamic, on-going, evolving result of complex interactions, which primarily take place within communities of people. (314p)*

The building of knowing is always situated. De Jong & Fergusson-Hessler (1996) describe five types of knowledge: *situational*, which refers to knowledge about situations as they normally take place in a domain; *conceptual*, factual knowledge of an area; *procedural*, acceptable actions or manipulations within a field; and strategic, a sequence of actions leading to solutions.

The knowledge available to learners and how this is exchanged is also relevant. Tobin (1990) summarised the value of constructing shared knowledge through peer discussions. This process allows learners to articulate and clarify their own ideas, exposes learners to their peers' views (through attentive listening), and allows learners to evaluate and reflect on their own and others' ideas and see if they are viable. It gives learners an opportunity to justify and defend and possibly debate their own views and allows them to negotiate and make meaning together. The promotion of dialogue and reflection through peer learning is most important: "Social constructivists believe that meaning making is a process of negotiation among the participants through dialogues or conversations" (Jonassen et al., 1999, p. 5).

Peer collaboration provides a supportive environment that encourages students to experiment with and test new ideas, thereby critically re-examining their own conceptions (Damon & Phelps, 1989). It is rich in mutual discovery, feedback and sharing of ideas and is especially useful for tasks that require new insights and the development of knowledge structures.

As concerns to group formation and membership, there are several variations on the group and task arrangements that can influence the interaction in a group and that are relevant to this study. Johnson & Johnson (1999) propose three types of groups. *Formal cooperative learning groups* have a lifespan of a class to several weeks and are

recommended when students need to achieve shared learning goals and complete particular assignments. *Informal cooperative learning groups* are integrated by temporary ad hoc collaborators who work together to obtain shared goals during a shorter period of time, a few minutes or a class. C*ooperative base group*s are characterized by a small heterogeneous membership which provides the continuous peer-support needed to encourage its members to maintain hard work.

The size of a group strongly depends the composition of the group, its duration, and the physical context. Effective collaborative groups are formed by two to six members (Barkley et al., 2005), In formal educational settings five is considered to be an appropriate size (Bean, 1996). However, groups of three are more effective at the beginning of the task to achieve greater engagement (Smith, 1996), and in general to avoid competitiveness among peers (Trowbridge, 1987). The optimal group size is relative however, if the group is too small it may not be able to trigger interaction; if it is too large interactions may not place at all (Dillenbourg et al.1996). For instance, in larger groups individuals are less likely to see their personal contribution as important to the group success (Kerr, 2001) and social loafing is likely to increase (Johnson & Johnson, 2005).

Another way to create individual accountability could be the evaluation of the individual's role during the process (Strom and Strom, 1996). According to Cohen (1994), interdependency should be fostered by presenting challenging tasks and stimulating learner's intrinsic motivation and collaborative skills.

2.2.1.2 Social and motivational factors

In her research, Orlikowski (1992) found that the organisation's culture and the users' understanding of the technology have an impact on the degree to which a groupware technology affects collaboration among group members. Among these, social and motivational factors can impact on groupware in that it interferes with complex social dynamics common to groups. Central to group activity, however, are social, motivational, political and economic factors that are rarely explicit or stable. The main focus is on the reward which is the condition under which students operate.

From a motivational perspective, group members can attain their own personal goals if all the members of the group are successful. In these conditions, group members must both help their group mates to do whatever helps the group to succeed, and to encourage their group mates to exert maximum efforts (Slavin, 1995; Johnson & Johnson1999). Social interdependence differs from social dependence, independence, and helplessness.

In a situation of dependence the actions of learner A influence learner B's actions but the reverse does not apply; in independence, actions by either learner do not affect the other; in helplessness, neither learner can affect the achievement of the goal (Johnson & Johnson, 2005).

Social interdependence influences on the sense of responsibility, accountability, and group cohesiveness: the more learners perceive their contributions is unique for the group, the more they will contribute to it (Johnson & Johnson, 2005). Hence, high individual accountability, clear distinction of contributions, elimination of redundant efforts, group cohesiveness, and responsibility for the final outcome reinforce the group cohesion (ibid).

Asymmetries of action and status (Dillenburg, et al.1996) also impact on the affective and motivational aspects of working together. In particular, they indicate the need for a sense of community in which an open and sensitive atmosphere are preconditions for collaborative learning (Weinberger et al.2008). In groups, competitive and individual behaviour should be deterred because they cause inaccurate communication, stereotyped and static views of others (Johnson & Johnson2005). As pointed out above, the group cohesiveness (and symmetry of action and status) promotes commitment towards the achievement of the shared goals, personal responsibility, motivation, persistence on the task, and greater likelihood that peers will be influenced by each other and the facilitator (Johnson & Johnson,2006); peers feel they ought to do their part, provide input, and adhere to the group's rules.

Keller (1987b) suggests motivation as composed of two dimensions: the choices one makes and the effort needed to pursuit those choices. Motivational design is concerned with setting the conditions, arranging resources and procedures, likely to bring about changes in motivation (Keller, 1988). As it applies to the education field, four aspects of motivational design are considered: Attention, Relevance, Confidence, and Satisfaction. *Attention* can be gained both by provoking curiosity and exposing learners to unexpected and unusual situations (ibid). In order for learners to perceive the *relevance* of the task, language and experience they are familiar with should be used (Keller, 1987a). *Confidence* can be accommodated by providing feedback and endorsing learners with control over their learning process and self-assessment (ibid). finally, *satisfaction* refers to the reward learners obtain, such as sense of achievement, praise, or simple entertainment (Keller, 1987a).

Dynamics of symmetries of action and status are central to the intentional design and are influenced by the nature of the task, the division of labour among group members, and the group workflow.

Intentional design (Barkley et al.2005, p. 4) underlines that, although collaborative partners are to take responsibility for their own learning, the onus for defining and structuring tasks that will allow them to do so rest on the instructors.

Fundamental for symmetry of status, and core to symmetry of action, is that all members of the group hold the same status (Dillenbourg 1999). Successful collaborative interactions are characterised by constructive interpersonal relationships (Meier et al.2007), and peers should be taught and motivated to use interpersonal skills. In order to coordinate their effort and achieve shared goals, group members must become acquainted with each other, communicate accurately and unambiguously, accept and support each other, and resolve conflict constructively (Johnson & Johnson2006).

2.2.3. CSCL and Social Technology Influence

Recently, a variety of new tools and technologies fostering computer-supported collaborative learning (CSCL) and computer-supported cooperative working (CSCW) appeared and established themselves on the Internet (Beldarrain 2006; Bryant 2006). This development is frequently referred to as Web 2.0 (Bridsall 2007; Murugesan 2007). On the one hand, the term Web 2.0 describes a set of new interactive technologies and services on the internet (Richardson 2006). On the other hand, it refers to a modified utilization of information (Tredinnick 2006).

What is of particular importance in the Web 2.0 context for CSCL researchers is the integration of so-called social software (Kesim and Agaoglu 2007; Kolbitsch and Maurer 2006). Social software refers to systems which facilitate human communication, interaction, and collaboration in large communities (Wagner and Bolloju 2005; Ward 2006). These systems support the constitution and maintenance of self-organizing social networks and communities (Köhler and Fuchs-Kittowski 2005; Lin et al. 2006; Moore and Serva 2007; Wasko and Faraj 2005). Weblogs (blogs), file-sharing communities, and especially wikis loom large in this social-software context (Wagner and Bolloju 2005). Whereas others Web 2.0 systems mainly serve for pooling information (e.g. Blogs, file sharing etc.,), *wikis* have special potential for computer-supported collaborative knowledge building and learning (Bruns and Humphreys 2005; Chong and Yamamoto 2006; Kim et al. 2006; Reinhold 2006; Wang and Turner 2005; Yukawa 2006).

Social presence model proposed by (Short et al., 1976) states that the most significant factor in the communication medium is its social presence. In addition, reduced social cues approach claims that certain characteristics associated with CMC encourage psychological states which challenge the social influences on individuals or groups thus leading to intense anti normative behaviour (Kiesler et al.,1984). It is evident that there is scholarly consensus that adherence to social cues is decreased in CMC (Kiesler et al., 1984). However, it has also been suggested that CMC accentuates behaviour under social influence (Lea and Spears, 1992). Some research has been conducted regarding computer mediated argumentation, but mostly in the context of collaborative construction of knowledge rather than mere discussion.

The social network provides opportunities for the individual learner to create sound and viable knowledge syntheses from fractured and inchoate information. The generation of viable ideas, sharing of common classes of problems and the mutual pursuit of solutions enables individuals to aim toward a common goal of knowledge creation (Owen, Grant, Sayers & Facer, 2006).

2.2.3.1. Wikis and "the architecture of participation"

Knowledge creation through user-created content is currently capturing the imagination of students and teachers alike, and one social software tool—the wiki—is developing quickly as a favourite in all sectors of education (Horizon, 2007). The word 'wiki' (from the Hawaiian wiki wiki, by Ward Cunningham in 1995) is translated as 'to hurry', and wikis certainly enable rapid and easy authoring direct to the Web. Wiki pages can be used by all to publish new content direct to the Web, including text, images and hyperlinks; to edit existing content; and also, because the wiki is fluid and open to all, to 'roll back' if necessary to previous versions through a 'page history' utility. Students can develop their own knowledge content with alacrity using a wiki and seldom need to study alone because of participation in a technologically mediated social space conducive to the formation of communities of practice (Boulos, Maramba & Wheeler, 2006).

This "architecture of participation" (Barsky & Purdon, 2006, p. 65), the generation and sharing of digital artefacts by groups, teams and individuals, ensures that Web 2.0 is responsive to users. It thrives on the concept of collective intelligence, or "wisdom of the crowds" (Surowiecki, 2004), which acknowledges that when working cooperatively and sharing ideas, communities can be significantly more productive than individuals working in isolation.

Wikis enable students to collaboratively generate, mix, edit and synthesize subject specific knowledge within a shared and openly accessible digital space. The combined knowledge of the group—dubbed 'the wisdom of the masses'—is assumed to be greater than that of the individual, and the group that creates the wiki space is the same group that reads it (Owen et al, 2006). While this 'architecture of participation (O'Reilly, 2004) has obvious attractions to the digital generation, what is contentious is the extent to which lay-generation of digital artifacts is accurate and appropriate to professional education. Doubt also hangs over the concept of student created content and whether it will ever be legitimized by the traditional education establishment. Patently, there is a sea of issues within which wiki activities are found to be afloat.

Perhaps the most important issue for educators derives from the user generated nature of the wiki and the potential problems associated with it. There are no guarantees for accuracy and veracity on a wiki, although a recent survey conducted through the journal Nature found that Wikipedia, one of the most popular wiki knowledge repositories, is at least as accurate as Encyclopaedia Britannica (Terdiman, 2006). Wikis are susceptible to vandalism (virus) attacks (Terdiman, 2006) so those moderating their use must be

vigilant. Although the openness of wikis creates opportunities for the deliberate sabotage, Owen et al (2006) point out that there is often a critical mass of users who have sufficient ownership of the wiki to quickly intervene and clean up unwanted postings and recover the site. RSS (Really Simple Syndication) feeds alert community members to any changes that have been made to content, so that validation of the entries can be undertaken quickly and effectively. 'Roll-back' correction facilities can be used to restore the page to a previous condition if, for any reason, the additions need to be rejected.

2.2.3.2. Some pedagogical applications of wikis

A number of high-level thinking skills and socially rich activities could result from the use and management of wikis. A few teachers are already exploiting the potential of wikis to transform the learning experience into one in which student centered learning can be facilitated. The wiki may become a focal point of interest for developing communities of practice, within which they can store their treasure house of knowledge about their specific interests and learning. In classroom learning, teachers will need to encourage all members to contribute thereby fostering a sense of community, but it is inevitable that some students will contribute more content than others. Social loafing is sometimes observed where the contribution rate for some students is disproportionate to others. However, providing all members are deemed to have contributed something within a defined period, teachers might adopt a laissez-faire attitude. Previous studies have shown that some students learn even when they do not directly contribute to a message board, which has been termed 'lurking' (Beaudoin, 2002).

Usually, wikis are used for writing and revising text. Users can create content, hyperlink it with other content, and add, delete and change any part of the text as they please (Raitman et al. 2005). This way, a group of users can jointly create one digital artefact, and this activity will facilitate the collaborative development of knowledge (Fuchs-Kittowski & Köhler 2005; Köhler & Fuchs-Kittowski 2005). These characteristics make wikis a valuable technology for many purposes, especially in educational contexts (Bruns & Humphreys 2005; Wang &Turner 2004; Chong &Yamamoto 2006; Notari 2006; Trentin 2009). Some researchers have drawn attention to the potential of wikis for collaborative learning: Chong and Yamamoto (2006) refer to the ability of wikis to facilitate debate-based learning. Reinhold (2006, p. 47) assumes that wikis 'facilitate collaborative finding, shaping, and sharing of knowledge'. Wikis do indeed support various processes involved in learning as they facilitate collaborations between different people (Han et al. 2006; Notari, 2006). They have also been associated with higher inventiveness (Guzdial et al. 2001), with the concept of design-based learning (Rick &

Guzdial 2006), or with inquiry learning and co-reflection by other learners (Yukawa 2006).

Trentin (2009) points out another critical issue which arises in the educational use of collaborative learning that is the teacher's difficulty in evaluating the contribution and participation of each student in group-work. To this end, the author elaborated a methodology that enables evaluation of the collaborative learning process based on co-writing in a wiki environment.

Wikis offer appropriate environments within which students, who are separated geographically from one another, can develop social ties. Teachers may cause distributed groups to 'draw together' by encouraging each physically dislocated member to create a specific section or 'stub' on the wiki, so that others are then able to add to it over the life of a course of study. Individual students can be assigned the task of finding relevant and reliable websites they can hyperlink back to the main wiki. Each student can also be assigned a specific time period during which they have responsibility to 'patrol' the wiki to ensure it has not been sabotaged or defaced in some way.

2.2.3.3. Wikis for collaborative argumentation

According to Scardamalia and Bereiter's emphasis on the importance of knowledge-creating competencies "in a knowledge society" (Scardamalia 2002, p. 67), it is important to systematically analyze the potential of new tools (such as wikis) for knowledge building. Wikis are web sites which allow users not only to have access to its content but also to change the content online (Leuf and Cunningham 2001; Raitman et al. 2005). Wikis are not only available in the WWW but can also be implemented in intranets or on local computers. Wikis do not require software, are easily accessible, and are simple to use for everybody (Désilets et al. 2005).

These qualities make wikis valuable tools for a multitude of purposes (Joyce 2005). Wikis are used for knowledge-management (Fuchs- Kittowski and Köhler 2005; Wagner 2006; Wagner and Bolloju 2005) as well as for educational purposes (Bruns and Humphreys 2005; Chong and Yamamoto 2006; Notari 2006; Wang and Turner 2005); in economical (Wagner and Majchrzak 2007) or in political contexts (Makice 2006). Wikis are mostly used to develop written text. Their special feature is that people can do all kinds of revision of the text: they can create hyperlinks and fill them with content, they can revise a text by adding, deleting, or changing any parts they want to (Raitman et al. 2005). In this way, large groups of like-minded people are able to work collaboratively on one and the same text about a certain topic. In wikis, all users jointly create one hypertext,

an activity which allows the collaborative generation of knowledge (Fuchs-Kittowski and Köhler 2005; Köhler and Fuchs-Kittowski 2005).

Wikis' potential for collaborative learning lies in their ability to allow for debate-based learning experiences (Chong and Yamamoto 2006) or to facilitate shaping of knowledge (Reinhold 2006). Wikis can be regarded as media which support learning due to their ability to facilitate collaboration (Kim et al. 2006; Notari 2006), to allow for design-based learning (Rick and Guzdial 2006), to enhance inventiveness (Guzdial et al. 2001), and to support inquiry learning and the co-construction of knowledge (Yukawa 2006). Overall, wikis can be considered to support social constructivist learning in general (Bruns and Humphreys 2005).

2.3. Argumentation

Argumentation exists from way before the 19th century, where the Aristotle's logical theory is found first. This indicates that argumentation was an important factor already in society. Until the 1950s, the approach of argumentation was based on rhetoric and logic.

In the United States debating and argumentation became an important subject on universities and colleges. Textbooks appeared on 'Principles of Argumentation' (Pierce, 1895). In the 1960s and 1970s Perelman and Toulmin were the most influential writers on argumentation. Perelman tried to find a description of techniques of argumentation used by people to obtain the approval of others for their opinions. Perelman and Olbrechts-Tyteca called this 'new rhetoric'. Toulmin, the other influential writer developed his theory (starting in 1950's) in order to explain how argumentation occurs in the natural process of an everyday argument. He called his theory 'the uses of argument'.

Argumentation theory cannot be seen as the theory for argumentation. Various authors have used the argumentation theory all in a slightly different way; it is not to say which version is the most developed. The terms argument and argumentation reflect the two senses in which the term argument is used, as both product and process. An individual constructs an argument to support a claim. The dialogic process in which two or more people engage in debate of opposing claims can be referred to as argumentation or argumentative discourse to distinguish it from argument as product. Nonetheless, implicit in argument as product is the advancement of a claim in a framework of evidence and counter claims that is characteristic of argumentative discourse, and the two kinds of argument are intricately related (Billig, 1987; Kuhn, 1991). Most of the empirical research on argument has been devoted to argument as product.

Recently, however, this picture has begun to change, reflected in a landmark special issue of the journal Discourse Processes (Voss, 2001) that contains articles on argumentative discourse and its development.

2.3.1. Defining the Argumentative Process

Within the emerging multidisciplinary field of Argumentation Studies (van Eemeren, 2001; van Eemeren et al., 1996) argumentation tends to be defined in terms of social purpose, rather than according to the rules of formal logic:

> *Argumentation can be defined as a verbal, social and rational activity aimed at convincing a reasonable critic of the acceptability of a standpoint by advancing a*

constellation of propositions justifying or refuting the proposition expressed in the standpoint. (van Eemeren, 2001: 11)

In educational studies, the social function of argumentation has been similarly emphasized – both with regard to its role in building disciplinary knowledge and its role in facilitating students' learning and understanding of disciplinary knowledge (see Costello, 1995; Mitchell, 1994; Mitchell&Andrews, 2000; Riddle, 1997). In particular Mitchell asserts that argument is about 'bringing difference into existence' and that from a students' point of view, this can be a difficult task. Not only do students have to acquire the discourse of the discipline and 'to manage the actual voices and meanings of others in the forms of citations and references to existing writers in the field' but in addition they have to go 'beyond this, to construct an argument out of and in response to these voices' (Mitchell, 1994: 21). As Mitchell (1994) points out, the result of this process can be the suppression of the student's voice whereby the writing may contain arguments of others but not present itself a strong argumentative line.

Even young children show some competence in producing arguments in support of a claim (Anderson, Chinn, Chang, Waggoner, & Yi, 1997; Clark & Delia, 1976; Eisenberg & Garvey, 1981; Orsolini, 1993; Stein & Miller, 1993) and in understanding the structure of an argument (Chambliss & Murphy, 2002). Educational studies have documented that constructing arguments (Voss & Wiley, 1997; Wiley & Voss, 1999; Zohar & Nemet, 2002) and engaging in argumentive discussion (Mason, 1998, 2001) enhance conceptual understanding of subject matter in school-age children, as well as college students. Nonetheless, serious weaknesses have been observed in the arguments of adolescents and young adults. They are unlikely to construct two-sided arguments or to distinguish evidence and explanation in support of their claims (Brem & Rips, 2000; Kuhn, 1991, 2001b; Kuhn et al., 1997; Perkins, 1985; Voss & Means, 1991). College students show some skill in evaluating arguments (Rips, 2002) but also significant weaknesses, especially in susceptibility to belief bias (Klaczynski, 2000). The evidence available regarding argumentive skills in classroom discourse is consonant with this picture. Pontecorvo and Giradet (1993) reported that the large majority (81%) of utterances by small groups of 9-year-olds asked to reach agreement about a historical claim were devoted to espousing their own claims and justifications of them. Instructional units devoted to construction of arguments have been found productive in enhancing the quality of arguments supporting a claim (Hidi, Berndorff, & Ainley, 2002; Knudson, 1992).

Consistent with the theoretical perspective indicated earlier, however, Kuhn et al. (1997) and Lao and Kuhn (2002) have shown that extended engagement in argumentative discourse, in the absence of any additional instruction, is a sufficient condition for

enhancement of the quality of arguments produced by individuals following discourse. Studies by Anderson and colleagues (Anderson et al., 1997; Anderson, Chinn, Waggoner, & Nguyen, 1998; Anderson et al., 2001; Chinn & Anderson, 1988; Reznitskaya et al., 2001), which are discussed in more detail later, also support this conclusion. According to Walton (1989), skilled argumentation has two goals. One is to secure commitments from the opponent that can be used to support one's own argument. The other is to undermine the opponent's position by identifying and challenging weaknesses in his or her argument. Drawing on Walton's analysis, Felton and Kuhn (2001) identified two potential forms of development in argumentative discourse skills: enhanced understanding of discourse goals and application of effective strategies to meet these goals. To examine development in argumentative discourse skills, Felton and Kuhn (2001) conducted across-sectional comparison of the dialogues of young teens and community college young adults arguing about capital punishment (CP). The results revealed striking differences between the two groups. Teens' discourse focused largely on the arguments supporting their own position, at the expense of addressing the arguments of their opponents. Adults, in contrast, in addition to advancing their own arguments, were more likely to address the opponent's argument, most often through counterargument. In undertaking to undermine their opponent's argument, as well as advance their own argument, adults' dialogues thus came closer to achieving the dual goals of argumentative discourse. These appear to be skills that need to develop during child hood and adolescent years. Deep-level processing of the opponent's argument, in addition to articulating one's own argument and negotiating the mechanics of discourse, may represent cognitive overload for the novice arguer.

Kuhun & Udell (2003) claim the emergence of a dialogic dimension in participants' individual arguments. The point is an important one for it suggests that a dynamic, dialogic approach is the best way to support the development of skilled argument. If individual arguments supporting a claim are conceptualized as 'interiorized' dialogic argument (Billig, 1987; Kuhn, 1991), then the externalization that discourse offers should provide the most effective support for the development of both forms of argument skills. They are of course not the first to make this claim.

Beginning with Vygotsky (1981), numerous authors have emphasized the value of external social collaboration in promoting more advanced forms of individual reasoning. Most notable among researchers to adopt this perspective with respect to argument are Anderson, Reznitskaya, and their colleagues. Reznitskaya et al. (2001) engaged school-aged children in small-group discussions (with 6–10 children per group) of a story and demonstrated that subsequent written arguments in support of a claim showed improvement in quality relative to those of a control group.

Reznitskayaet al. did not assess argumentative discourse directly but noted that it would be important to do so. However, Kuhn and De Fuccio (2002) showed that gains are not limited to the topic or content of the intervention, a critical step in cognitive intervention research (Sa, West, & Stanovich, 1999; Stanovich, 1999). Anderson et al. (2001) examined discourse in their6- to 10-child groups of fourth graders discussing a story. Group size precluded use of the kind of discourse coding scheme employed here and by several other researchers (Keefer et al., 2000; Rips etal., 1999) that tracks the precise relation between one speaker's utterance and another's reply (because in groups it is often not clear whether an utterance is directed at any particular individual or subgroup of individuals) counterargument.

> *''Collaborative discussion appears to be an effective training ground for the development and internalization of generalized knowledge of argumentation,''*

concluded Reznitskaya et al. (2001, p. 173). If discourse is indeed the social scaffold from which individuals' argumentative reasoning develops, it stands to reason that analysis of its development is of interest not only in its own right but because of he insight it promises into the developing cognitive competence of individuals, a more traditional topic of psychological investigation.

In the present context, it is enough to suggest that the developmental research presented here offers a contribution devising more comprehensive indicators of educational achievement than those represented by the traditional assessment instruments educators continue to rely on so heavily (Bereiter, 2002; Yeh, 2002). Learning and cognitive development indeed come together at this point.

2.3.2. Dialogic argumentation

Over the last decade, sophisticated online learning environments have been developed to support students engaging in dialogic argumentation. Dialogic argumentation focuses on the interactions of individuals or groups attempting to convince one another of the acceptability and validity of alternative ideas. Engaging students in dialogic argumentation is considered a powerful mechanism for increasing students' understanding of challenging concepts (e.g., Andriessen et al. 2003; Hogan et al. 2000; Leitão 2000; Driver et al. 2000) as well as for increasing students' ability to engage in productive argumentation and reasoning practices (e.g., Baker 2003; Bell 2004; Kuhn et al. 1997; Teasley 1997).

Scripts and awareness heightening tools Scripts are tools embedded into technology enhanced learning environments that enable designers to specify, sequence, and assign

roles or activities for students (Fischer et al. 2007; Weinberger 2003) in order to foster productive argumentation. These tools, which are based on O'Donnell's (1999) scripted cooperation approach, are often used to scaffold learners' construction of an individual argument or to guide learners through a specific argumentation sequence (e.g., Stegmann et al. 2006). Scripts can also group students with opposing perspectives together into the same discussion forum (e.g., Clark and Sampson 2005, 2007a, b; Jermann and Dillenbourg 2003). Awareness heightening tools, on the other hand, provide feedback to learners about the quality of their interactions in order to foster more productive argumentation (Jermann et al. 2001). These tools can heighten awareness in terms of the number of words contributed or utilize sophisticated computer-based text analysis technology to provide feedback based on automated analysis of students' argumentation (Dönmez et al. 2005; Erkens and Janssen 2006; Jermann et al. 2001). Participants can use this feedback to modify how they interact with others (Hesse 2007). The data gathered by these awareness heightening tools can also allow the environment to actively modify other structural features to scaffold the learners in terms of script implementation, group organization, or data access.

2.3.3. The Toulmin's model

Toulmin's scheme for the layout of arguments (Toulmin, 1958) represents an influential tool for the analysis of arguments. Pursuing his belief that traditional logic is incomplete as a tool of rationality, Toulmin published *Uses of Argument* in 1958. His chief purpose in writing The Uses of Argument in the late 1950s was to relate traditional philosophical paradoxes to the standing contrast between 'substantive' and 'formal' aspects of reasoning and argument.

One of the most fundamental concepts in Toulmin's perspective is that of *argument fields*. Practical argument, he asserts, is a tool that is used in a variety of different fields, and some aspects of arguments vary from field to field. These he calls "field-dependent" aspects of argument. Other elements of argument are the same from one field to another; Toulmin calls these elements "field invariant." Toulmin believes that the ideal of formal logic assumes that all aspects of argument are field invariant. Formal logic assumes that mathematics (particularly geometry) is the standard by which arguments in all fields can be judged:

> *"These special characteristics of their first chosen class of arguments [mathematics] have been interpreted by logicians as signs of special merit; other classes of argument, they have felt, are deficient in so far as they fail to display all the characteristic merits of the paradigm class. . . . Many of the current problems in*

the logical tradition spring from adopting the analytic paradigm--argument as a standard by comparison with which all other arguments can be criticized"[Uses of Arguments, pp.145].

But since all fields of human activity are not based on assumptions identical to those of mathematics and geometry, logical arguments are largely irrelevant to the practical world of rationality. Because they are derived from mathematical fields, analytic arguments are highly impersonal. The person "doing" logic is no more important to formal logic than the person "doing" mathematics is to the formula for determining the circumference of a circle, for example. In contrast, the person engaging in argument is extremely important in rational assessment in the practical world. Rational procedures, according to Toulmin, "do not exist in the air, apart from actual reasoners: they are things which are learned, employed, sometimes modified, on occasion even abandoned, by the people doing the reasoning."[pp.212] Toulmin does not conclude that analytic logic needs to be abandoned completely; he simply sees its range of applicability as much narrower than many philosophers have claimed: "This is not to say that the elaborate mathematical systems which constitute 'symbolic logic' must now be thrown away; but only that people with intellectual capital invested in them should retain no illusions about the extent of their relevance to practical arguments [pp.185].

Another reason Toulmin considers formal logic to be largely irrelevant to practical argument is that formal logic assumes concepts do not change with time. For an argument, to be considered valid in formal logic "it must surely be good once and for all"[184]. Toulmin believes, however, that most argument fields cannot accommodate "timeless" claims to knowledge. He phrases this claim in a question to which he provides the answer: "Can one cast into a timeless mathematical mould the relations upon which the soundness and acceptability of our arguments depend, without distorting them beyond recognition? I shall argue that this cannot be done."[pp.182] Even in a highly specialized science such as astronomy, the requirement that analytic arguments be "timeless" is problematic. One difficulty with the application of absolutism to practical problems is that answers are either "correct" or "incorrect" instead of "probably correct" or "probably incorrect." Many of the questions that rational procedures are designed to answer cannot be answered with certainty. *Did George Bush lie to the American public when he said, "Read my lips--no new taxes"? These answers are probably, but not certainly, yes*.

2.3.3.1. Toulmin's layout of Argument (micro-structure)

The element of Toulmin's theory that is most well known is his layout of practical argument, which he believes avoids formal logic without resorting to relativism.41 This layout of argument was developed from his concern for the justificatory function of substantive argumentation [pp.6]. The primary use of substantive arguments is to justify claims rather than to infer claims from evidence. Justification is a retrospective activity, while inference is a prospective one. In other words, justification of a claim involves producing reasons for a claim after the fact of arriving mentally at that claim. Inference, on the other hand, refers to the uses of reasons to arrive at a claim and is the province of analytic argumentation. From the perspective of justification, reasoning is less a way of hitting on new ideas for what is to be used ad imaginations--than it is a way of testing and sifting ideas critically. Even in the sciences, where one of argument's functions is discovery (or inference), justification plays an important role in argument. As Toulmin claims: "The making of discoveries may be one facet of the scientist's professional work, but the justifying of his discoveries--by the presentation of 'acceptable' supporting arguments--is another, complementary facet of this same work" (Toulmin, Human Understanding, p. 313).

The scheme enriches the traditional premises-conclusion model of arguments by distinguishing additional elements, like warrant, backing and rebuttal. In recent research on defeasible argumentation (cf. e.g. the work of Pollock, Reiter, Loui, Verheij, Vreeswijk, Prakken), arguments are evaluated in terms of a so-called dialectical interpretation of their assumptions. In such an interpretation, an argument's assumptions can be evaluated as defeated, e.g., when there is a defeating reason against the assumption. More specifically, this Verheij (2003) contains a formal elaboration of Toulmin's scheme, and extends it with a treatment of the formal evaluation of Toulmin-style arguments, which Toulmin did not discuss at all.

In his book The Uses of Argument, Stephen Toulmin (1958) has argued that arguments need to be analyzed using a richer format than the traditional one of formal logic in which only premises and conclusions are distinguished. He has proposed a scheme for the layout of arguments that in addition to data and claim distinguishes between warrant, backing, rebuttal and qualifier.

As an illustration, Toulmin discusses the claim that Harry is a British subject. The claim can be supported by the datum that Harry was born in Bermuda. That there is a connection at all between datum and claim is expressed by the warrant that a man born in

Bermuda will generally be a British subject. In turn, the warrant can be supported by the backing that there are certain statutes and other legal provisions to that effect. The warrant does not have total justifying force, so the claim that Harry is a British subject must be qualified: it follows presumably. Moreover there are possible rebuttals, for instance when both his parents were aliens or he has become a naturalized American. Schematically, the result is as in Fig. 3 (Toulmin, 1958, p. 105).

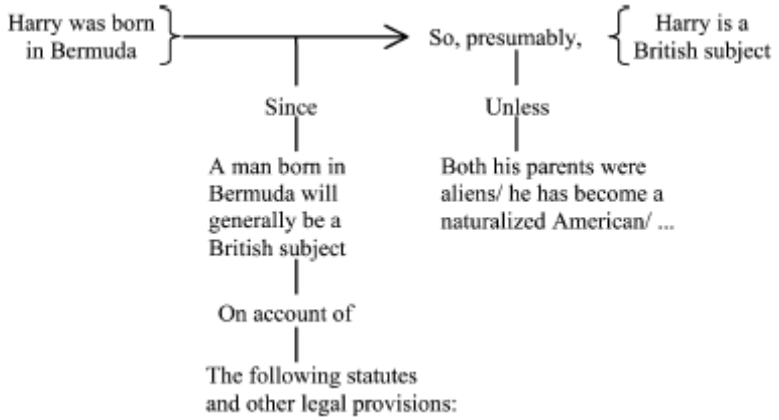

Fig. 3 - An example of Toulmin's scheme for the layout of arguments

Toulmin's scheme for the layout of arguments has had a continuing influence on argumentation researchers (cf., e.g., van Eemeren et al. (1996, pp. 129–160), Bench-Capon (1997)).

Its general form is shown in Fig. 4**Errore. L'origine riferimento non è stata trovata.** (Toulmin, 1958, p. 104):

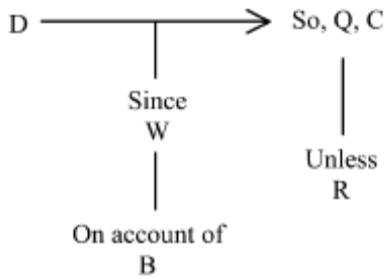

Fig. 4 - The general form of Toulmin's scheme for the layout of arguments

Toulmin presented a model that describes the constitutive elements of argumentation and represents the functional relationships between them. This account is still influential and, in recent years, it as been drawn on increasingly by science educators (and educators in other subject areas) provide a template for the description of students'

arguments (Druker, Chen, & Kelly, 1996; Jime´nez-Aleı´xandre, Bugallo-Rodrı´guez, & Duschl, 1997; Krummheuer, 1995; Russell 1983).

Essentially, Toulmin's model specifies the components in reasoning from data to a conclusion or knowledge claim. The main components identified by Toulmin are:

- *Data*: these are the facts that those involved in the argument appeal to in support of their claim.
- *Claim*: this is the conclusion whose merits are to be established.
- *Warrants*: these are the reasons (rules, principles, etc.) that are proposed to justify the connections between the data and the knowledge claim, or conclusion.
- *Backing*: these are basic assumptions, usually taken to be commonly agreed that provide the justification for particular warrants.

Based on this model, the basic structure of argument as represented in sentences is thus:

because (data) . . . since (warrant) . . . on account of (backing) . . . therefore (conclusion).

In addition, Toulmin identified two other features in more complex arguments:

- *Qualifiers*: these specify the conditions under which the claim can be taken as true; they represent limitations on the claim.
- *Rebuttals*: these specify the conditions when the claim will not be true.

Good points of Toulmin's work were his emphasis on the following:

- In argumentation, the warrants of arguments can be at issue and their backings can differ from domain to domain.
- Arguments can be subject to rebuttal in the sense that there can be conditions of exception.
- Arguments can have qualified conclusions.
- Other kinds of arguments than just those based on the standard logical quantifiers and connectives (for all x, for some x, not, and, or, etc.) need to be analyzed.
- Determining whether an argument is good or not involves substantive judgments and not only formal.

Since the appearance of Toulmin's book, all of these points have found increasing support in different research communities (under the direct influence of Toulmin or independently). Notwithstanding Toulmin's critical stance towards formal logic, in the present paper, a formal elaboration of Toulmin's central ideas will be given.

Toulmin's analysis, however, is limited as, although it can be used to assess the structure of arguments, it does not lead to judgments about their correctness. As he himself pointed out, it is necessary, if judgments of this kind are to be made, that subject knowledge is incorporated for arguments to be evaluated. Furthermore, Toulmin's scheme presents argumentation in a de-contextualized way. No recognition is given to the interactional aspects of argument as a speech event, or that it is a discourse phenomenon that is influenced by the linguistic and situational contexts in which the specific argument is embedded. In analyzing actual arguments it is necessary to take these factors into account, and therefore, some interpretation of the text is necessary. For example: (i) the same statement may have a different meaning in a different context, so the context needs to be taken into account in inferring meaning; (ii) parts of arguments such as warrants are often not explicitly stated in speech but are implicit; (iii) in the natural flow of conversation points are not necessarily developed sequentially and reference has to be made across extensive sections of the text to identify features of the argument; and (iv) not all points are made through speech as some are made through semiotic gestures, pointing at objects, nodding, etc., especially in science where manipulable materials are used. Moreover, illustrations and graphics are no longer supplementary but a central communicative feature of texts.

The social relations within the group developing an argument also need to be taken into consideration. For instance, are they contributing to the co-construction of a single argument? Are they developing their separate lines of reasoning? How do the assumed roles of the different members of the group influence the way the argument progresses and the progress made by the group? As a result of many studies of learning in groups it is now recognized that understanding in such situations is a product of both cognitive and social factors (Alexopoulou & Driver, 1997; Richmond & Shriley, 1996) and, in order to interpret the products of group discussion, both these dimensions need to be taken into account in the analysis.

A number of further approaches to argumentation theory have been developed. In some cases the theoretical position is a purely descriptive one—the approach being to provide an analytical account of argument as it is practiced. Kuhn (1993), in her research into the arguments used by young people and adults about social issues, used a framework for dialogic argument that included: describing and justifying theories; being able to present alternative theories; being able to present counterarguments; and being able to provide rebuttals.

In contrast, Cerbin (referred to in Marttunen, 1994) chose to emphasize the skills of recognizing, composing, and evaluating arguments. His proposals are based on

Toulmin's analysis of the components of an argument (a claim, grounds for the claim, warrants, backing, a qualifier and rebuttal) and he argued that a person who is skilled in informal argumentation possesses the ability to identify these components and to evaluate them. Any evaluation of argument must focus on: (a) the clarity of the claim; (b) the relevance and sufficiency of the grounds; (c) the relevance of the warrant; and (d) whether exceptions have been taken into account in drawing conclusions and whether counterarguments have been presented.

All of these more recent developments in argumentation theory indicate that argument *is socially situated.* Hence, any educational program designed to enhance processes of argumentation will require not only cognitive models of argument, but will also need an understanding of the social and cultural settings in which argument is carried out. In education, therefore, it is necessary to pay attention not only to the ways in which students understand the argument process, but also to the social skills necessary for conducting arguments in groups.

2.3.3.2. Argumentation sequence (macro-structure)

The presence of sequences or argumentation cycles containing counter-argumentation in discussion is a matter of extensive empirical record in various settings. For instance, in the context of face-to-face discussions, Pontecorvo (1987; Orsolini and Pontecorvo, 1992) found that elaborate oppositions are often followed by elaborate counter-oppositions (and also by further counter-oppositions). To quote one example, in the context of pre-school children discussing two different tasks (scientific and narrative) in small or large groups (face-to-face), Orsolini and Pontecorvo (1992) found that disputes (essentially, counterarguments) have the effect of eliciting explanations. Similarly, sequences of claims, oppositions and counter-opposition turns between discussants were found to produce a need for justification and consequently explanation in children, as described by Pontecorvo (1987). Pontecorvo (1993), in her review of research concerning social interaction in knowledge construction, further elaborated on this effect, claiming (pp.301-302) that "oppositional interaction supports children's efforts to produce 'good' arguments, to make explicit certain passages, and to go deeper into the meaning of the discourse." There is also some research that points to further polarization of an original opinion after a counter-argument has been examined, i.e. changes in the opposite direction (e.g., Kuhn, 1991).

To the scope of this study, Leitão's (2000) sequence model has been considered in that it is one of the most influential and well-elaborated models regarding the effect of counter-arguments in the context of collaborative knowledge building (see Section.

Leitão considers counter-argumentation to be "a basic developmental mechanism", and further argues (p. 33) that "the experience of being opposed releases processes of belief reappraisal that enable people to move on from old (already existing) to new perspectives on a topic". The basic unit used in her model to analyze such processes is a three-part sequence, in which the first element is n argument (A), the second is a related counter-argument (CA) and the third is a reply to this counter-argument (R).

In Leitão's model, counter-arguments can be categorized as *supporting the other side of the question, bringing the truth of a claim into question, or questioning a reason, position link*. Similarly, the response, or reply to counter-arguments can assume four different forms:

1. *dismissal*, in which the information conveyed in the counter-argument is dismissed, and the original argument remains more or less as it was;
2. *local agreement*, in which there is some (minor agreement) with the counterargument (or elements thereof), though the previous position is still defended and the original argument stands (more or less);
3. *integrative reply*, in which the content of the counter-argument is integrated into the original argument by allowing some exceptions or conditions to the original position, and/or by changing the degree of certainty associated with the original argument (e.g., confessing less certainty, cf. Baker, 2003), and/or rephrasing the original argument or the counter-argument (lexical changes, may be related to negotiation of meaning, see Pontecorvo, 1993 and Baker, 2003); or
4. withdrawal of the initial view, altogether.

According to this model, therefore, a counter-argument does not have to be fully accepted or fully rejected – there remains the possibility of modifying, restricting, and/or specifying positions so that more integrative arguments are created ("new forms of knowledge"). More drastic changes in position, such as withdrawing an argument completely, are less likely to occur in a discussion. However, "more subtle forms of revision of the speaker's position do commonly occur during argumentation, as seen in integrative replies." (Leitão, 2000 p. 357.) It may further be said that instances of both

local agreements and integrative replies can be seen as results of negotiation of meaning and/or refinement of opinions.

It is important to note that the sequences in Leitão's model (2000) do not necessarily reflect turn-taking, and may be used to represent arguments and counter-arguments as expressed in, say, a monologue or argumentative writing from a single individual. One of the criticisms leveled against this model (cf. Pontecorvo and Pirchio, 2000) is that it doesn't allow enough substance to the role of the other, to opposition between individuals rather than ideas. I will return to this point in the methodology-oriented part of the discussion.

Most of the researchers and theoreticians cited in this paper (e.g., Pontecorvo, 1993; Leitão, 2000; Dreyfus, Hershkowitz, & Schwarz, 2001; Nathan, Eilam, & Kim, 2007; Baker, 2003) share an over-arching characteristic, namely a focus on cognitive processes (e.g., reasoning, argumentation, abstraction, problem solving) from a social, interactional, dialogic and/or collaborative point of view, and attempt to identify and describe related phenomena. Even when researchers share this characteristic, they may exhibit considerable variance with regard to the specific assumptions, goals, contexts and, consequently, scope, units of analysis and specific methodological practices. Leitão (2000) and Pontecorvo (1993), for example, interpret the dialogic dimension in a different way.

Leitão (2000) criticizes turn-taking approaches to discourse such as that of Pontecorvo (1993), because in her view they do not suitably represent the dialectical nature of argumentation, which implies opposition between views (and not necessarily between individuals). Pontecorvo and Pirchio (2000) countered this argument from a developmental perspective, claiming that, while adults may be able to incorporate the other's view in their talk, young children "require the social support (in a Vygotskian meaning) of the other." These differences have ramification with regard to the unit of analysis. While Pontecorvo would segment the discussion relying on turn taking (i.e. each time the speaker changes, a new turn begins), Leitão would further segment each turn according to its content.

2.4. Argumentative knowledge construction

Argumentative knowledge construction is based on the assumption that learners engage in specific discourse activities and that the frequency of these discourse activities is related to knowledge acquisition (Weinberger & Fisher, 2006). Learners construct arguments in interaction with their learning partners in order to acquire knowledge about

argumentation as well as knowledge of the content under consideration (Andriessen, Baker, & Suthers, 2003). This definition of argumentative knowledge construction includes that discourse activities on multiple process dimensions may facilitate knowledge acquisition. Analyzing and facilitating argumentative knowledge construction on multiple process dimensions may extend and refine the understanding of what kind of student discourse contributes to individual knowledge acquisition (van Boxtel & Roelofs, 2001).

2.4.1. Argumentative knowledge construction in CSCL

Approaches to analyze discourse have developed simultaneously in different fields, such as linguistics, analytical philosophy, anthropology, etc. and have also inspired educational research, e.g., the concept of "grounding" in different media (Clark & Brennan, 1991) has been transferred to CSCL (Baker and Lund, 1997 and Dillenbourg et al., 1995). These approaches need to be well connected to questions and theories of educational research (see De Wever, Valcke, Schellens, & Van Keer, this issue). The fit between theoretical and methodological approach is vital with regard to decisions on how to sample, segment, and categorize the discourse corpora. Counting the frequency of specific speech acts, for instance, may be more valuable to linguistic than educational research, because speech acts may not well represent relevant cognitive processes of learning. Furthermore, there are a number of different theoretical approaches to collaborative learning, which stress different process dimensions as indicators of knowledge building. Coding the discourse corpora with regard to one process dimension of collaborative learning may have blind spots regarding effects and side effects of other process dimensions on knowledge building. By analyzing whole samples of discourse corpora on multiple process dimensions it is possible to better understand how specific processes of (computer-supported) collaborative learning contribute to and improve individual acquisition of knowledge. So far, the analysis of multiple processes is cumbersome, but as a result of this type of analysis, it is possible to instructionally support those process dimensions of collaborative learning that are known to facilitate knowledge acquisition. First, discourse is analyzed on two dimensions based on speech acts (Fischer, Bruhn, Gräsel, & Mandl, 2002). Then, categories are revised and added, and the discourse corpora is segmented with different grain sizes (Stegmann et al., 2004, Weinberger, 2003 and Weinberger et al., 2005).

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Participation dimension. The participation dimension provides with two important kinds of information: Do learners participate at all and do they participate on an equal basis? To gather this kind of information, the quantity of participation and the heterogeneity of participation are considered (see Table 1).

(1) The quantity of participation, i.e., to what extent learners contribute to discourse, has been regarded as an important indicator of knowledge construction (Barab and Duffy, 2000 and Cohen and Lotan, 1995). The quantity of participation indicates if learners login and enter a CSCL environment at all. The quantity of participation can thus indicate if learners had theoretically been in the position of being able to acquire knowledge within the environment. In text-based CSCL environments, the quantity of participation may be generally higher than in traditional classrooms. The fact that text-based, asynchronous CSCL may proceed in parallel discussion threads may support participation, because production blocking effects are being reduced. Learners can elaborate their contributions without interruptions from co-present peers, which may suggest to write longer and more elaborated messages (Kern, 1995 and Quinn et al., 1983).

(2) Heterogeneity of participation. Classroom discourse has been investigated with regard to heterogeneity of participation among participants. Collaborative learning in small groups may reduce heterogeneity of participation because all learners are supposed to contribute to small group discussions, whereas only some students have the opportunity to contribute to a discussion in the whole classroom (Cohen & Lotan, 1995). Highly heterogeneous participation has also been described as a consequence of social loafing (Latané, Williams, & Harkins, 1979) or free riding (Kerr & Bruun, 1983). At best, only some learners may benefit from knowledge co-construction scenarios while others are left behind. CSCL may contribute to a more homogeneous participation, e.g., by representing the discourse history on a discussion board. The discourse history may facilitate the learners' awareness of their participation quantity and converge towards a group norm (cf. Kreijns, Kirschner, & Jochems, 2002).

Table 1 – Categories of participation dimension in argumentative knowledge construction

Category	Description
Quantity of participation	Entering a CSCL environment and contributing to online discourse
Heterogeneity of participation	(Un-)Equal participation of learners in the same group

Epistemic dimension. In contrast to participation, on an epistemic dimension not only the quantity, but also the content of learners' contributions is being analyzed. An epistemic dimension refers to how learners work on the knowledge construction task they are confronted with (Fischer et al., 2002). First, it is analyzed whether learners are engaging in activities to solve the task (on-task discourse) or whether they are rather concerned with off-task aspects. Second, specific epistemic activities to solve a task are differentiate. The adequacy of these epistemic activities of learners can be considered in order to detect misconceptions of learners (see Table 2).

Table 2 - Categories of epistemic dimension of argumentative knowledge construction

Category	Description
Epistemic activities	
Construction of problem space	Learners relate case infor
Construction of conceptual space	Learners relate theoretica
Construction of adequate relations between conceptual and problem space	Applying the relevant theo
Construction of inadequate relations between conceptual and problem space	Applying theoretical conce
Construction of relations between prior knowledge and problem space	Applying concepts that ste
Non-epistemic activities	Digressing off-topic

Discourse is on-task when learners attempt to contribute to solve the task. On an epistemic dimension, the amount of on-task discourse, in contrast to off-task discourse, can be determined. The amount of on-task discourse has been found to be positively related to individual knowledge acquisition (Cohen, 1994). Many studies report that text-based CSCL supports learners to concentrate on on-task activities, in contrast to off-task activities (Kiesler et al., 1984, Kiesler and Sproull, 1992, Rice, 1984 and Woodruff,

1995). On an epistemic dimension, on-task discourse can be further differentiated regarding the specific epistemic activities that describe in a more detailed and systematic way within a specific domain how learners solve the task. Learners may apply different strategies to solve the task, which may be more or less efficient with respect to the individual acquisition of knowledge (Hakkarainen and Palonen, 2003 and Pontecorvo and Girardet, 1993). Different tasks require different epistemic activities.

Depending on the task, specific epistemic activities may foster knowledge acquisition. Tasks for argumentative knowledge construction, which require learners to analyze learning cases using theoretical concepts, include at least three different kinds of epistemic activities (Fischer et al., 2002). Learners need to construct the problem space, the conceptual space, and relations between conceptual and problem space (see Table 2). The construction of problem space is required for the understanding of a problem. Learners select, evaluate, and relate single components of problem case information. It has been found, however, that successful learners often go beyond the concrete level of case information and rather relate to theoretical concepts (Fischer et al., 2002, Salomon and Perkins, 1998 and Weinberger, 2003). Learners focusing on the construction of problem space at the cost of neglecting other epistemic activities may retell rather than interpret a problem. Accordingly, it has been shown that discourse beyond a concrete level of the problem space may foster the individual acquisition of knowledge in learning scenarios based on complex problems (Fischer et al., 2002 and Hogan et al., 2000). The construction of conceptual space comprises summarizing, rephrasing, and discussing theoretical concepts and principles. Learners construct relations between single theoretical concepts or distinguish concepts from each other. Learners define and categorize concepts. This has been argued to be essential to understand the theoretical concepts that are supposed to be learned (De Grave et al., 1996 and Pontecorvo and Girardet, 1993).

The construction of relations between conceptual and problem space can be regarded as the main task in problem-oriented learning environments (De Grave et al., 1996). The individual relations between concepts and problem information that learners construct can indicate how learners approach a problem in detail, as well as to what extent learners are able to apply knowledge adequately. Therefore, relations between conceptual space and problem space can indicate knowledge application on the basis of the concepts that learners resort to in order to analyze the problem. With respect to complex problems with multiple facets, learners need not only to construct one specific relation between conceptual and problem space, but to apply multiple concepts to multiple facets of the problem. The collaborative application of theoretical concepts to problem space may indicate the internalization of these relations between conceptual and problem space

(Palincsar, Anderson, & David, 1993). In other words, learners who apply theoretical concepts to problems collaboratively may be able to transfer this knowledge to future problem cases and apply theoretical concepts individually (Vygotsky, 1978). The frequency of the construction of relations between conceptual and problem space may thus indicate knowledge acquisition.

A further question is if learners apply new conceptual space that is to be learned or apply concepts from prior knowledge. Another question is whether learners construct relations between conceptual and problem space adequately and acquire adequate application-oriented knowledge or if collaborative learners do not apply knowledge adequately and may acquire misconceptions (e.g., Palincsar et al.,1993, Schwarz et al., 2000 and Weinberger et al., in press-a).

Argument dimension. In argumentative knowledge construction learners need to inquire complex problems. Learners need to construct and balance arguments and counterarguments in order to prove possible resolutions to these problems (Walton & Krabbe, 1995). Learners thus continuously warrant, qualify or argue against solutions to the problems until they converge towards a joint solution. On the argument level, discourse corpora can be analyzed with respect to (1) the construction of arguments (see Table 3) and (2) the construction of sequences of arguments (see Table 4).

Table 3 - Categories of micro-level of formal dimension of argumentative knowledge construction

Category	Explanation
Argumentative moves	
Simple claim	Statements that advance a position without limitation of its validity or prov
Qualified claim	Claim without provision of grounds, but with limitation of the validity of the
Grounded claim	Claim without limitation of its validity, but with the provision of grounds tha
Grounded and qualified claim	Claim with grounds that warrant the claim and a limitation of its validity
Non-argumentative moves	Questions, coordinating moves, and meta-statements on argumentation

Table 4 - Categories of macro-level formal dimension of argumentative knowledge construction

Category	Description
Argumentative moves	
Argument	Statement put forward in favor of a specific proposition
Counterargument	An argument opposing a preceding argument, favoring an opposite proposit
Integration (reply)	Statement that aims to balance and to advance a preceding argument and c
Non-argumentative moves	Questions, coordinating moves, and meta-statements on argumentation

Apart from argumentative moves, non-argumentative moves can be differentiated. Non-argumentative moves do not contain a claim and comprise questions, coordinating moves, and meta-statements on argumentation.

(1) The construction of single arguments is based on Toulmin's model of arguments focusing on the elements claim, ground with warrant, and qualifier (Toulmin, 1958, van Eemeren, 2003, Voss et al., 1983 and Voss and Van Dyke, 2001). Claims are statements that advance the position learners take. Grounds with warrants present the reason why a claim is valid. Grounds are evidences, e.g., observations or experiences, and warrants are logical connections between the grounds and claims that indicate how a claim is supported by the grounds. Qualifiers, on the contrary, are statements that limit the validity of a claim to specific circumstances. Constructing arguments with these elements facilitates self-explanation of the learning material (Baker, 2003). Self-explanation is supposed to facilitate the integration of new knowledge into existing cognitive structures. Self-explanations were spontaneously generated by good students, and learners prompted to give self-explanations acquired higher forms of knowledge than unsupported learners (Chi et al., 1989 and Chi et al., 1994). There are indications that even adult learners rarely construct warranted and qualified claims on their own (Kuhn, 1991). In asynchronous CSCL, however, learners have more time to formulate their arguments, which may facilitate argumentative knowledge construction (Marttunen & Laurinen, 2001). In CSCL, argumentation can also be visualized, e.g., by graphical connections that indicate arguments and the corresponding counterarguments on the screen, and support learners to refine their argumentation (Kirschner, Buckingham Shum, & Carr, 2003).

(2) In discourse, single arguments need to be arranged in a line of argumentation. Typically, participants collect arguments that support one specific perspective rather than

building sequences of arguments that represent different perspectives (Kuhn, 1991). Specific sequences of argumentation representing different perspectives, however, facilitate knowledge acquisition (Leitão, 2000). These specific sequences of argumentation consist of arguments, counterarguments, and replies. Leitão states that the individual steps of this argumentation sequence represent a knowledge building cycle. First, knowledge building in discourse requires that learners construct arguments to justify their position. This construction of arguments facilitates self-explanation of the learning material (see Baker, 2003). Second, learning partners construct counterarguments to challenge and reconsider these positions. Counterarguments facilitate meta-cognitive activities, prompting learners to rethink their initial argument (Leitão, 2000). Finally, learners construct replies and eventually refine the initial positions. By balancing arguments and counterarguments in order to solve complex problems, participants may learn how to argue within a domain and acquire content-knowledge. With the construction of sequences of argumentation, learners may acquire multiple perspectives upon a problem. The acquisition of multiple perspectives on a problem facilitates learners to flexibly apply the newly acquired knowledge to solve future problems (Spiro, Feltovich, Jacobson, & Coulson, 1991).

Dimension of social modes of co-construction. The way how learners solve a task and construct arguments may be distributed to different degrees over several members of one learning group. The social modes of co-construction describe to what extent learners refer to contributions of their learning partners, which has been found to be related to knowledge acquisition (Fischer et al., 2002 and Teasley, 1997). Specific social modes differ in the degree to which learners refer to contributions of the learning partners (see Table 5).

(1) Externalization means that learners make contributions to discourse without reference to other contributions. When externalizing, learners may explicate their knowledge, e.g., writing a new analysis of a problem case. Discussions typically start with externalization. Externalization is mainly motivated by social situations (Cobb, 1988). Learners externalize what they know, e.g., to explain their perspective. This may also make (mis-)conceptions accessible for learners in a group. By externalizing, learners need to restructure knowledge into a linear form. Thus, knowledge is simultaneously reorganized when it is externalized (Huber, 1987).

(2) Elicitation has been described as using learning partners as a resource by asking questions (Dillenbourg et al., 1995). Elicitation aims at receiving information from the learning partners. Some studies showed that in more successful groups more task-related questions have been asked (e.g., King, 1994). Based on these findings, some

approaches successfully foster group learning by facilitating the generation of questions (King, 1999 and Rosenshine et al., 1996). There are, however, indications that elicitation and reception of help can be detrimental when learners become dependent on this help (Webb, Ender, & Lewis, 1986). Instead of attempting to work on the learning task, students may rather seek help from others, e.g., teachers. Thus, elicitation appears to facilitate knowledge acquisition only if learners receive help and apply the help in the situation themselves (Webb, 1989).

(3) In order to improve collaboration, learners need to build a task-specific minimum consensus or common ground regarding the learning task in a process of negotiation (Clark & Brennan, 1991).There are different styles of reaching consensus, however. Quick consensus building can be described as learners accepting the contributions of their learning partners not because they are convinced, but in order to be able to continue discourse (Clark & Brennan, 1991). In this way, quick consensus building may not indicate an actual change of perspective, but is rather a coordinating discourse move (Fischer et al., 2002 and Weinberger, 2003). Even though quick consensus building may be fundamental to manage interaction in CSCL, quick consensus building may be detrimental to individual knowledge acquisition, when learners disregard other forms of consensus building in favour of quick consensus building (Keefer et al., 2000, Leitão, 2000, Linn and Burbules, 1993 and Nastasi and Clements, 1992).

(4) Recent approaches towards collaborative learning stress that collaborative learners may eventually establish and maintain shared conceptions of a subject matter (Roschelle & Teasley, 1995). Learners approximate and integrate each others perspective, synthesize their ideas, and jointly try to make sense of a task (Nastasi & Clements, 1992). In contrast to quick consensus building, integration-oriented consensus building is characterized by a take over of perspectives. Integration occurs when individual learners operate on the basis of the reasoning of their learning partners. An indication for integration-oriented consensus building is that “participants show a willingness to actively revise or change their own views in response to persuasive arguments” (Keefer et al., 2000, p. 77). Learners may give up or modify initial beliefs and correct themselves on the basis of peers’ contributions. Studies to date have produced inconclusive results on integration-oriented consensus building and individual knowledge acquisition (Fischer et al., 2002 and Weinberger, 2003). Integration-oriented consensus building appears to take place rarely in comparison to other social modes of co-construction. Learners seem to hardly elaborate a change of their perspectives in discourse.

(5) Conflict-oriented consensus building has been considered an important component in the socio-cognitive perspective upon collaborative learning (Doise and

Mugny, 1984 and Teasley, 1997). By facing critique, learners may be pushed to test multiple perspectives or to find more and better arguments for their positions (Chan, Burtis, & Bereiter, 1997). When building consensus in a conflict-oriented manner, learners need to pinpoint out specific aspects of their peers' contributions and modify them or present alternatives. Thus, learners need to more closely operate on the reasoning of their peers in comparison to, e.g., simple acceptance of peers' contributions.

Table 5 - Categories of social dimension of argumentative knowledge construction (SOC)

Category	Description
Externalization	Articulating thoughts to the group
Elicitation	Questioning the learning partner or provoking a reaction from th
Quick consensus building	Accepting the contributions of the learning partners in order to r
Integration-oriented consensus building	Taking over, integrating and applying the perspectives of the le
Conflict-oriented consensus building	Disagreeing, modifying or replacing the perspectives of the lear

The extent to which learners operate on the reasoning of their peers has been termed transactivity (Teasley, 1997). Transactivity of learners' discourse is positively related to individual knowledge acquisition (Teasley, 1997). Teasley has defined a scale of transactivity on which the different social modes can be allocated. The five social modes of co-construction represent different degrees of transactivity according to this scale. Externalization, for instance, is regarded as the least transactive social mode, whereas conflict-oriented consensus building is the most transactive social mode on Teasley's scale.

2.5. Specific theoretical perspectives used in this study

Three theoretical perspectives and approaches contributed to shape this study: Scardamalia and Bereiter's (1994, 2002, 2003) theory of knowledge building; Vygotsky's dialogic perspective (1986, 1991), and, finally, Baker's (2003) approach on argumentation and learning. These theories will not be fully discussed in full detail, but only their aspect related to this study will be considered.

Collaborative knowledge building. The theory of knowledge building deals with how a community of learners jointly creates knowledge (Scardamalia & Bereiter, 1994). Knowledge-building is defined as "the production and the continual improvement of ideas

of value to a community, through means that increase the likelihood that what the community accomplishes will be greater than the sum of individual contributions and part of broader cultural efforts" (Bereiter & Scardamalia, 2002, pp. 57). These authors emphasize the distinction between 'learning' (the product of the collective knowledge building process) and knowledge building:

> *Learning is an internal, unobservable process [. . .], a by-product of this constructive process of collective knowledge building. Knowledge building, by contrast, results in the creation or modification of public knowledge [. . .] that lives "in the world" and is available to be worked on and used by other people' (Bereiter & Scardamalia, 2003, pp. 58).*

Therefore, knowledge building gives rise to learning as a cultural process. The focus of knowledge-building communities is on developing a collective knowledge base and enhancing learners' problem-solving skills. Specifically, Ton, Huge and Scardamalia (2006) argue that the knowledge building pedagogy engages students directly in knowledge production, putting them into a "development trajectory to be knowledge producers" (Tan, Hung & Scardamalia, 2006 pp.93). Students take on ownership of learning by collaboratively and continually improve initial ideas.

Knowledge building is thus consistent with the social constructivist philosophy in engaging learners in meaningful learning. By engaging learners directly in working with knowledge, it avoids the pitfall of many constructivist approaches that focus on task completion (Tan, Hung & Scardamalia, 2006 pp.104).

These authors distinguish between knowledge *about* and knowledge *of*. Whereas knowledge about is approximately equivalent to declarative knowledge, knowledge of is a rich procedural knowledge which implies application skills. In order to be useful outside the limited domain of school courses, knowledge needs to be organized around problems rather than topics (Bereiter & Scardamalia, 2006, pp.105).

The theory of knowledge building also refers to knowledge building discourse, whose aim is learners' knowledge advancement (*idea improvement*). It involves three distinctive characteristics (Scardamalia & Bereiter, 1994 pp. 271):

Focus on problems and depth of understanding. In knowledge-building, the focus is on problems rather than on topics. Explaining is the major challenge, with encouragement to advance theories through using them to explain ideas. Engagement is at the level of how things work, underlying causes and principles, and interrelatedness of ideas.

Decentralized, open knowledge building, with a focus on collective knowledge. From the perspective of social interactions, there is an expectation of constructive response to one another's work. In knowledge-building discourse, more knowledgeable learners participate actively, suggesting to others learners resources and methods of use that may prove helpful. Less knowledgeable learners also play an important role in the discourse, pointing out what they find difficult to understand, as well as inadequacies in explanations.

The broader knowledge community. Peer review for scientific publication exemplifies this concept of working with ideas in contexts broader than one's immediate community. In fact, peer review implies rewriting an article in response to issues that had not been raised in more local review processes. Additionally, it implies adapting it to different perspectives brought by reviewers depending on their expertise. Hence, working within the broader knowledge-building community places one in what the authors define a "second-order environment[7]" and accustoms participants to viewing ideas from the perspective of multiple expertise and issues.

By these criteria, argumentation and debate as currently promoted in higher education fall short because its emphasis on persuasion does not favor understanding nor help to progress in problem-solving (and idea improvement):

> *There is plenty of discourse in schools, but […] generally led by the teacher. [..] Teacher, playing Socrates, gives the discussion such direction as it has, […] (thus having) substantive influence on the outcome. The students' own goals may influence how successful the discussion is, mainly through influencing the extent of their cooperation. Transcripts of classroom discussion indicate that […] each unit (consists) of the following conversational moves: teacher initiates, student responds, teacher evaluates (Heap, 1985). Whatever this formula represents, it surely does not*

[7] Scardamalia & Bereiter (1994) distinguish between first- and second-order environments. In first-order environments, adaptation to the environment involves learning, but the learning is 'asymptotic' - one can become comfortably integrated into a relatively stable system of routines (e.g. schools can be defined as "first-order environments" as they are characterized of both didactic and child-centered orientations). In second-order environments, learning is 'not-asymptotic' because what one person does in adapting changes the environment itself so that others must readapt (e.g. competitive sports and businesses, where participants' accomplishments raise the standard). Adaptation itself, hence, involves contributions to collective knowledge. Because this very activity increases the collective knowledge, continued adaptation requires contributions beyond what is already known, thus producing non-asymptotic learning.

represent the pattern of discourse in a knowledge-building community (Scardamalia & Bereiter, 1994 pp. 270).

In order to support knowledge building, learning environments should allow for self-organizing system of interactions among participants and their ideas:

In knowledge building, ideas are treated as real things, as objects of inquiry and improvement in their own right. Knowledge building environments enable ideas to get out into the world and onto a path of continual improvement. […]. Threaded discourse, which is the predominant Internet technology for idea exchange, has limited value for this purpose. Typically, ideas are lodged within conversational threads, contributions are unmodifiable, and there is no way of linking ideas in different threads […]. A shared workspace for knowledge building enables a self-organizing system of interactions among participants […]. Advances within this communal space continually generate further advances, with problems reformulated at more complex levels that bring a wider range of knowledge into consideration (Scardamalia & Bereiter, 2003).

Scardamalia and Bereiter's theory of knowledge building, with its emphasis on computer technologies, plays an important role in the context of Computer-Supported Collaborative Learning (Scardamalia & Bereiter, 1996; Lee et al. 2006; Oshima et al. 2006). Technology, as a matter of fact, is critical in the knowledge-building process:

"Although in principle you could have the practices without the technology, we have found the technology to be important not only for practical reasons--to overcome the objective obstacles created by classroom condition--but also for conceptual reasons" (Scardamalia, 2003, p. 75).

Vygotsky's dialogic perspective. The dialogic dimension of collaborative argumentation leads to consider the role of dialogue in the construction of thought. In Vygotsky's theory, language fulfils two fundamental functions: "communication tool," to share and develop the knowledge which makes social life possible; "psychological tool" for reflecting on one's own activity, hence making it possible to reason, plan, organize thought and assess one's own actions (Vygotsky, 1986).

In Vygotsky's work, a couple of aspects appear of particular relevance to shed light on argumentation (Andrews, 2010 in press). The first is the connection between argument and reflection. Reflection is seen as a dynamic mental space informed by social arguments. It is also a dialectical operation, as it implies a self-dialog of the individual involving his/her experience (the 'outside world') together with his/her ideas and beliefs. The second aspects, unusually in agreement with Piaget's work, is the significance he

attributes to the transition from pre-school to school due to the new and more structured context and the new relations with peers and teachers, which induce the advancement of thought and argumentation skills. It is interesting to note that an analogue transition takes place when students pass from pre-university to higher education and need to adapt to the framing of new disciplines, subjects and fields of enquiry, as well as to a different way to interact with peers and teachers.

Argumentation and learning. Baker (2003), based on the outcomes of several authors, identifies four stages in argumentation that support learning. These are based on general findings of the learning sciences that can be applied broadly to a wide range of content knowledge (Andriessen, 2003).

In order to understand Baker's approach, it is necessary to detail how argumentative knowledge is constructed. Developing argumentation skills entails that learners understand how to construct a single argument and how to correctly sequence arguments. As concerns the construction of single arguments, a widely applied approach is represented by Toulmin's (1958) model which will be discussed in detail in Chapter 2. This model includes three fundamental concepts: claim, data and warrant. Claim is the position an individual stands for, which is supported by providing data and explaining why these data support the claim (warrant). Toulmin's model thus provides the reference framework for the microstructure of arguments. As to argument sequencing (the macrostructure), according to Leitão (2000), it involves construction of arguments, counterarguments and integrative arguments. Learners engage in elaborating content while generating longer argumentative sequences; this process also results in an acquisition of more discipline-specific knowledge. Moreover, by engaging in meaningful sequences of argumentations, learners internalize these processes and become able to apply them also in other contexts. Whereas single arguments can be evaluated with regard to microstructure, macrostructure describes the dynamics of the argumentation processes (Leitão, 2000).

The joint application of these two models provides a complete approach to argument construction. Firstly, students construct arguments based on Toulmin's model to support their positions. By constructing arguments, each learner self-explains the reference material and integrates such new knowledge into his/her own cognitive structure. Then, each learn constructs counterarguments to peers' claims, in order to challenge their initial positions. The construction of counterarguments stimulates meta-cognitive activities and engages learners in reflecting on their initial positions. Finally, each learner constructs integrative arguments and consequently refines his/her initial position. By sequencing

arguments and counterarguments learners acquire domain specific knowledge, as well as knowledge on argumentation.

Based on this argumentation structure, Baker defines the operations involved from the point of view of learning:

Making knowledge explicit: Argumentation provides many opportunities for explanation; moreover, preparing a justification or argumentative defense fosters reflection that often leads to deeper understanding. This explains why learners who provide explanations, or explicit the reasoning underlying their problem solving behavior, show the highest learning outcomes (Chi & van Lehn, 1991).

Conceptual change: Debating a question may raise doubts that lead to spot initial misconceptions. Thus, conceptual transformation is supported by argumentation.

Co-elaboration of new knowledge: In argumentation, learners work together to develop new knowledge. The interactive interpersonal nature of verbal interaction helps to scaffold individual learning.

Increasing articulation: Argumentation obliges learners to precisely formulate statements and questions. The articulation needs to be transformed and deepened during the process.

Chapter 3 Research Methodology

3.1. Introduction

In this chapter, the rationale for the selection of ethnographic case study research as the methodology for the current study is explained. Ethnographic research is a naturalistic, observational method that produces real descriptions of context and culture. The objective of ethnography is to understand the meaning a phenomenon has for those involved (Creswell, 2005). By using ethnographic research, the students' experience of constructing argumentative knowledge in wiki-based environments can be discovered and understood.

Among common methods in qualitative inquiry (such as action research, grounded theory, narrative analysis, etc.), the ethnographic study was chosen for this research because it is a method that can be used to identify the issues for the participants; furthermore, it can help the researcher to raise issues that the participants may not have been aware of themselves.

Ethnography research has been extensively used throughout the disciplines and in applied fields of practice, including the study of networked learning (Conole, 2009; Hodgson & Watland, 2004; Rice-Lively, 1994). As Howard (2002) observes, this approach is qualitative based on 'systematic description of human behavior and organizational culture based on first-hand observation'. At the heart of ethnographic investigations is 'thick descriptions' (Geertz, 1999):

> *"Culture is not a power, something to which social events, behaviors, or processes can be causally attributed; it is a context, something within which they can be intelligibly – that is, thickly – described" (p.14)*

Ethnographic descriptions embed three main characteristics: firstly, they are interpretive; secondly, what is interpreted is the flow of social interactions and discourse; thirdly, the interpretation itself seeks to sort out the structures of significations (i.e. conveying of meaning) and explores the main elements of the discourse (Geertz, 1999). Hence, the context in which a phenomenon takes place has to be observed and interpreted in relation to participants' understanding, views, and perceptions.

Against this background, the following sections present the rationale for the Case study research strategy adopted in this thesis. Moreover, the research phases are described and an overview of procedures, data collection and analysis techniques is provided.

3.2. Case Study Research

A case study is an in-depth investigation of a single individual, group, or event in its 'real-life' context (Yin 2003). The nature and scope of the cases can vary significantly and thus, case study research can also be considered as a form of interpretative ethnography 'that explores one, or multiple, 'bounded' system (a *case*) over a period of time, through detailed data collection involving multiple sources of information (e.g., observations, interviews, documents, etc.) and reports a case description and case-based themes (Cresswell 2005, p.73).

The case-based approach enables to gather a rich, contextual understanding of a situation in context. As Yin (2003, p. 13) observes, case study is a design that particularly suits those situations where it is impossible to separate the phenomenon's variables from their context. By concentrating on a single phenomenon, the researcher aims to unveil the interaction of significant factors which characterize the phenomenon. In particular, the vivid descriptions of relevant episodes and the chronological narratives (Hitchcock & Hughes, 1995) enable researchers to establish cause and effect relationships as they occur in their authentic context (Yin, 2003). Case studies have been used in varied investigations, particularly in sociological studies, but increasingly, in educational research because they are 'strong in reality' and concerned with studying authentic, contextualized effects (Cohen et al., 2000).

Case study as a research strategy comprise a broad method, including the logic of design, data collection techniques, and procedures for data analysis (Yin, 2003). Robust procedures have been developed by Yin (2003), Stake (1994), and others (Lincoln and Guba, 1985; Patton, 1990) who have wide experience in using this methodology. Furthermore, case studies have a distinctive place in evaluation research (Cronbach et al, 1980; Lincoln and Guba, 1985; Patton, 1990). Yin (1993) has identified some specific types of case studies: *Exploratory*, *Explanatory*, and *Descriptive. Exploratory cases* are sometimes considered as a prelude to social research as they aim to inform questions and hypothesis for subsequent investigations. *Explanatory case* studies may be used for doing causal investigations as they are driven by 'how' and 'why' questions. *Descriptive cases* require a descriptive theory to be developed before starting the project; they provide a full account of phenomenon in their context (Tellis, 1997). According to Stake (1994), three other types of case studies can be identified:

- *Intrinsic*, when the researcher is interested in understanding a particular case;

- *Instrumental,* when it aims at providing insight into an issue or problem or to refine a theory (the case is used to understand more than what is obvious to the observer)
- *Collective*, when a number of cases are studies jointly in order to understand a phenomenon, population or general condition.

In all of the above types of case studies, there can be single-case or multiple-case applications. Case study research is not sampling research; that is a fact asserted by all the major researchers in the field, including Yin (2003), Stake (1994), Feagin and others (1991). However, selecting cases must be done so as to maximize what can be learned in the period of time available for the study. Yin (2003) suggests Case studies can further be qualified as single, multiple, embedded and holistic (see Fig. 5).

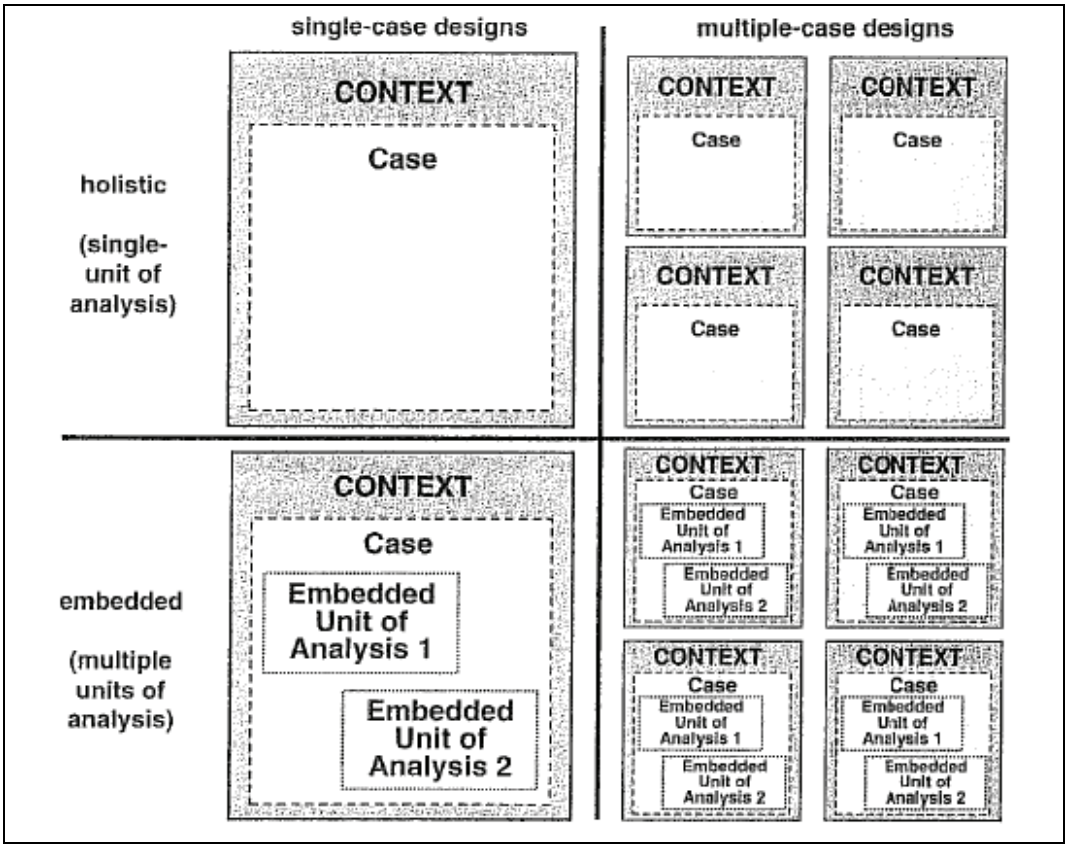


Fig. 5 – Yin's basic types of Designs for Case Studies (2003, p.40)

One rationale for a single Case study is analogous to a single experiment and applicable when it "represents (a) a critical test of an existing theory, that is, a case which meets all criteria or conditions for testing a specific theory, (b) a rare or unique circumstance, that is, a case that is so rare that warrants further investigation, or (c) representative or typical case, that is, a case whose object of study is assumed to behave in

ways typical of a class or group, or when the case serves (d) revelatory, that is when a researcher has the opportunity to observe a phenomenon previously inaccessible to scientific investigation; or, finally, (e) longitudinal purposes, that is studying the same single case at two or more different point in time" (p. 40). A single-case study may also be used as a pilot case that is the first of multiple-case study.

Multiple case can be compared to multiple experiments which seek to achieve 'replication' by either conducting the investigation under the exact same conditions, or by modifying conditions not relevant to the original result (p.48). Either way, two are the likely outcomes: *literal replication*, similar results which highlight patterns common to all cases; or *theoretical replication*, contrasting results accounted for by predictable reasons (Yin, 2003). When replications occur across cases, they strengthen confidence over the findings and the overall results. The fact that a design calls for multiple-cases does not eliminate the embedded or holistic variation discussed above. The same case study may, in fact, involve more than one unit of analysis, that is, within a single case, attention is given to one or more subunits (see Fig. 5, type 2). Hence, *embedded* case studies are composed by sub-unit/s which are examined in their own right, while *holistic* represent a single unit investigated as a whole. In general, criticism about Single case studies regards the uniqueness and artifactual conditions surrounding the case. Yin suggests that embedded design (i.e. having more than two cases) can be an effective mechanism to focus inquiries (p.52).

3.2.1. Trustworthiness in Case Study Research

It is important for any research to evaluate the 'accuracy' or the 'goodness' of the study with regard to the applied methods of data gathering and analysis. In order to make the research at high quality level, it is important to critically evaluate the quality of the research itself. To this purpose, Eisner (1991) suggests three features that ought to be considered in qualitative research: *coherence, consensus* and *instrumental utility*. *Coherence* (e.g. how have the conclusions been supported?) relates to the notion of "structural corroboration," also known as triangulation (p. 55). *Consensus* concerns the condition in which the readers recognize that findings are consistent with the evidence presented (p. 56). Finally, *Instrumental Utility* deals with the usefulness of the qualitative study and how it helps to understand a situation that would otherwise be confusing (p. 58). According to Linconln & Cuba (1985), the basic question addressed by the notion of trustworthiness is

> *"How can an inquirer persuade his or her audiences that the research findings of an inquiry are worth paying attention to?" (1985, p. 290) "*

Means for conducting this kind of evaluation include *construct validity, internal validity, external validity* and *reliability* (Lincoln and Guba, 1985; Strauss and Corbin, 1990; Yin, 1993).

Construct validity is about establishing correct operational measures for the concepts being studied. Wigdor & Garner 1982 discuss that the assessment of construct validity involves subjective judgement rather than an empirical issue. This can be tackled by using multiple sources of evidence and establishing chains of evidence while collecting the data (Yin, 1993). In the present study, construct validity was fostered through using data triangulation (Patton 1999) in the sense that the different types of empirical material collected (e.g. interviews, talk aloud session transcripts, wiki-based documents etc.) were contrasted with each other when categorizing the various types of material to ensure the correct operational measures (see Chapter 4, 5 and 6).

Internal validity refers to the extent to which findings accurately describe reality (Yin 1993). Lincoln and Guba (1985) state that "the determination of such isomorphism is in principle impossible" (p. 294), because one would have to know the "precise nature of that reality" and, if one knew this already, there would be no need to test it (p. 295). In order to ensure accuracy and alternative explanations, qualitative researchers generally use a *triangulation* (Stake, 1995) procedure that involves using multiple data sources in an investigation to produce understanding. Denzin (1978) and Patton (1999) identify four types of triangulation: 1) methods triangulation, checking out the consistency of findings generated by different data collection methods; 2) data source triangulation, examining the consistency of different data sources from within the same method; 3) triangulation through multiple analysts, using multiple analyst to review findings or using multiple observers and analysts; and 4) theory triangulation, using multiple theoretical perspectives to examine and interpret the data. With respect to this criteria, Yin (1989) also points out that *internal validity* is more essential when aiming at establishing causal relations than in explanatory research. The present study aims more at creating understanding of the research phenomena and internal validity was therefore not that intensively considered.

External validity refers to the ability to generalize findings across different settings (Yin 1993). It also indicates the fit between theoretical conclusions and empirical data (Grönfors 1982 p. 174). Lincoln and Guba (1985) considers generalizability as "an appealing concept," because it allows a semblance of prediction and control over situations (pp. 110, 111). According to Cronbach, "when we give proper weight to local conditions, any generalization is a working hypothesis, not a conclusion" (p.125). It is a frequent criticism of Case study research that the results are not widely applicable in real life. Yin (1999) contrasted that criticism by presenting a well constructed explanation of

the difference between analytic generalization and statistical generalization: "In analytic generalization, previously developed theory is used as a template against which to compare the empirical results of the case study" (Yin, 1984). Whit respect to external validity, the present study draws some general consideration especially concerning the proposed conceptual architecture (WikiDiA) to CSCL research. Architectural implications can also be seen to be applicable in a variety of collaborative learning settings in Argumentation studies.

Reliability refers to the notion of repeating the case study with the same results (Yin 1989). It mainly aims to ensure consistency, stability and predictability. However, Yin (2003) emphasizes it implies conducting the exact same case again rather than replicating the results by conducting another case. Although Kirk and Miller (1986) gave several examples of how reliability might be viewed in qualitative work, Lincoln and Guba (1985) summed up the essence of these examples in the following statement: "Since there can be no *validity* without *reliability*, a demonstration of the former is sufficient to establish the latter" (p. 316). In the present study reliability was fostered through documenting and reporting the empirical research process thoroughly. The aim has been to describe the progression of the research process as precisely as possible (see Chapter 4, 5 and 6). The purpose of transcribing the interviews and the talk aloud sessions was also to increase the reliability of the research.

To judge the overall trustworthiness of a qualitative study consistently with the naturalistic paradigm, Lincoln and Guba (1985, p. 300) have identified one alternative set of criteria: *confirmability, credibility, transferability, dependability. Confirmability*, as opposed to construct validity, refers to demonstrating the neutrality of the research interpretations through a "confirmability audit."; *credibility*, as to internal validity, depends less on the size of the unit than on the richness of the information gathered; the *transferability*, as to external validity- depends on the degree of similarity between the original situation and the situation to which it is transferred; *dependability, as* to reliability, is enhanced by the use of an "inquiry audit," in which reviewers examine both the process and the product of the research for consistency (pp. 317)

3.2.2. Data Collection and Analysis Techniques

Typically, case study research mainly uses interviews and documentary materials without using participant observation. The distinguishing feature of ethnography, however, is that the researcher spends a significant amount of time in the field, thus the fieldwork notes become an important addition to any other data gathering techniques. Furthermore, as pointed out above, multiple methods for collecting data are all likely to be used in case study research to attain the richest possible understanding (and validity) of a case.

Observation is a systematic data collection approach. Researchers use all of their senses to examine people in natural settings or naturally occurring situations. In Case study research, *participant* and *non-participant observation* are two predominant modes of collection data (Cresswell, 1998; Fetterman,1998). The former, adopted in naturalistic paradigms, underscores the person's role as participant in the social setting he or she observes. The range of roles one may play as a participant observer have been describe by Adler and Adler (1984) and others (Atkinson, 1994; Savage, 200). Hence, the researcher is the primary instrument of research (Eisner, 1991) and he/she plays a central role both in data gathering and analysis (Phelps et al., 2005). Non-participant observation is observation with limited interaction with the people one observes. It is more suited to settings where variables are controllable, such as laboratories, and where the researcher can adopt a detached observer role (Harrison et al., 1998). In relation to the importance of collecting multiple data sources for triangulation purposes, Yin (2003) identifies six types of data source: documents, archival records, interviews, direct observation, participant-observation, and physical artifacts. Self reports (Langenbach et al., 1994), research journals, students' work, and audio-visual materials are also proposed (Creswell, 2005). Observing by video or audio recording provides also valuable insights and conveys characteristics of the cases which may not otherwise be available (Atkinson, 1994). In order to diminishing potential biases and focusing the practice, observation protocols are usually defined.

The other principal technique to collect data in case study research is that of the *interview*. Most often interviews are used to complement the data collected through observation (Malone, 1998). Such data can be used to increase the understanding of the phenomenon under investigation, to incorporate different perspectives, and to make effective use of time. The types of interviews conducted by researchers vary in degree of formality (informal interview to semi-structured to structured interviews) (Yin, 2003) . The last aspect of ethnographic methods that should be addressed is *transcription*.

Transcripts and tapes are not equivalent. The act of transcribing is an interpretive act. The choice of a system of transcription conventions reflects the researcher's theoretical stance, analytical focus, and relationship to the participants. When transcribing tapes it is important to be explicit about how and why certain aspects of the data were not included in the transcripts and why others were. For example, gestures, expressions, and tone of voice usually help the researcher interpret utterances on videotape in a way that needs to be communicated in a transcript.

Researchers may also learn about a bounded system by collecting and studying *texts* and *artifacts* used by members of the system or case being studied (e.g. individual argument and argumentative network on the wiki, educational handouts, students' essays, etc. in the present study). In particular, digital artifacts such as the products of technology-mediated practices may allow for examination beyond and above what can be directly observed.

As concerns to the analysis techniques, Yin (1994) encouraged researchers to make every effort to produce an analysis of the highest quality. Yen presented two analytic strategies for general use that can successfully lead to conclusions: one is to *rely on theoretical propositions of the study*, and then to analyze the evidence based on those propositions. The other technique is to *develop a case description*, which would be a framework for organizing the case study. In order to accomplish this, he presented four principles: showing that the analysis relied on all the relevant evidence; including all major rival interpretations in the analysis; addressing the most significant aspect of the case study; using the researcher's prior, expert knowledge to further the analysis.

Pattern-matching is another major mode of analysis (Tellis, 1997). This type of logic compares an empirical pattern with a predicted one. Internal validity is enhanced when the patterns coincide. If the case study is an explanatory one, the patterns may be related to the dependent or independent variables. If it is a descriptive study, the predicted pattern must be defined prior to data collection. Yin (2003) recommended using rival explanations as pattern-matching when there are independent variables involved. This requires the development of rival theoretical propositions, but the overall concern remains the degree to which a pattern matches the predicted one. The initial propositions can be compared to other information of the same case or to another case. This type of process allows the refinement of theoretical propositions and is well suited to multiple case studies.

Stake (1995) recommended categorical aggregation as another means of analysis and also suggested developing protocols for this phase of the case study to enhance the quality

of the research. He also presented ideas on pattern-matching along the lines that Yin (1993) presented. Runkel (1990) used aggregated measures to obtain relative frequencies in a multiple-case study. Stake (1995) favored coding the data and identifying the issues more clearly at the analysis stage. Eisner (1990) placed a high priority on direct interpretation of events, and lower on interpretation of measurement data, which is another viable alternative to be considered. In this respect, Creswell (2005) points out that the lack of explicit standards, as well as the abundance of complex data are seriously challenging data analysis in this field. To this respect, Creswell suggests a number of steps for the process: 1. *Preparing the data for analysis*; it includes transcribing interviews, typing field notes and classifying various data type according to sources or other criteria; 2. *Immersing oneself in the data,* by reading through it to get a sense of what the participants are saying. This step generally constitutes a preliminary exploratory analysis; 3. *Detail analysis of the data through coding*, which involves identify common categories and labelling data accordingly. Coding schema from literature may also suits the purpose; 4. *Make a list of codes and group similar ones* in order to eliminate redundant codes; 5. *Return to the data* with the list of codes to verify if new codes emerge; 6. *Develop interpretations* or meaning of the data which put forward the lessons learnt and present them. Hence, specific guidelines for the development of the design and execution of a case study have been provided by the extensive work of Hamel (1993), Stake (1995), and Yin (1993, 2003).

In the present study, the some of proposed methodology for the development of survey instruments were adopted to ensure the correctness and quality of data gathering function. The researcher of this study spent a total of six months (January to June 2007) collecting qualitative data by using a multiple set of methods among all those discussed above (details are provided in Chapter 4, 5 and 6).

3.3. Research Methodology of this Study

As stated in the introduction, the objective of the present study is, on one hand, to evaluate the effectiveness of the use of wikis in collaborative processes of argumentative knowledge construction; on the other hand, to define a conceptual architecture for wiki based learning processes in the area of argumentation. To this end, the previous chapter presented a review of the literature which provides the theoretical background to inform the design of the approach. The inexistence of similar methods and the ambitious objective of the research required that the investigation was conducted in two phases, each of which addressing distinct research questions. The questions naturally fell under one phase or the other; however, there were questions that overlapped both, such as those related to orchestration models and the influence of the technology on the phenomenon under investigation. The two phases of the study and the two main hypotheses are as follows:

H1. The use of wikis can promote the creation of learning environments conducive to argumentative knowledge construction. In particular:

- Wikis can effectively support collaboration and decision making processes
- Wikis help to structure argumentative discourse at both micro- and macro-level.

H2. Learners respond (in terms of rebuttals/counterarguments) more to peers mediated communication, than in face to face discussions.

The objectives of the research required the investigation of a group of people and phenomena to construct understanding in relation to the research questions through description, interpretation and generation of propositions. Hence, ethnographic research was deemed the most appropriated method. Given that the study aimed to examine an instance in action of a bounded system, comprising the participants, the researcher, an activity, and technology to enable the completion of the task, case study was adopted as a research strategy. This decision was further supported by the fact that the researcher had little control over the events. Although she was to propose an activity and an approach to completing it, she could not exert control in an experimental fashion on the participants and the numerous complex possible contextual variables. Furthermore, the phenomenon under scrutiny involved real people in a real situation, which again supported a case study approach.

According to Yin's (2003) case study types (see Section 3.2), the present thesis can be considered as *Exploratory* case; in fact, a situation that was not previously available for investigation is examined. The research firstly aims to design and develop an approach to, in a second stage, proceed to its implementation and testing of some key hypothesis. It also qualifies as *Exploratory* in that what is under investigation arises from the study's conceptual articulations.

A participatory observations approach was adopted. This was necessary to develop a double insider perspective in to designing and developing the pedagogical model. Firstly the field literature informed the design of how the activity should be performed with social technologies to trigger certain types of interactions. Secondly, from the foregoing insider perspective an insider analysis of the instance in action was required to ascertain whether the various interventions were yielding the desired outcomes, and to inform subsequent iteration to the design when needed. Although the present investigation as a whole qualifies as *Exploratory* case study, each stage had distinct objects and they are further distinguished into: *Exploratory case study* in the first stage; and *Explanatory case study* in the second.

The investigation concerned with the evaluation and Iterative Design Process to develop the propose conceptual architecture Wiki*DiA*. Additionally, the expectation was for these questions to inform further questions and hypothesis for the subsequent stage of the research. The implementation and evaluation of the Wiki*DiA* is considered an Explanatory case study because it explicitly addresses 'How' questions which implicitly bring about 'Why' questions regarding the Wiki*DiA* under investigation, and its broader implications. Furthermore, the second phase of the research sought to elucidate cause and effect relationships.

In sum, the present investigation is a multiple case study implemented in three distinct phases: 1. exploratory case studies to evaluate the usability (ease of use, H1) of the wiki; 2. explanatory case study to implement and test the effectiveness of using wikis (H1). 3. Definition and tune-up of the proposed conceptual architecture Wiki*DiA*.

3.3.1. Overview of the research phases

The evaluation of the use of wikis to support argumentative knowledge construction developed through experimental situations aimed to show different aspects related to technology-enhanced collaborative argumentation. Detailed information regarding the participants, sites, duration, data collection instruments, data sets, and procedures followed for each phase of the research are provided in the pertaining chapters (Chapter 4, Chapter 5 and Chapter 6). This is done in an attempt to contextualize the research methodology adopted rather than artificially separate it from its applicative setting. In order to help understanding, however, an overview of research phases is given here.

The experimental component of this thesis articulated in three distinctive phases. In the first phase (F1), an exploratory study was designed to investigate the use of wikis to support the co-decision process in small-group learning. The usability (ease of use) was the main focus of this case study.

The second phase (F2) of the research focused on the effectiveness of wiki technology to facilitate students' argumentative knowledge construction.

The third phase (F3) of the research aimed to evaluate mediated communication effects on counter-arguments; in particular, the aim was to observe whether face-to-face discussion *vs.* debate mediated by other technology instead of wikis gave rise to a higher number of rebuttals than the other one, hence providing information if other kind of communication technology can be as supportive as wiki for this kind of task.

The different objectives underlying the research phases have also led to different experimental architectures: each phase of research was characterized respectively by the design of the architecture and the experimental situation.

Experimental outcomes specifically informed the definition and contributed to tune-up the proposed Wiki*DiA* conceptual architecture, as depicted in Fig. 6.

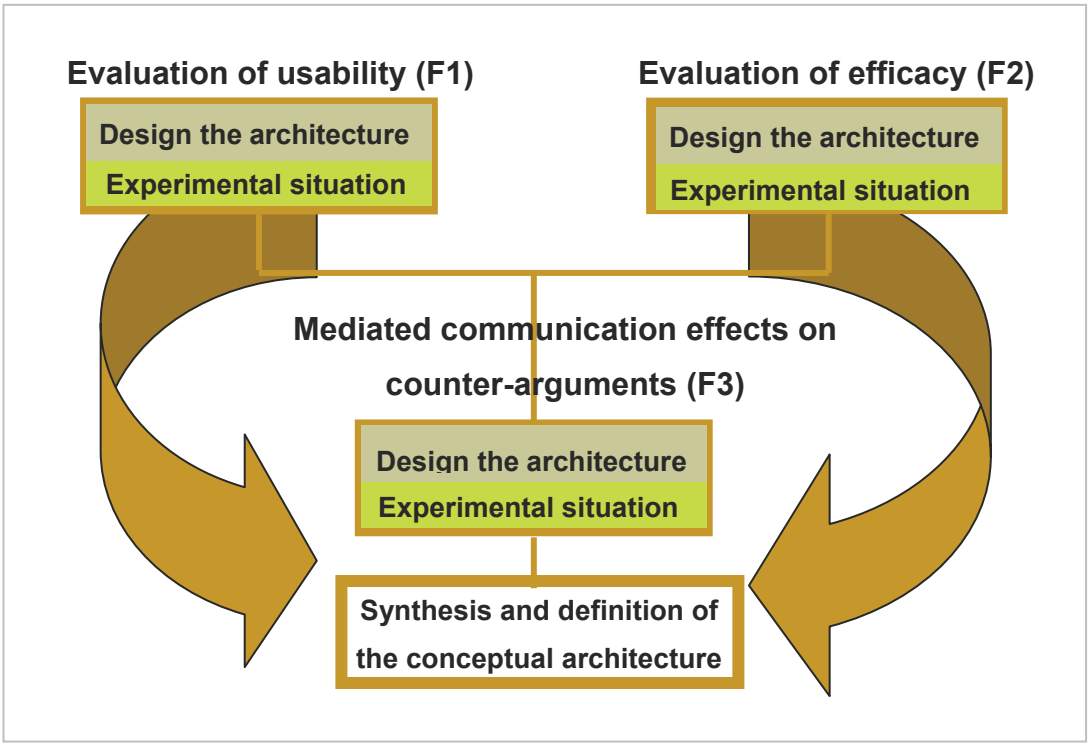


Fig. 6 – The four research phases of this study

Ethical issues in relation to the research in both stages were dealt with following research ethics recommendations (Cohen et al., 2000). All participants were informed of the purpose of the research and their consent (Appendix A) sought before the research began.

3.3.2. Pedagogical and technological means

At the beginning of Case study 1 and Case study 2 students were briefed about how to write compelling arguments in the following way:

> *"[…] One way to help you make a critique compelling is to avoid unsubstantiated opinion and instead gather together substantiated argument both for and against each claim. One, accessible, set of guidelines on how to write compelling arguments is provided by Wikipedia's Neutral Point of View (NPOV; Wikipedia, 2007). You first need to read NPOV principles. Then you'll work in small groups (of 2 or 3; a pair is ideal!) to critique web 'comments' to two selected articles from The Guardian online journal. How well do authors and commentators use NPOV in these two examples? Which arguments are subjective and which are objective?"*

Fig. 7 - NOPV and proposed starting activity

Assuming students were not familiar with wiki technologies, reference material about the "wiki way", its structure and main characteristics was distributed too.

The technology environment adopted in Case study 1 and study 2 was TWIKI (http://www.twiki.org) an open source wiki platform available for Windows and Mac OS. Fig. 8 shows the main home page set up for Case study 2 course. A self-discovery-driven approach to 'training' students on the use of the TWIKI was adopted in both cases. Students were asked to access the wiki space set-up for the course activities (Fig. 8) and to start using the 'editing' functionalities needed to create/modify a wiki page for their activities.

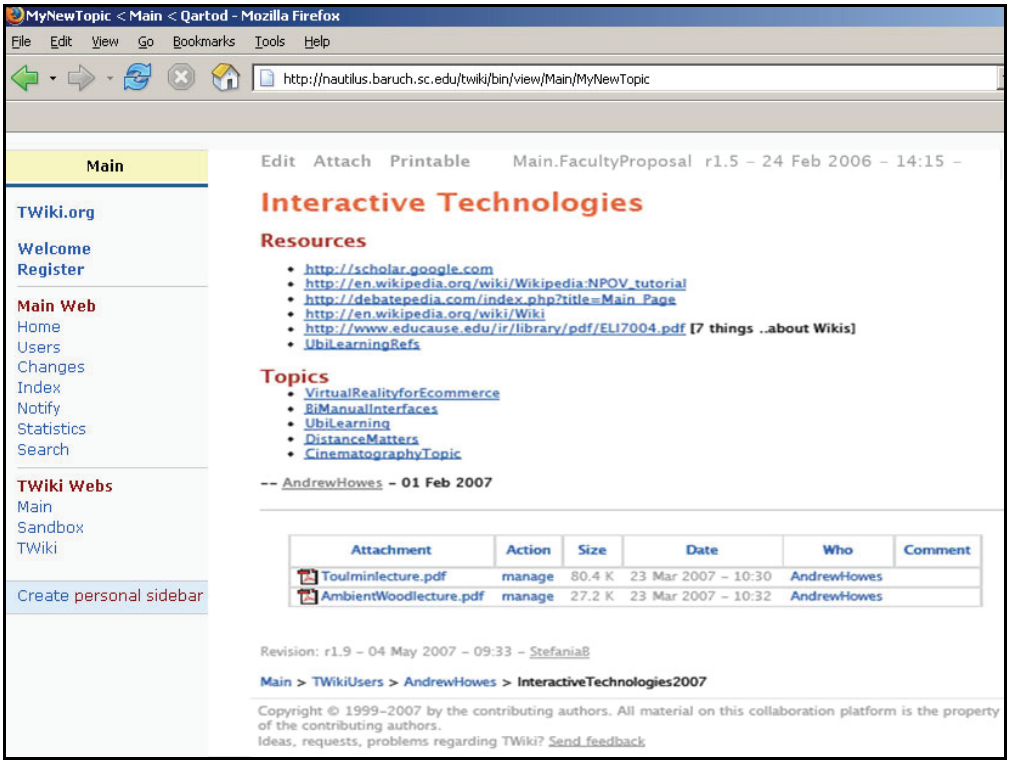


Fig. 8 - TWIKI interface. Case Study 2 course homepage

Considering the key role played by technology in the phenomenon under investigation, even if this approach was considered more conducive to collaboration than a 'formal' training approach, supporting notes were also prepared and delivered to students. Students' pages created on TWIKI were all protected with login and password. Authentications were required for viewing content as well as for adding/editing content.

3.3.3. Main functionalities of the wiki environment

TWIKI is a wiki platform which allows for easy operations. Student pages were automatically created just by adding the new page name (e.g. JeremyCothran) to the current wiki web (Main) listed in the browser address. The editing environment on TWIKI allowed students to change the content or wiki formatting. Revisions of the page by different students and sessions were tracked for comparison or restoration of previous content. Other functionalities available to students in the TWIKI environment set up for the study were:

- 'Attach' – add attachments, images to the wiki page
- 'Printable' – create a printable version of the wiki page
- 'Total page history' – shows the previous edits on the wiki page
- 'More topic actions' - delete or rename a wiki page
- 'Reversion'- to restore previous version of the page

To support students' collaborative work and allow them to engage in dialogic argumentation, the "Add comment" box was activated in each wiki page (Fig. 9).

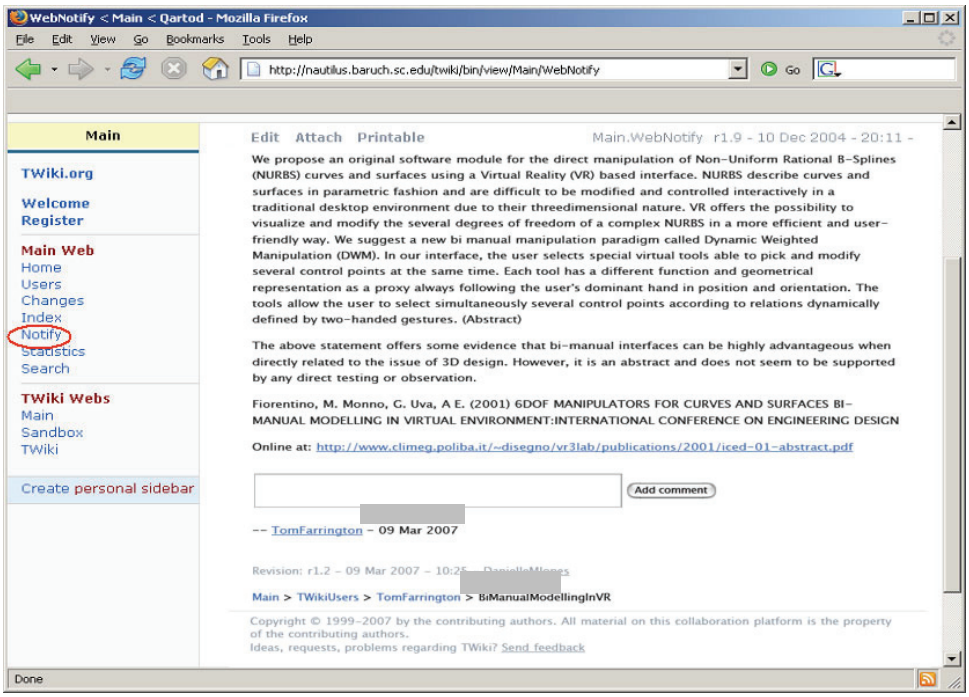


Fig. 9– TWIKI sample page (Case Study 2) with "Add Comment" box

This feature allowed students to post their 'rebuttal' directly on the main argument page. Fig. 9 shows an example of an 'argument' page from Case Study 2 with the comment area.

3.3.4. Trustworthiness and Data Analysis

Given the distinct objective of the three phases of the research, different data collection instruments and sources were applied. Once collected, the data was initially treated in the same fashion. To familiarize with it, the participant researcher immersed herself in the data by reading her observations, watching the video recordings of the students' sessions, reading all the arguments on wiki pages created by the participants at different develop stages, as well as their intermediate and final essays. During the immersion stage, the participant researcher annotated the data. For instance, the initial arguments created by the participants with wiki technology were expounded with information extracted from the videos footage, and transcripts of group conversations, or "scratch notes" regarding students' emotional reactions and dispositions during dialogic argumentation were added (Fig. 10).

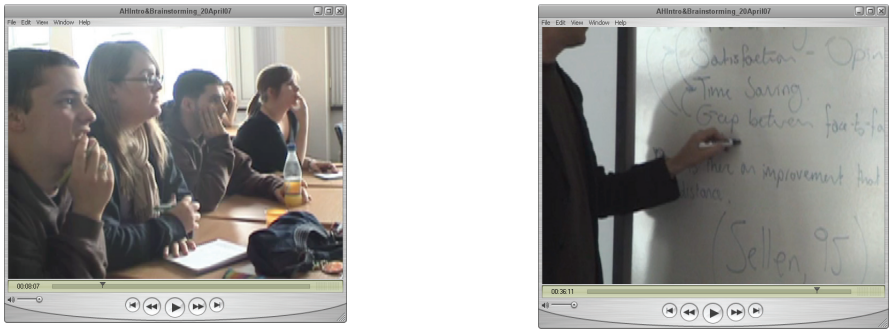


Fig. 10 - Case study 2. F2F round robin activity with students

"AH introduces the new claim "Distance Matters" ... and starts a round robin of definitions. Members of FOR group start proposing element to be added on the common list… Students seem all very nervous…they do not seem to be familiar with the topic proposed…AH moderates the round robin and cleared-up the points raised… only 2 (U & S) out of 9 students attending today's lecture remain silent …IDEA: AH could challenge them with "provocative" (unsubstantiated) claims….." [Excerpts from "F2F session on 20/04/07" field notes - Case study 2]

The immersion stage was followed by the transcription of the video recording of the face to face sessions, the "think aloud" of sample participants, and Interviews. The transcription of all the case studies presented here was done by the participant researcher. Transcribing became a reconstruction of episodes by embedding relevant arguments created by the participants at the precise moment in which it was being discussed or used in the transcript. During the second phase, the researcher started analyzing the data by

identifying episodes relevant to the issues under investigation, applying the Explanation building strategies (Yin, 2003). Additionally, in order to test the interpretations and propositions arising from one data set, these were checked against other data sets. For instance, the observations made by the participant researcher were tested against data from the video recordings of the sessions, the interviews with the students, and the participants' comments recorded in final questionnaire. All the arguments created by the participants, at different development stages, were also analyzed against the foregoing data sources. In particular, the reconstruction of contextualized argumentative episodes as they happened was possible by watching the "think aloud" video recordings and simultaneously analyzing the wiki page at that precise moment of their creation. The foregoing enabled the researcher to re-contextualize single units of argumentation, rebuttals, strategies adopted, students' approach and movements in the wiki environment, and conversations to gain insight into the meaning of the episodes themselves.

In this study, various types of empirical data has been gathered as illustrated above. Construct validity was fostered through using data triangulation (Denzin 1984) in the sense that different types of empirical material (e.g. students' interviews, talk aloud transcripts, wiki-based documents, including suggested procedures) were contrasted with each other when categorising the various types of material.

Chapter 4 Using Wikis in Small Group Learning – Case study 1

4.1. Introduction

This chapter presents the first of the three case studies carried out while developing the Wiki*DiA* conceptual architecture.

The next section presents the objectives which guided the general design of the first exploratory study. This is followed by an overview of the specific methodology adopted in this case study, a description of the context and participants, an outline of the procedure, a summary of the data sources and main outcomes. The chapter concludes with a discussion of the outcomes as they regard the design and development of the Wiki*DiA*, and the hypotheses examined in this phase of the research.

4.2. Objectives

This case study focused primarily on the ease of use of wiki technology in supporting small group learning on collaborative argumentation. The assumption is that the recognition of the interactive process of cognition does not preclude examination of argumentative skills and outcomes with the individual (Kuhn et al, 1997). Here, the focus is on outcomes in the form of individuals' acts of reasoning with respect to the topic that has been the focus of pair interaction, seen as a means of engagement in dialogic argumentation and co-decision strategies.

Particularly, this case study was underpinned by the following statements of purpose concerning the objective of the research:

- Increase peer interaction opportunities to engage with argumentative activities.
- Support critical operations in co-decision processes of small group learning.
- Create conditions conducive to the emergence of critical thinking (weaknesses of other people's standpoints).
- Create conditions to nurture argumentative reasoning (one's own positions supported with relevant and adequate grounds).

4.3. Methodology

In Case study 1, a 'mixed' approach was adopted, based on both quantitative and qualitative methods that complemented one another (Bryman & Bell, 2007). By using a mixed approach, it was possible to gather a variety of data and gain different-angle perspectives on the considered experimental situation, which allowed to build a wide and precise picture of students' behavior and achievements, therefore getting in the position to draw more meaningful conclusions.

The first approach adopted is based on content analysis. This is a research method to investigate the dynamics indicated by written interactions between subjects, which is increasingly used in CSCL since it supports an objective and systematic description of the content of communication. It consists in detecting phrases, expressions and indications of operations carried out that reveal the aspects of interest in the written messages exchanged by a group of learners. Hence, through a qualitative analysis it leads investigators to gather quantitative data about the frequency and nature of the considered actions. The purpose of carrying out content analysis in this case study was to get an overall picture of what actions students carry out when using wiki spaces in co-decision processes. As stated by Bryman & Bell, (2007) a major advantage of content analysis is that it is an unobtrusive method of investigation, as it does not require anything from participants. Moreover, it allows the researcher to analyze directly what students actually did over the whole duration of the activity, hence providing data which are not possibly affected by learners' *a posteriori* reflections, hence providing a good tool to complement other sources of data, like questionnaires (Dettori & Persico, 2008). Finally, content analysis appeared particularly suited in this case, since students' actions constitute manifest elements, and hence their detection could be automated and was therefore not biased by coders' points of view.

The second approach adopted was qualitative, that is interviews with students. This technique placed more emphasis on a qualitative approach, collecting qualitative data by setting up a situation (the interview) stimulating students to talk about their own insight and views on several aspects of interests for the phenomenon under investigation.

A semi-structured interview was chosen for this case study to get in-depth information on students' point of view and to generate data about critical incidents. There are various advantages and disadvantages to this type of interview, as detailed below.

- High validity: people are able to talk about a topic in detail and depth. The meanings behind an action may be revealed, as interviewees are able to speak for themselves with little direction from the interviewer;
- Complex questions and issues can be discussed/clarified: the interviewer can tackle areas not planned *a priori* but suggested by the respondent's answers, by picking up information of which the interviewer had no prior knowledge;
- Lack of pre-judgment: the conversation is not, or in very limited measure, biased by the interviewer's pre-judgment of what is or is not important information. This allows also information on unexpected aspects to surface.

Semi-structured interviews, however, also show some disadvantages (Bryman & Bell, op.cit):

- They are more time-consuming than tightly structured interviews or questionnaires, since the interviewees have a good amount of freedom in their answers.
- They are difficult to replicate: since the questions asked are not standardized, respondents may react in different ways, which may lead the conversation in different directions from case to case; this my result in gathering interviews non completely comparable with each other.
- Depth of qualitative information: since an unlimited number of points may be considered, it may be difficult to analyze the total amount of data, for example deciding what is most relevant.

In this case, however, these drawbacks do not appear to limit the feasibility and quality of the study, due both to its exploratory nature and to the fact that interviews' outcomes are complemented with data of a different nature.

All but 5 interviews were tape-recorded and transcribed: 1 participant refused to be taped and the tape recorder malfunctioned during another interview. All participants were assured that their responses would remain confidential and anonymous.

For interviews not taped, alongside with the others, detailed notes about how the interview went (was interviewee talkative, cooperative, nervous) were also recorded as well as any other feelings about the interview (did it open up new avenues of interest?) and the setting (busy/quiet, many/few other people around in the vicinity).

4.4. Context and participants

The activity was carried out within the postgraduate course on "Human Computer Interaction (HCI) and Web User Interfaces" at the School of Informatics, University of Manchester, (UK) in the spring semester 2007 and was counted for credits within the course activity. The course was aimed at developing abilities to:

- Construct arguments that are based on supporting literature (not personal opinions).
- Discuss various topics in pair and group settings in a scientific and collegial manner.
- Combine contributions from group members into a coherent report.
- Present your ideas verbally in a clear, structured and succinct way.
- Apply HCI principles to design lifecycle.

The course was therefore a good environment to carry out an activity on dialogic argumentation (see the coursework details in the Appendix B). Despite the central role of argumentation in the course program, no argumentation model was given to the students except for the Neutral Point of View tutorial described in the Chapter 3.

The experimental group included all participants of the course: 42 postgraduate students, among which 30 males and 12 females.

The ages were ranging from 24 to 48, with an average of 26.6.

Since the course was interdisciplinary, the participants had a variety of background: engineering, business technology, philosophy and religion. Participants did not have previous experience in collaborative argument construction.

Also the country of origin of the students was rather various, as shown in Table 6 below.

Table 6 – Country of origin of participants in Case study 1

Country of origin	Number	Percentage
China	15	35.71%
Greece	8	19.05%
UK	9	21.43%
Egypt	2	4.76%
Palestine	2	4.76%
India	2	4.76%
Saudi Arabia	1	2.38%
Nigeria	1	2.38%
Portugal	1	2.38%
Israel	1	2.38%

The presence of students from many different countries, who were therefore not native English speakers, did not affect the outcome of the study since all of them had a sufficiently good knowledge of English.

A consent form to use any data of this experience was signed by all participants (see Appendix A).

4.5. Procedure

The course module lasted 8 weeks, 1 hour per week. Case study 1 involved practical exercises aimed at developing students' skills in reflecting, discussing and negotiating web user interfaces design principles. To facilitate negotiation process, a scenario-based activity was proposed about designing a 'targeted' advertisement for Manchester city as a tourist destination. The design activity was organized around three main topics and related tasks:

- **Task 1**. 'Format' choice for the advertisement (e.g. among big screen, touch screen or paper-based).
- **Task 2**. 'Target audience' or advertisement focuses definition (e.g. outdoor sport, history, science and industry, culture and arts, etc.)
- **Task 3**. 'Color scheme' and screen template choice for the website.

Students were randomly assigned to small groups learning: 7 groups were created and worked in parallel. Each group was split into three pairs and given a TWiki space for tasks activities and collaborative production. The architecture of this experimental situation is depicted in Fig. 11.

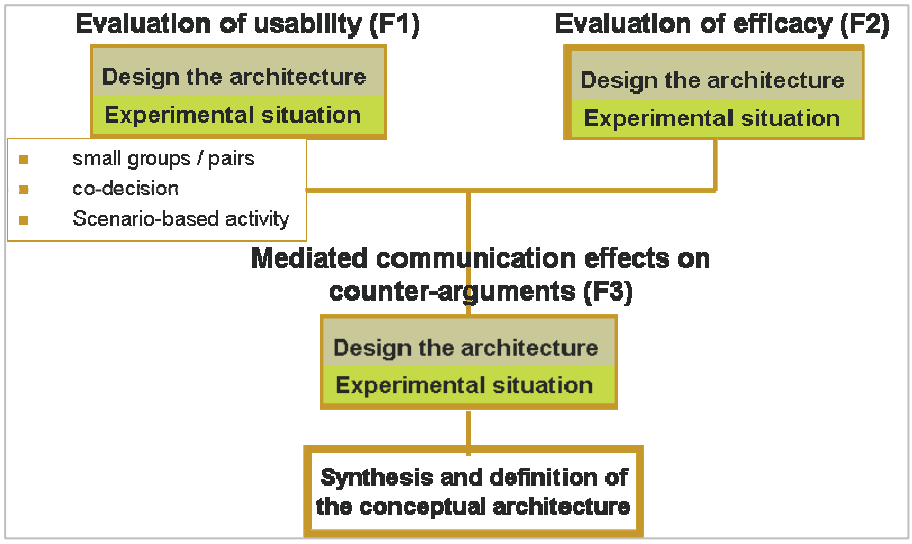


Fig. 11 - Architecture of the experimental situation for this case study (phase 1)

Pairs within a same group were invited not to cover the same topic. For each task, the procedure described in Table 7 was adopted.

Table 7 – Small groups and Pairs activity structure

Session	Duration	Collaboration level	Activity/ Aim
Classroom session (face to face)	1 hour	Group	**Discussion (15 min).** To define, before the end of the session, which topic (e.g. format) each pair was going to analyze and 'defend' during the following week (as a group, they must gather information about all the three proposed formats).
		Pairs	**Get organized (45 min).** To start gathering information on the chosen topic (e.g. touch screen format) and organize pair's collaborative production.
Outside classroom (wiki-based)	2 weeks	Pairs	**- Pair's position paper (1 week).** To explain and argue strengths of that particular choice (e.g. touch screen format) (max. 250 words). **- Comments on the other two pair's papers (3 days).** To highlight "con" and weaknesses of the other two choices (e.g. paper-based and big screen format). **- Summary of strengths and weaknesses (2 days).** To compose a table to summarize the "pro" and "con" of their own choice (based on comments from the other 2 pairs).
Classroom session (face to face)	1 hour	Group	**Final decision (15 min).** To negotiate and co-decide what option (e.g. format) among those discussed to be adopted and implemented by the group's final project work.

In order to help group activity, each group gathered in its wiki space all the facts and documents collected. Hence, each group used its wiki space to collaboratively produce a position paper, comment other pair's papers and summarize the "pros" and "cons" of their own claim. Having all materials and discussion in one place, resulted useful when students wrote their final report.

4.6. Data sources and analysis procedures

An overview of the data sets collected during Case study 1 is presented in Table 8. Data include: tape recording of group face to face discussion during classroom sessions; the participant researcher's notes on group member interactions and discussion during classroom sessions (Fig. 14); group' position papers (on wiki pages) related to all tasks; students' comment to other pair's position papers (on wiki pages) related to all tasks; pairs' summary strengths and weaknesses of their own paper (on wiki pages) related to all tasks; group final decision (reported on wiki pages) related to all tasks; history of all operations (and type of) performed on wiki pages; interviews full transcripts; interviews notes.

Table 8 – Set of data collected for Case study 1

GROUPS	Tape recording classroom sessions	Observer 's notes on f2f debates	Pairs position papers (wiki pages)	Pairs' comments (wiki pages)	Summary strengths & weaknesses (wiki pages)	Group final decision (wiki pages)	History of operations on wiki pages	Interview transcripts	Interview notes
G1	x	x	6	✓	✓	✓	✓	1	✓
G2	x	✓	6	✓	✓	✓	✓	1	✓
G3	x	✓	9	✓	✓	✓	✓	0	✓
G4	x	x	11	✓	✓	✓	✓	1	✓
G5	x	✓	9	✓	✓	✓	✓	1	✓
G6	x	✓	8	✓	✓	✓	✓	1	✓
G7	x	x	8	✓	✓	✓	✓	0	x

During classroom sessions, 3 to 4 groups were meeting in the same lab (Fig. 12 and Fig. 13); for this reason, tape/video recording of face to face discussion resulted in poor quality (or bad) audio and video information and was, therefore, not used in the study.

Fig. 12 - Classroom session – Group 5 discussion

Fig. 13 - Group 1 final decision

February 22nd 2007 -Thursday. G5 meeting was about to make a decision on which format they should choose for their final project. There were only two formats considered (touch screen and big screen) due to insufficient group members. Pair1 (actually three students) analyzed big screen format, while pair2 did the touch screen format. After 'passionate' discussion on strengths and weaknesses of the two formats, the group finally decided to choose big screen format". [Excerpt from Group5Meeting – observation notes].

Fig. 14 - Example of the participant researcher's observation notes.

4.6.1. Semi - structured interviews

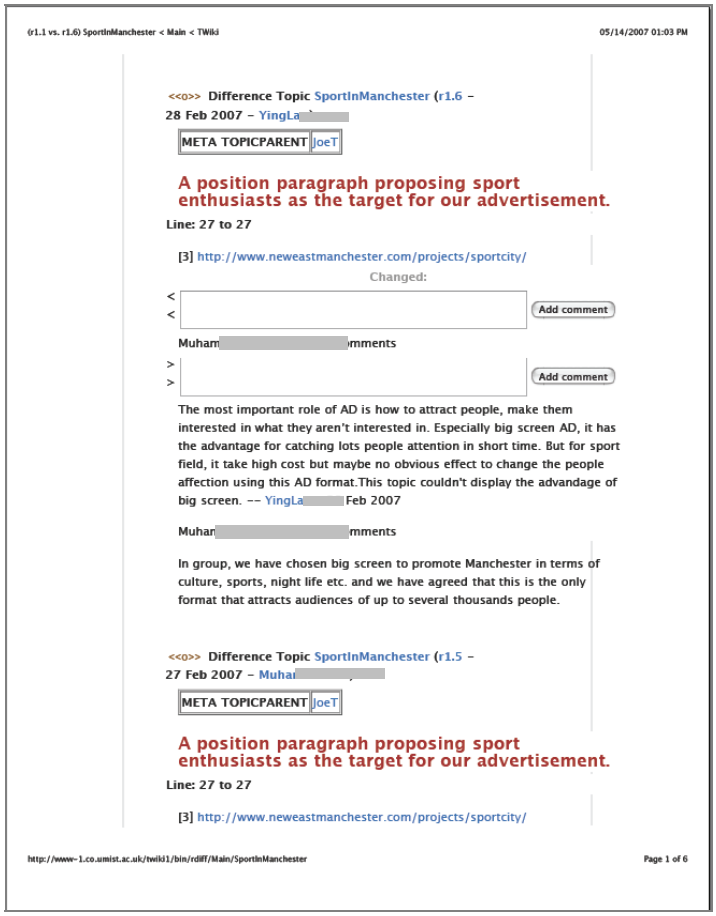
The interview covered a range of issues including motivations, organizational culture, dialogic argumentation, co-decision strategies (see the interview guide in Appendix C). It also included questions about the role of wiki technology and pair's collaboration style. In this analysis, the main focus was on sections of interview that deals with decision making process in constructing dialogic argument and the role of social text; this formed the basis for conclusion on how social text technologies supports dialogic argument construction in small group learning.

Semi-structured interviews with 7 students (one representative from each group agreed to participate on a voluntary basis) were conducted. Interviews took place in a school lounge and lasted between 45 minutes and 1 hour and a half.

4.6.2. Content analysis

History files of all wiki pages created by students were the primary source of information on the usability of the TWIKI environment. To this end, the present content analysis focused on students' usages of wiki base functionalities to create and develop their collaborative argumentation. Fig. 15 shows data (type of changes, author's changes, date, sections modified) contained in the history files.

All versions were included in the process to make sure that the categories cover the full range of possible data variations. Considering important similarities with patterns of change identified by Zaphiris et al. (2006) and extensively used for studies on Wikipedia, it appeared adequate to rely on those categories, slightly adapted to better suit this case study, to code history entries.


(r1.1 vs. r1.6) SportInManchester < Main < TWiki 05/14/2007 01:03 PM

<<o>> Difference Topic SportInManchester (r1.6 – 28 Feb 2007 – YingLa

META TOPICPARENT JoeT

A position paragraph proposing sport enthusiasts as the target for our advertisement.

Line: 27 to 27

[3] http://www.neweastmanchester.com/projects/sportcity/

Changed:

< Add comment

Muham mments

> Add comment

The most important role of AD is how to attract people, make them interested in what they aren't interested in. Especially big screen AD, it has the advantage for catching lots people attention in short time. But for sport field, it take high cost but maybe no obvious effect to change the people affection using this AD format.This topic couldn't display the advandage of big screen. -- YingLa Feb 2007

Muhar mments

In group, we have chosen big screen to promote Manchester in terms of culture, sports, night life etc. and we have agreed that this is the only format that attracts audiences of up to several thousands people.

<<o>> Difference Topic SportInManchester (r1.5 – 27 Feb 2007 – Muhai

META TOPICPARENT JoeT

A position paragraph proposing sport enthusiasts as the target for our advertisement.

Line: 27 to 27

[3] http://www.neweastmanchester.com/projects/sportcity/

http://www-1.co.umist.ac.uk/twiki1/bin/rdiff/Main/SportInManchester Page 1 of 6

Fig. 15 - History of operations for wiki pages

4.6.2.1. Coding schema

Zaphiris et al. (2006) framework highlights several elements as relevant to understand contributors' activities (operations) in a wiki environment (Table 9):

Table 9 - Zaphiris et al. (2006) Wikipedia categorization

Name of Category	Explanation
Add Information	Addition of topic-related information (the information must not consist only of links).
Add Link	Addition of links to an existing set of listed links or linking of a word within an existing sentence to a page (links to other Wikipedia pages or to external Internet pages).
Clarify Information	Rewording of existing information without adding new information. Rewording done in order to clarify the content (e.g., substitution of certain words for a better understanding, change of the word order or deletion/ addition of words in order to clarify).
Delete	Information Deletion of topic-related information (the information must not consist only of links).
Delete Link	Deletion of links from the set of listed links or removal of the linking function from a word within an existing sentence (links to otherWikipedia pages or to external Internet pages).
Fix Link	Modification of an existing link (can be an alteration of the linked URL or the name of the link).
Format	Contributions that affect the appearance or structure of the whole page (e.g., addition of space lines, sorting/moving of papers or links and addition of subtitles in order to structure the content).
Grammar	Alterations of the grammar (e.g., change of punctuation).
Mark-up Language	Changes in the mark-up language that have no impact on the appearance of the page or the text (e.g., both ‘‘example’’ and ,b.example,/b. print the word example in bold face).
Reversion	Reversion of the page to a former version (in order to reverse certain activities of users or to go back several versions in one step).
Spelling	Correction of spelling mistakes (e.g., reversed letters or capital letter).
Style/Typography	Contributions that affect the presentation or appearance of the text (e.g., bold/ italic/underlined text).
Vandalism	Entries/actions that are made in order to demolish the page

All categories except vandalism were applied in this content analysis. However, for the purpose of this study and for the sake of clarity, it was considered more meaningful presenting results by clustering Zaphiris' categories as follows (Table 10):

Table 10 - Clustering of Zaphiris' categorizations

Operation Cluster	Zaphiris' original cathegories
ADD	Add Information
	Add Link
MODIFY	Clarify Information
	Reversion
DELETE	Delete
	Delete Link
FORMAT CHANGES	Fix Link
	Format
	Grammar
	Mark-up Language
	Spelling
	Style/Typography

The history files were analyzed by means of qualitative data analysis software (ATLAS.ti), which allows one to locate, code, and annotate findings in primary data material, weight and evaluate their importance, and visualize complex relations among them (see Fig. 16).

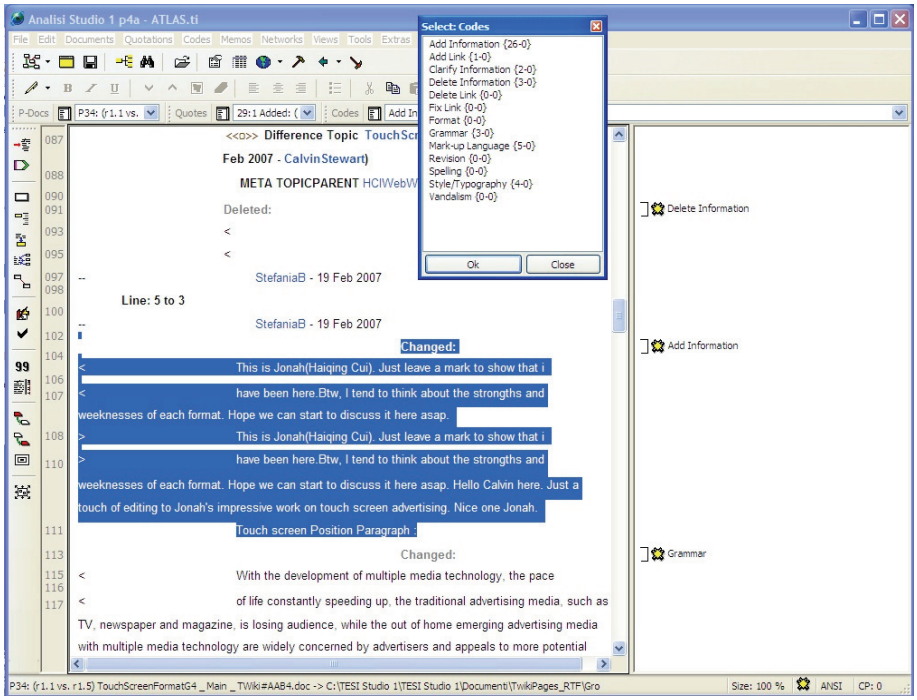


Fig. 16 - Qualitative data analysis software for coding history entries

The content analysis on history entries produced a number of interesting occurrences discussed in the following section and combined with students' interviews to get an overall picture of the experience.

4.7. Outcomes

All students took part at the activities from the beginning to the end, and all participated in document production even though in different measures. The analysis mainly focused on what kind of changes (henceforth *operations*) the students applied on their dialogic argumentation acts (that is within wiki pages, henceforth *documents*). These quantitative data were analysed by computing averages and standard deviation (SD).

For each group and for each task, the type of operations performed and their frequency in each task were analysed. Fig. 17 presents the average number of operations applied by each group across the three tasks. While Task 1 does not show significant differences in the average number of operations, a great variety emerges between Task 2 and Task 3 as well as among groups.

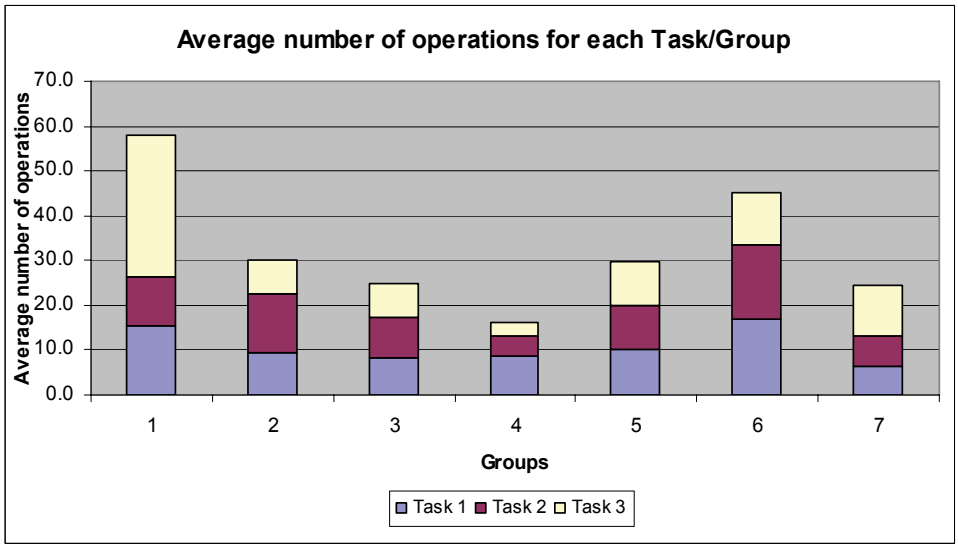


Fig. 17 - Average number of operations for each Task/Group

In the interviews, students confirmed the relevance and the type of operations they did (add, delete, modify or format changes) [excerpt 1,2]:

Interviewer: What did you edit of the work done by your pair (only doing changes, or adding stuff or even deleting)?

Interviewee4: I did a lot of tiding out proof of this particular group area, because people use different formats for linking to their pages…so I've just tried to make things in the same format, same way …this helped me reading people pages …so I'm okay, I'm happy with that …so…[pause – 30 sec]

Mainly were changes (I didn't delete anything) …and language corrections…just because I'm English native speaker… and most (in my group) were Chinese speakers …just tiding up …for me it was easy to see when you've tidied up …

Interviewer: Have you clearly discussed and established the norms of editing your common page with your pair?

Interviewee4: i didn't edit anyone else page (just the one with my pair) ..I read through them obviously but that's all… of course if I was an editor…that would be my job…I was a school teacher, you know…

Excerpt 1

Interviewer: Did you make any changes to the work done by your partner?

Interviewee1: yeah, most of the times I used to upload text or something like that…. to avoid meetings in order to start we said each of us can upload a text and the other could edit the text and make the corrections and all the stuff. So I made some changes to some of partners' text and I used to upload most of the text.

Interviewer: So did you make both Content changes? Language changes? in the structure and also by adding material…

Interviewee1: Everything…you just read the text and everything you want to …change…

Interviewer: have you also deleted some parts?

Interviewee1: Some of my text I uploaded and after 3 or 4 hours I decided that was not relevant…

Interviewer: did you notice some changes in you process of editing, adding, changing? …I mean, probably at the beginning you were not so comfortable in editing others contribution…

Interviewe1:…..wiki is easy to do but I haven't read the help since the first time I was trying if edit to see how to create links and all these and then I read you have two consecutive words with Capital letters in order to…[audio trace: 03:59] this a fact that I founded really ease to create links and edit them using "question" mark and…

Excerpt 2

Students stressed that they considered some operations particularly critical for the collaborative process with the group [excerpt 3]:

Interviewer: I mean… Have done any additions, deletions, changes suggested in the comments?

Interviewee1: I didn't want to do … but .. I thought of doing it …particularly in the last part that we wrote… about the screen template…the other pair just…. in our text we said like "to highlight …to show that the template we chooses… the right one… we will highlight the weaknesses of the others"… and we wrote a small paper of three lines… highlighting the weaknesses of the other format…and then the other pair … they had to write the weaknesses of our format …they just took this paper…. And said that "your format cannot do this kind…. Can't do this, Can't do this, Can't do this so… they said that our format can't do the things that the others could…and it was .. since I'm showing that in my paper … and say that what the others can do…and this is a weakness because is not suitable for our case…than the others used it as a weakness because It's something that my format cannot do… and they didn't even consider that is not suitable for the case that we were talking about

Interviewer: Why finally you didn't change it? You told I thought about to change but I didn't …

Interviewee1: ahhhh … I didn't want to be a mean …in some sort of way… I didn't want to…. Because is somebody's else work and it's their opinion … I didn't want to go and just delete the whole thing… because it wasn't no …additional changes that I could do …or add something to make it better …if I was going to make a change I was going to delete it …because it was nothing…it was not relevant with … it was not based on the concept of the…so I didn't want to be mean with the other pair… to delete the whole part…

Excerpt 3

Results in terms of the average number of operations for task documents are shown in Fig. 18. The ADD category is largely the most frequent operation with a steady growth over the 3 tasks. Compared to FORMAT, the high number of ADD operations shows that groups focused on shaping the content of their arguments much more than the formal appearance.

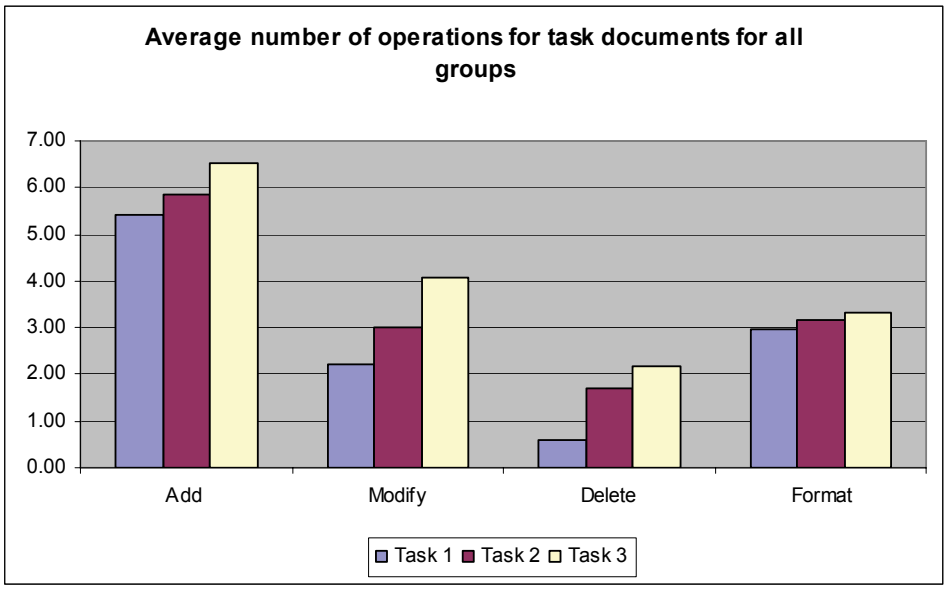
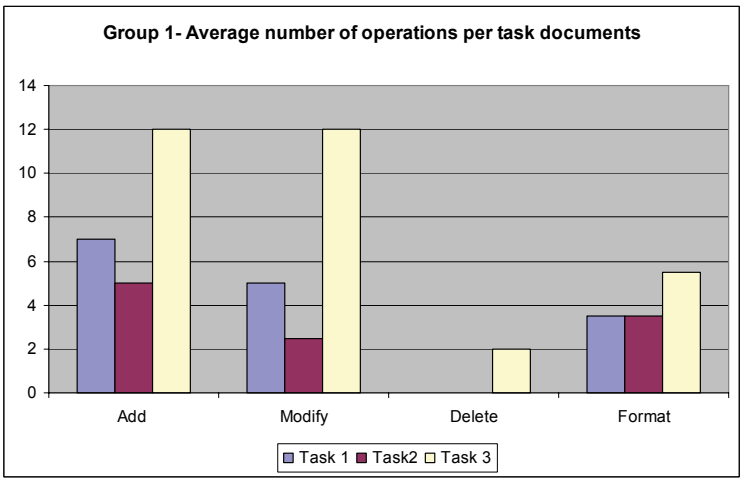


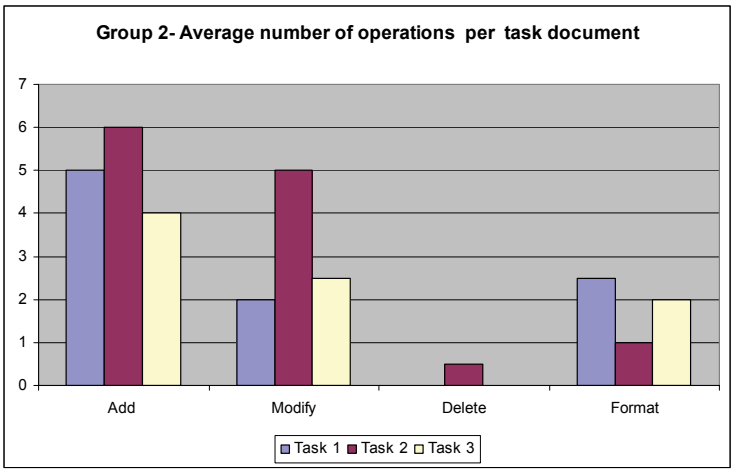
Fig. 18 - Average number of operations per task document

Also across tasks, the ADD operation appears the most frequently used by all groups (Fig 19 to Fig 25) and in all tasks (Fig 26).



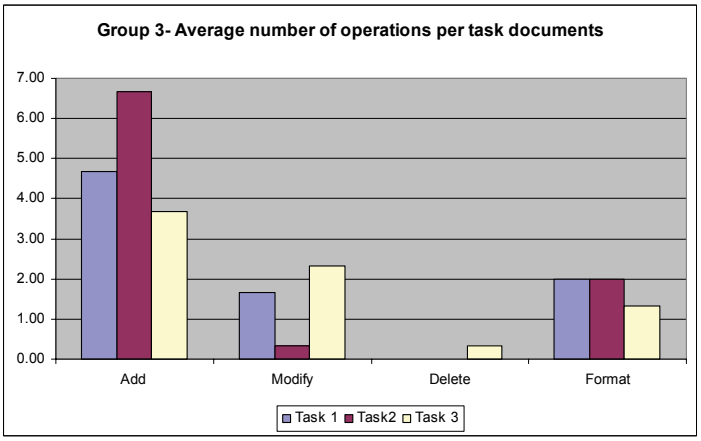
	Add	Modify	Delete	Format
Task 1	1.4	5.7	0.0	0.7
Task 2	1.4	3.5	0.0	0.7
Task 3	15.6	14.1	2.8	7.8

Fig 19 - G1 average number of operations per task document & Standard Deviation



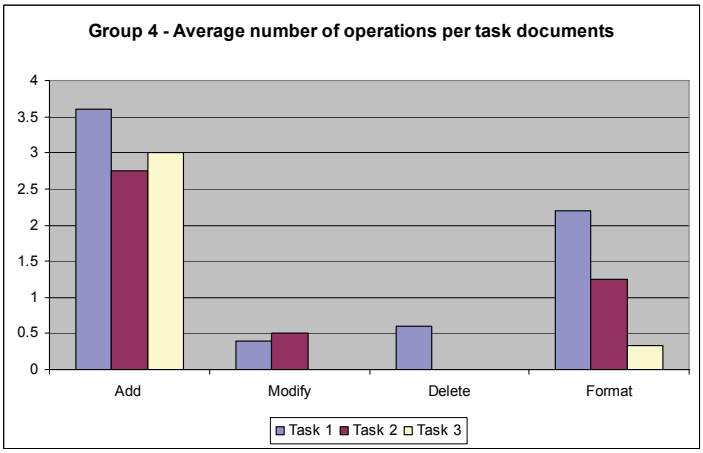
	Add	Modify	Delete	Format
Task 1	0.0	1.4	0.0	3.5
Task 2	4.2	2.8	0.7	1.4
Task 3	0.0	0.7	0.0	2.8

Fig 20 – G2 average number of operations per task document & Standard Deviation



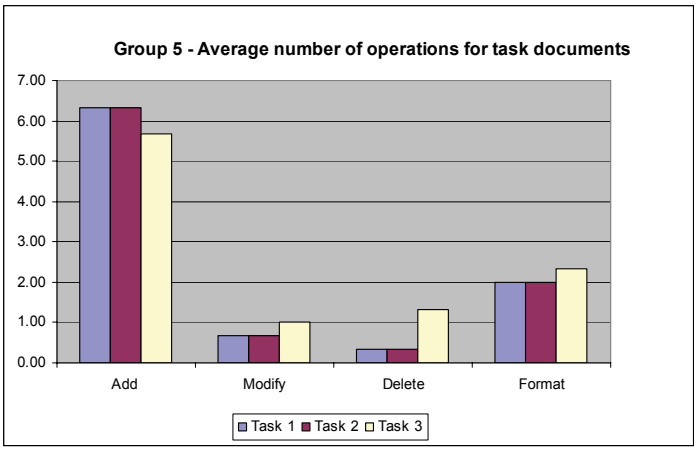
	Add	Modify	Delete	Format
Task 1	2.5	1.2	0.0	1.0
Task 2	2.3	0.6	0.0	1.0
Task 3	0.6	0.6	0.6	1.2

Fig 21 – G3 average number of operations per task document & Standard Deviation



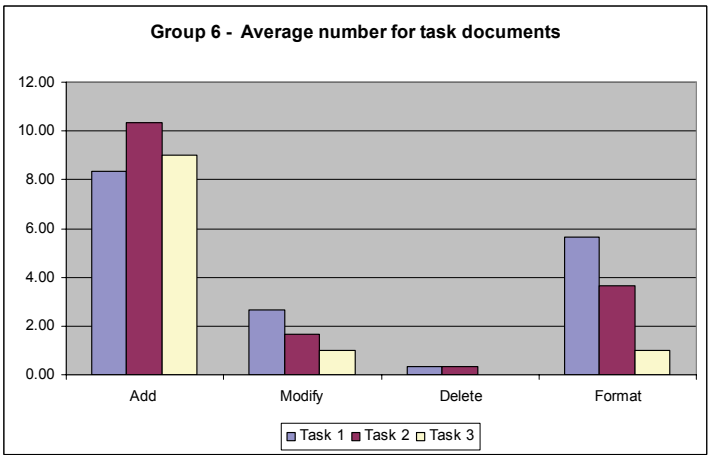
	Add	Modify	Delete	Format
Task 1	3.4	0.9	0.5	1.9
Task 2	1.3	0.6	0.0	0.5
Task 3	0.0	0.0	0.0	0.6

Fig 22 – G4 average number of operations per task document & Standard Deviation



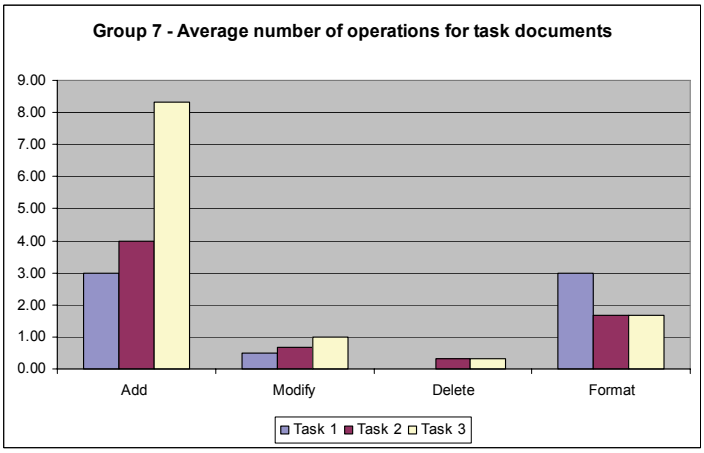
	Add	Modify	Delete	Format
Task 1	0.6	0.6	0.6	1.7
Task 2	0.6	0.6	0.6	1.7
Task 3	0.6	1.0	1.2	1.2

Fig 23 - G5 average number of operations per task document & Standard Deviation



	Add	Modify	Delete	Format
Task 1	0.6	3.8	0.6	4.0
Task 2	9.3	1.5	0.6	2.1
Task 3	1.4	1.4	0.0	0.0

Fig 24 – G6 average number of operations per task document & Standard Deviation



	Add	Modify	Delete	Format
Task 1	0.0	0.7	0.0	0.0
Task 2	2.0	0.6	0.6	1.2
Task 3	2.5	1.0	0.6	0.6

Fig 25 – G7 average number of operations per task document & Standard Deviation

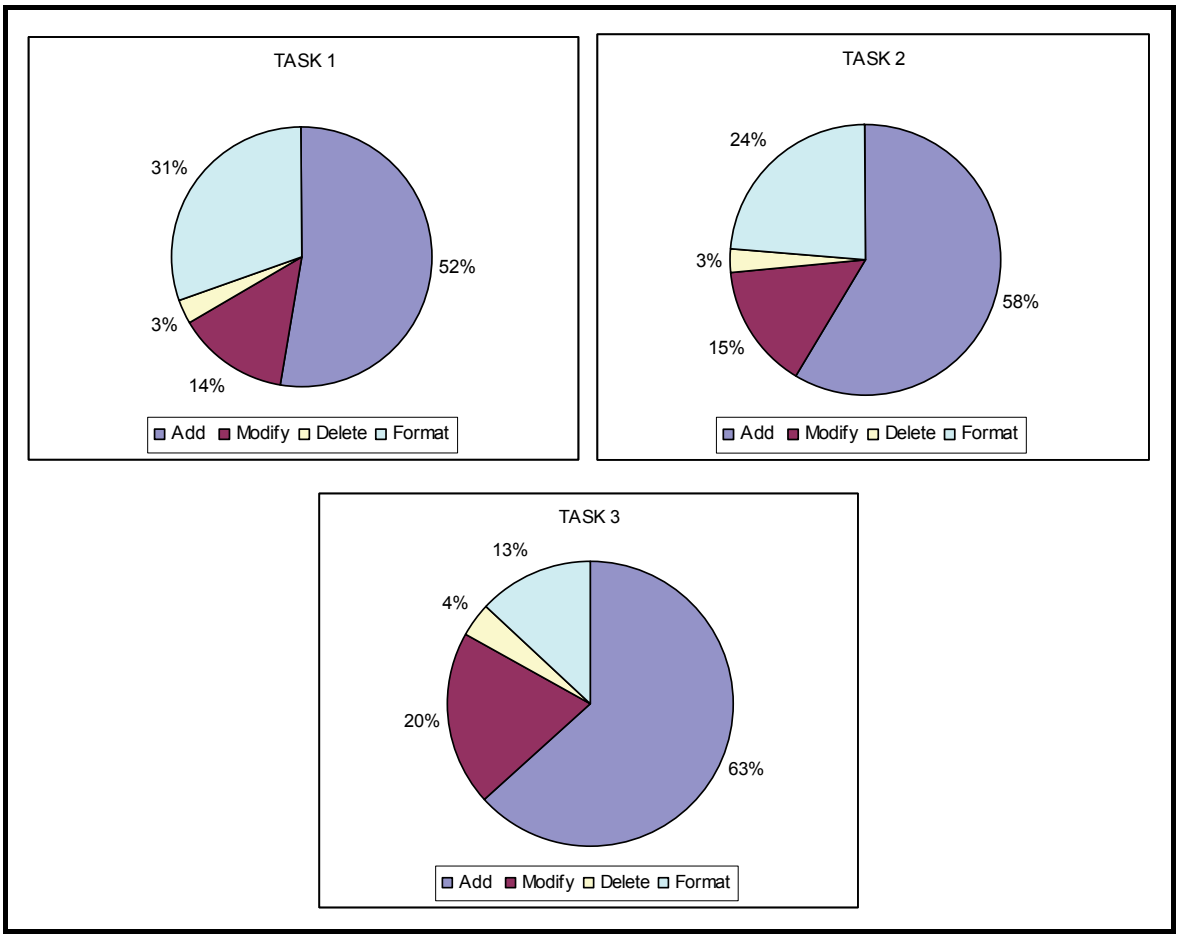
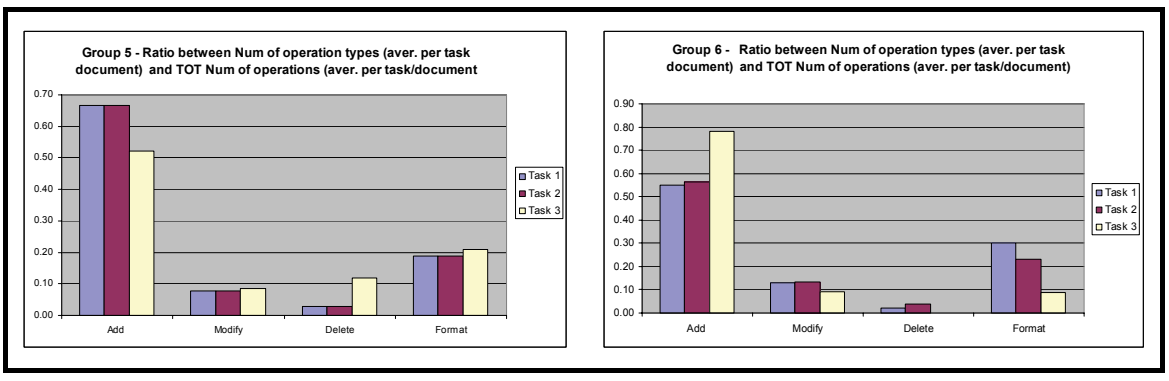


Fig 26 – Percentage occurrence of operation categories in the three tasks

Fig 27 shows the ration between the number of operation types and the total number of operations. This allows to verify operation trends without numerousness impact (in other words, to avoid the risk that groups who carried out a greater number of operations might affect results).



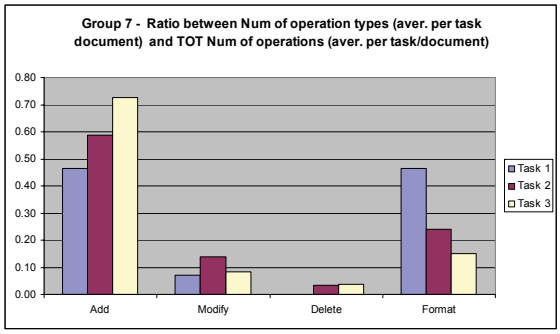


Fig 27 - Ratio: averaging number of operation / total number of operations (G5-G7)

In the interviews, students stress that the type of operations they choose to perform on their documents was often affected by social rules more than by the ease of use and the functionalities of the wiki space. The presence of collaborative functions in wiki environments does not appear sufficient to grant their use. Students tend to consider "inconvenient" to delete or modify their peers' arguments and for this reason they do not use much such functions. While students feel comfortable individually adding new contents, they feel the need to negotiate decisions about corrections and deletions. This underlines the importance that wiki spaces include not only an edit panel but also wide possibilities of discussion connected to it [excerpts 4, 5, 6]:

Interviewer: how did you communicate among you, I mean with your partners?

Interviewee1: Mostly by MSN, it could be useful if wiki had like a chat function or something because we will using wiki to edit the text and have a chance to chat because obviously you say a lot more in the chat and do less changes…instead of changing something and then wait for the other one to edit it and then you have to see it again and…

Excerpt 4

Interviewer: how did you communicate among you, I mean with your partners?

Interviewee1:: Mostly by MSN, it could be useful if wiki had like a chat function or something because we were using wiki to edit the text and have a chance to chat because obviously you say a lot more in the chat and do less changes…instead of changing something and then wait for the other one to edit it and then you have to see it again and…

Excerpt 5

Interviewer: Okay can you describe in details the development process you've got through during your last position paper?
Interviewee4: Okay…I went to this place (i.e. on Twiki) …then there were three things write… I did one, H. made the other and the last one we did it together … so I would open one, I would add something probably would remove or add… you know …(I: what have you added?) mainly new arguments …evidences, (reasons) that kind of things and would edit as well…
Interviewer: what did you discuss on MSN?
Interviewee4: I asked him to tell me his position on this position paper or whatever we had to do …and analysed tighter… if I had something better I would have tell him… if I think is wrong I tell him…if I think it's okay I tell him…
Interviewer: So it looks this was a fundamental part you did on MSN…something you think was not possible to do in wiki …
Interviewee4: Yeah, not possible…wiki is not live…you can do it but it will take more time I can put on something and he can think on this and he will change it and I can see it ….but it will take too much time…MSN, or skype are more immediate…"I think this, this, this…" and you've done…

Excerpt 6

Students' insights during interviews also help to gain a better understanding of the different use of the available operations: while few students created their draft contribution directly on the wiki [excerpt 5], others adopted a more traditional approach by creating it on their local computers and then "publishing" it in the wiki for peer's corrections and discussion [excerpt 7, 8]:

Interviewer: And how did you keep on working in the following tasks?
Interviewee1: the first time we didn't use wiki that much…. We met and we discussed… but the other times…. Because we founded that it was not convenient to meet we started using the wiki more and more …

Excerpt 7

Interviewer How did you interact with your pair? Mainly by face to face, or by email, or by wiki?

Interviewee 6: Mainly by phone, especially at the beginning for doing our paper on the wiki…I remember on the first week we discussed by the phone and we changed the whole content …and discussed what to put in the paper, what was good, what not…but the discussion was mainly on the phone but that was only on the first week…and then we decided who did the paper, who did the summary… just watching on the wiki…that was much easier…

Excerpt 8

A number of other factors also contributed to different use of available operations such as the task's overlapping with external commitments [excerpt 9], "trust" building [excerpt 10] and common understanding of collaborative dynamics [excerpt 11]:

Interviewer: Are you happy with the costs of time of the activities performed and the training you received?

Interviewee 5: The timing itself was not bad….the problem was the cost of time….probably it was me … I was very busy this semester so you have many assignments so you tend to set them all…so using wiki, discuss… it was a bit tight ….so you have to do one…some other type …sometimes I did it on the morning just before the deadline …. Do yes, I found that the cost if time was high… probably it's the time too tight… you would need one week to do this…rather than three days…activities were too frequent…

Excerpt 9

Interviewer: [So…did you feel free to make changes to others' contributions? I mean, did you trust them?]

Interviewee 6: Yes, I trusted him (*her pair*) otherwise I don't like anybody changes my content…that was a problem I realize… because I had access to all contents (position papers) of all the group and…that was… there was no protection, no privacy at all…anyone *(of students)* could have access, make changes, copying…

Interviewer: [what's your feeling about it?]

Interviewee 6: I'd prefer that others have no access to my content…

Interviewer:[but was it different with your pair?]

Interviewee 6: yes, was different because we were working together, we had the same task... *(objective, here)* but for the other I didn't like the fact they could access my content….

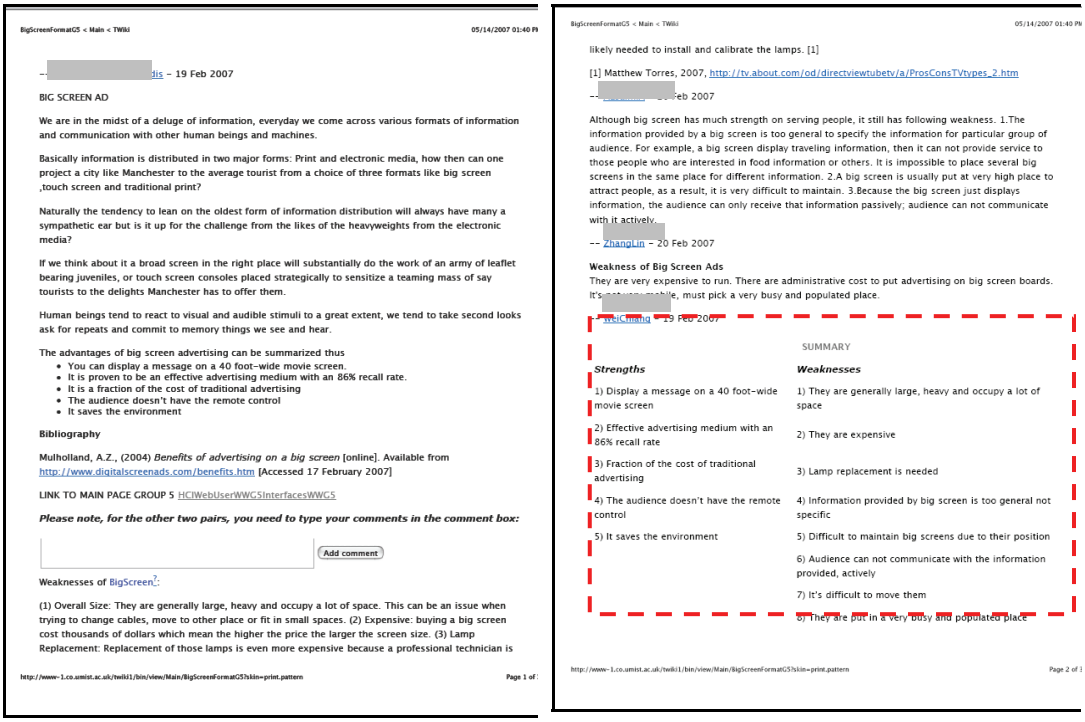
Excerpt 10

Interviewer Like for example?
Interviewee1: like changing the opinions through email or …messaging services or….. sending pieces of text, or in one situation we were programming…constructing a program …so …with my partner we were sending code… it was the first time that I used some sort of wiki technology to upload something and then the other part can edit the text at the same time and I can see the changes really fast … so, I prefer that …I think that.. as I told you before… if the whole team has a spirit through collaborate it's helpful but… if the ….whole collaboration with the team is not working very well and ….some members don't want to interfere with others or … they don't have a really good relationship…so wiki is not going to be helpful…because one member can upload the text the others don't even bother to take a look … if you don't have a f2f communication as well… because in f2f communication … even of there is a member who doesn't care…can't be just sitting in a corner…and don't speak … it comes time that the others will ask you ..but using wiki he can just deliberate to take a look…

Excerpt 11

In order to analyse students' decision making skills, the content analysis was extended to pairs' documents (i.e. pair's position papers – see Fig 28, comments to other pair's paper, summary of strengths and weaknesses, group final decision).

Surprisingly, the positions adopted by some groups was not the position for which more strengths were listed (see Table 11); in some cases (e.g., Group 4 on Task 1), groups choose on a position even when this showed more weaknesses than strengths. This suggests that the students did not based their the decision process simply on picking the position with the longest list on the positive side, but actually carried out an argumentation process also in the last phase of the activity, looking the content of the reported arguments and selecting the most convincing ones. This interpretation is supported by an opinion expressed by the course teacher, who was very satisfied of the quality of the groups' final reports.



BigScreenFormatG5 < Main < TWiki 05/14/2007 01:40 PM

-- [redacted]dis – 19 Feb 2007

BIG SCREEN AD

We are in the midst of a deluge of information, everyday we come across various formats of information and communication with other human beings and machines.

Basically information is distributed in two major forms: Print and electronic media, how then can one project a city like Manchester to the average tourist from a choice of three formats like big screen ,touch screen and traditional print?

Naturally the tendency to lean on the oldest form of information distribution will always have many a sympathetic ear but is it up for the challenge from the likes of the heavyweights from the electronic media?

If we think about it a broad screen in the right place will substantially do the work of an army of leaflet bearing juveniles, or touch screen consoles placed strategically to sensitize a teaming mass of say tourists to the delights Manchester has to offer them.

Human beings tend to react to visual and audible stimuli to a great extent, we tend to take second looks ask for repeats and commit to memory things we see and hear.

The advantages of big screen advertising can be summarized thus

- You can display a message on a 40 foot-wide movie screen.
- It is proven to be an effective advertising medium with an 86% recall rate.
- It is a fraction of the cost of traditional advertising
- The audience doesn't have the remote control
- It saves the environment

Bibliography

Mulholland, A.Z., (2004) *Benefits of advertising on a big screen* [online]. Available from http://www.digitalscreenads.com/benefits.htm [Accessed 17 February 2007]

LINK TO MAIN PAGE GROUP 5 HCIWebUserWWG5InterfacesWWG5

Please note, for the other two pairs, you need to type your comments in the comment box:

Add comment

Weaknesses of BigScreen?:

(1) Overall Size: They are generally large, heavy and occupy a lot of space. This can be an issue when trying to change cables, move to other place or fit in small spaces. (2) Expensive: buying a big screen cost thousands of dollars which mean the higher the price the larger the screen size. (3) Lamp Replacement: Replacement of those lamps is even more expensive because a professional technician is

http://www-1.co.umist.ac.uk/twiki1/bin/view/Main/BigScreenFormatG5?skin=print.pattern Page 1 of

BigScreenFormatG5 < Main < TWiki 05/14/2007 01:40 PM

likely needed to install and calibrate the lamps. [1]

[1] Matthew Torres, 2007, http://tv.about.com/od/directviewtubetv/a/ProsConsTVtypes_2.htm

-- [redacted] Feb 2007

Although big screen has much strength on serving people, it still has following weakness. 1.The information provided by a big screen is too general to specify the information for particular group of audience. For example, a big screen display traveling information, then it can not provide service to those people who are interested in food information or others. It is impossible to place several big screens in the same place for different information. 2.A big screen is usually put at very high place to attract people, as a result, it is very difficult to maintain. 3.Because the big screen just displays information, the audience can only receive that information passively; audience can not communicate with it actively.

-- ZhangLin – 20 Feb 2007

Weakness of Big Screen Ads

They are very expensive to run. There are administrative cost to put advertising on big screen boards. It's not very mobile, must pick a very busy and populated place.

-- WeiChiang – 19 Feb 2007

SUMMARY

Strengths	***Weaknesses***
1) Display a message on a 40 foot-wide movie screen	1) They are generally large, heavy and occupy a lot of space
2) Effective advertising medium with an 86% recall rate	2) They are expensive
3) Fraction of the cost of traditional advertising	3) Lamp replacement is needed
4) The audience doesn't have the remote control	4) Information provided by big screen is too general not specific
5) It saves the environment	5) Difficult to maintain big screens due to their position
	6) Audience can not communicate with the information provided, actively
	7) It's difficult to move them
	8) They are put in a very busy and populated place

http://www-1.co.umist.ac.uk/twiki1/bin/view/Main/BigScreenFormatG5?skin=print.pattern Page 2 of

Fig 28 - Pair 3 position paper and summary of strengths & weaknesses (G5-Task 1)

Table 11 – Strengths/Weaknesses op positions and final decisions

		Position	Strengths	Weakness	Position within the final report
GROUP 1	T3	position 1	5	2	
		position 2	5	6	x
	T1	position 1	9	8	
		position 2	8	5	x
	T2	position 1	5	4	x
		position 2	6	2	
GROUP 2	T1	position 1	8	4	x
		position 2	3	3	
	T2	position 2	6	1	
		position 1	9	3	x
	T3	position 2	3	3	x
		position 1	9	1	
GROUP 3	T3	position 1	3	3	
		position 2	3	2	
		position 3	4	3	x
	T1	position 2	6	5	
		position 1	5	5	x
		position 3	7	6	
	T2	position 1	4	4	
		position 2	4	1	x
		position 3	3	3	
GROUP 4	T3	position 1	2	2	x
		position 2	5	1	
		position 3	3	2	
	T1	position 3	8	6	
		position 1	4	6	x
		position 2	10	6	
	T2	position 3	3	3	
		position 1	6	3	x
		position 2	3	3	
GROUP 5	T3	position 1	3	1	x
		position 2	3	3	
		position 3	3	2	
	T1	position 3	5	8	x
		position 1	7	4	
		position 2	8	8	
	T2	position 1	4	2	
		position 3	6	6	x
		position 2	6	6	
GROUP 6	T3	position 1	6	1	x
		position 2	3	1	
	T1	position 3	8	5	
		position 1	7	7	
		position 2	9	5	x
	T2	position 2	5	4	
		position 1	3	2	x
		position 3	3	3	
GROUP 7	T3	position 1	1	1	
		position 2	2	2	x
		position 3	2	2	
	T1	position 1	6	3	
		position 2	4	6	x
	T2	position 1	3	2	
		position 3	6	5	
		position 2	6	5	x

In the interviews, decision making strategies emerged at both pair [excerpt 12] and group level [excerpt 13, 15]; these comments spot both positive and negative aspects of working in the wiki environment. They highlight in particular the need of giving the students a sound methodology to structure the work and lead the students to really get involve in the activity. It's interesting to note that several students appear to miss direct contact with their mate. This is not surprise since the students did not have any previous experience of online learning. This is a difficulty that novice online learners usually face and it is usually overcome with experience. The positive learning outcomes pointed out by the course teacher, suggest that despite their uneasiness the students managed to take advantage of this activity for learning.

Interviewer: Can you think of an example of where you and your partner did develop a new argument through interaction via the wiki?
Interviewee1: ehmm … when we had to choose the format of the whole advertisement …and we had to judge the other teams paper… and we came out with some weakness of the paper based format….. some of them came through conversations and some new ideas in some kind of way… new in the way that we didn't find them in a text or something like that … we…they came through thinking …from discussing…

Excerpt 12

Interviewer So you mean that what is missed here is the meaningful part that is the collaboration, the communication and interaction …
Interviewee1: Yeah it got strengths and weaknesses …you can collaborate really easy if you want to but …on the other hand if you don't want to collaborate is really easy just to upload something and miss the whole part…

Excerpt 13

Interviewer: Did you find it easier to make comments on someone's work through the wiki than face-to-face? **Interviewee1**: It was easier to make comments to other …to the other pairs work through wiki ..in my pair I think that there was no difference at all because we had some sort of personal contact …but with the other pair we didn't have that much personal contact in the beginning so it was a bit difficult to write a comment in wiki that "it was not very good" … so I preferred to make the comments afterwards in person …in the Lab…

Excerpt 14

The work organization was not much appreciated by all students. One student expressed her concern that the activity was too unstructured and that although she enjoyed it, some guidance would have been necessary in order to induce all group members to really deepen the discussion and avoid a shift from collaboration to competition. Another student reported confusion on this point as well, expressing uncertainty about what was required of them, and ambivalence regarding dialogic argumentation (at group level) and collaborative knowledge construction (at pair level) [excerpt 16].

Interviewer Did you receive any positive comments by your pairs? You told me that mainly they were negative…

Interviewee1: It was the structure of the coursework that ….we had on the instructions that …. highlight weaknesses… and highlight weaknesses…so …. I feel that sometime the whole thing just became …."let's find the weaknesses of the other pair and highlight them"…"why this is good and why this is bad"…or "our is better than yours"…. So it became a little bit like a …competition… that's why I thought that at some point it was not easy to… it was easy …but …It was not suitable to edit the other pairs text…because…. In the whole competition feeling about this… you didn't want to interfere with the other pairs job… (pause)

And I think…. It shouldn't be like that..it shouldn't be …competing with the other pair but the way that the whole things was structured… it gave me the feeling that at some time it ended up like being… and discussing with other of my friends that they have the same module and they were in other teams… they were considering like competition at some point …when …for example, a friend of mine told that: "The other pair wrote this to my comments and now I've to write something better to show them that they're wrong" …and when… especially in the first part …when we were supporting the touch screen and the others the paper based format…and it was not something really objective to say…you could say subjective ideas and express them in sort of way that conversation could get out of the formal of this strict followed that it had so … yeah, at some time it became a little bit like that and I felt it was not the right way to continue…

Interviewer: In your view it could be better in future think to a different structure not based on competition …I mean it seemed to you that competition didn't contributed to improve the argument construction…?

Interviewee 1: Sometime it improves the argumentation a lot …about…at some point when it tends to become to …. Some kind of…you don't see the limits…between competition and collaboration…because finally all of us were going to collaborate but ..at some point I think that the pairs didn't have in mind that finally the six of us are going to collaborate to build this stuff …not just the pair…so it was the concept of competition that they didn't have in mind that …at the end the whole six…the whole group Is going to collaborate… if this was more obvious from the beginning ….maybe this ….the whole competition things was not very strong..

Excerpt 15

Other students expressed appreciation for the facilities offered by the environment in particular for the possibility to always have a disposal the work of their peers, which helped them in elaborating of their own contribution. They also expressed appreciation for alternating individual work with peers' interaction as a way to make up and get enriched by ideas of others. These considerations suggest that sharing ideas on the wiki helps the students to learn from each others.

Interviewer Can you think of a way in which using the wiki may have increased the quality of your work? You talked mainly about organizational aspects but…..

Interviewee1 I don't know….depends …because using wiki you can work alone and after that your colleagues can edit your work otherwise if it was about meetings… all of the members were going to work together in produce something together…so sometimes is better to work alone because you work faster and more effectively and the other members can afterwards see your job and try to find weaknesses that if you all were working together they were not going to recognize or maybe you could convince them that they're not weaknesses.. even if they were…

Excerpt 16

Interviewer Do you find that using wiki technologies can change the negotiation process among groups of peers?

Interviewee1: I like the way it allows you to see others people's arguments …it's like a measure…it helps you like the way To find arguments before you'll find in the middle of the course…what you see (arguments) are on one side or the other…I think it's a good measure for that…

Using wiki we were able to see others arguments …I think if we were all thinking about it …you put your arguments and others reinforce it ….

Excerpt 17

Students also reported that they were able to develop their critical thinking skills through the use of the wiki spaces and coursework activities. A consideration of the work of other students in their groups (e.g. commenting on other pair's paper) and the co-decision, negotiation process with the pair appears to be a powerful catalyst [excerpts17].

Interviewer: What do most people think of using wiki technologies in learning context is that student's focus on selection of contents rather than developing ideas (there is no sense of group nor knowledge construction). Is that the way you feel too?

Interviewer 4: Yes…just because of what I said about …reading the information and putting it all together and get familiar with your point and taking all the points through evidences because they are written …because it's quite when you finish it..it's quite a body world to read through…and I admit people are more focused on what they did themselves and the content wrong and the details that have been watched by other people…

Well, obviously when you're negotiating you want to have the relevant information and to have it quickly …in that sense twiki works…but if you're writing a position paper …so if you are in a group involved in a negotiation process it's hard to read on laptop, discuss it and have a good point …I think the table was helpful, using a structure …and yeah, link to other pages as well…

Excerpt 18

Some differences with face to face situations also emerged [excerpt 18]; students, in particular, appreciated the support to work organization and the possibility to have more time to reflect before contributing:

Interviewer: Do you find it easier working in pair using technology?g5

Interviewer5:Depends on your partners. Using Wiki technology was useful probably in organizing work …yes, it's formal than I guess you get to deal with structure …

Interviewer; Did you find it's easier or harder to receive comments on wiki rather than f2f?g5

Interviewer5: I find it's easier on wiki… cause if you're in f2f you can forget.. you know… like "give me three reasons" …I don't remember when I talk… …

Interviewer: did you find it was easier or harder to make you point in twiki rather than f2f? I mean more embarrassing …

Interviewer5: It's easier for me to use wiki because when I'm writing in formal (of course this is my personal view) keyword I tend to give it more thought, I tend to think more…than when you're saying something…while talking I don't' really have much time to think …I'm basically saying that it let more time for me when I'm writing than when I'm talking …if you ask me a question I can't live you for 10 min before answering …it's really nasty… but when I write I can think more … I feel more comfortable…

Excerpt 19

4.8. Discussion

The data presented here provide evidence that the learning environment set up supported the collaborative process of argumentative knowledge construction as well as the co-decision process. Critical thinking was driven by tasks' organization and structure at group level; from the interviews, it emerges that critical thinking spontaneously appeared also at pairs level, as pairs applied the same model of groups to consolidate strengths in their position paper.

Fig 29 summarizes the dialogic argumentation process as implement in this case study.

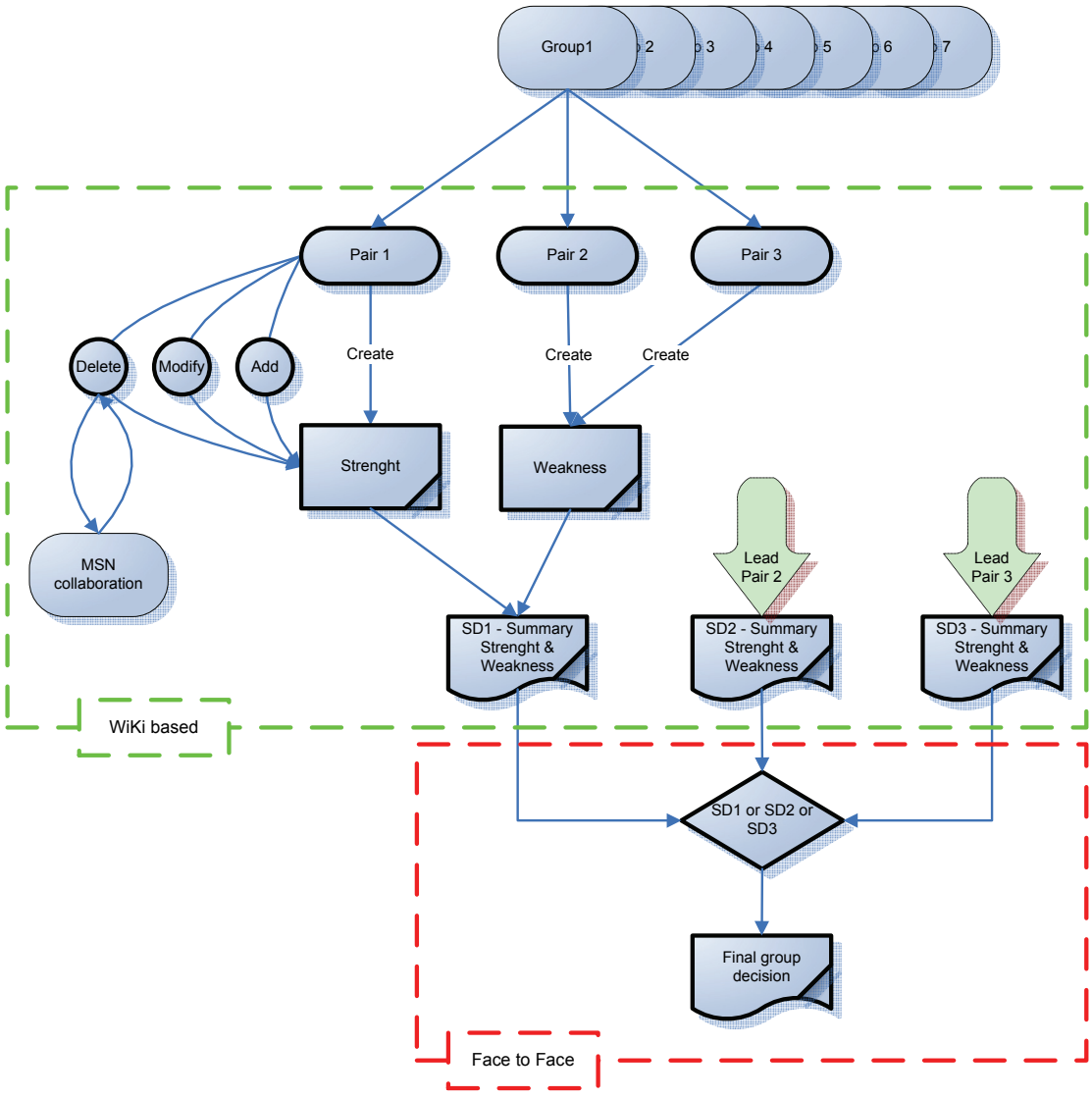


Fig 29 – Implementation of dialogic argumentation in Case study 1

The data on the operations carried out and interviews with students show that students tend to add content much more than to correct their peers contributions. This appears to be

due to their wish to maintain good social relations with their peers, avoiding to directly critique their work. This is likely a consequently of the scarce importance usually given to argumentation in education. This suggest that activities of this kind should be proposed to students more often, possibly already in early stages of their school path, so as to create a culture in this sense.

Interviews also highlighted that students feel the need of having at disposal different forms of communication to support their collaborative knowledge construction. To this end, it is important to choose a wiki platform that provides some forum or other interaction tools, besides the editing pane. It might also be necessary to complement and integrate the wiki environment with other forms of communication, such as the MSN used by the students in this case study and, occasionally, also face-to-face meeting. This is not in contradiction with the fact to use online technologies like wikis, since the aim of integrating social technology in higher education is not to substitute face to face with online instruction but rather to enrich the learning environment but providing students with richer learning experiences.

The potential of the environment set up emerges from students' interviews, as they express appreciation for several features at disposal, from the formatting facilities as a support to "clean-up thoughts", to the dilated interaction times that allow students to reflect before contributing longer than it would be possible in face to face, and up to the possibility to easily access the contribution of peers as a stimulus to reflection and source of ideas. This last point appears particularly important in that it highlights an increased possibility for the students to learn from each other, hence playing for each other, each to his/her own extent, the role of "more competent peer", capable to stimulate the proximal development zone (Vygotsky, 1978). This suggests that experiences of this kind can actually improve the learning environment of higher education in a constructivist sense.

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Chapter 5 Collaborative Argument construction with wiki – Case Study 2

5.1. Introduction

This chapter presents the second of the three case studies carried out.

The following sections present the objectives of this study, an overview of the specific methodology, a description of the context and participants, an outline of the procedure, a summary of the data sources and main outcomes. The chapter concludes with a discussion of the outcomes.

5.2. Objectives

This case study focused on the very process of collaborative knowledge construction. Here, the focus was particularly on students' construction of rebuttals/counterarguments and the potential of wiki technology to facilitate the overcoming of social constraints and engagement in counterarguments/ rebuttals.

This experimental study was action-oriented, i.e., the procedure implemented was repeatedly adapted during the development of the experience, based on students' feedback and partial evaluation.

Particularly, this case study was underpinned by the following statements of purpose concerning the objective of the research:

- Social constraints pose limits to student's engagement in effective counter-argument/rebuttals. Thus, they engage in "conjunctive argument", providing/adding evidences and references also to the original arguments of their peers.
- Wiki-based environments support argument construction by facilitating the construction of both the argument micro-structure (based on Toulmin's layout) and the argumentation sequence (macro-structure).
- Since teacher-assigned claims are compound and well-defined, it's hard for the students to construct good rebuttals/counterarguments.
- A suitable organisation of the set up learning environment helps students to produce better individual and collaborative arguments; it also improves the quality of the discussion and thus promotes learning.

5.3. Methodology

In order to observe individual users interacting with the wiki technology environment, the "think aloud" methodology was adopted to gather insights in wiki's support to argumentative knowledge construction. In this study, watching students attempt to accomplish argumentation tasks at the TWiki site enabled the participant researcher (henceforth, observer) to pinpoint specific problems in using this technology for argument construction. The purpose was to discover problem areas and potential solutions so the design of this study (and of Wiki*DiA*, as well) could be improved to more closely match students' needs.

Think aloud is a process often used to observe tool usability (Eriksson et al., 1993). It involves users being instructed to express aloud their thoughts, decisions they make, doubts and reactions while interacting with an artifact. Thinking aloud is unlikely to be natural to participants, hence the observer may be required to prompt utterances. It is vitally important to make sure participants understand that the purpose of the observation is to test the technological artifact, not to evaluate them; hence, problems they may have performing some of the tasks is the fault of the product and not of the user. If this is not done, it may cause distress to the participants who may feel at fault in case of difficulties of use. In the interest of fairness and validity, the observer also needs to make sure that the participant does not have any information about the artifact more than real users will. This is achieved by avoiding to explain in detail how to use the product nor to help the users with any problems they encounter. Taking notes on the problems they encounter is the essential role of usability observations. In order to prevent frustration and improve scientific validity, the tasks should be timed and a time limited assigned. At the end of the test, the observer discusses any interesting behaviors or spoken thoughts that need clarification. The observer should then review the data collected during the observation, looking for specific areas where users appeared to have problems. Data collected can then be analyzed and used to help prevent or overcome the problems encountered and improve the ease of use.

In this study, four participants were recruited among the students of an undergraduate course at the University of Manchester (details on context and participants are provided in the following section). None of the participants had used a wiki environment before, although some had a basic understanding of what wikis are. All the participants were briefed on the purpose, uses and benefits of wikis. The introduction also informed them of the prospective use of the data to be collected, as well as of their anonymity and their right to withdraw from the test. Another important aspect of the introduction was the

explanation of 'think aloud' because it is crucial for the efficacy of the method that the participants understand it.

Participants were tested one at a time; in order to avoid different observation perspectives, only one observer was in charge of collecting data. Using one observer, therefore, meant there was less room for discrepancies due to individual interpretation of the participant's responses.

The participants were asked to sit at a computer with a web browser which displayed the home page of the TWIKI course site. Students were then asked to perform their argument construction task, contributing to the collaborative debate. Regular prompts were needed from the observer to elicit the 'think aloud' comments as most students, when stuck, remained quiet. There was no other interaction between the observer and the students other than to provide reassuring comments (such as "well done" and "keep going"), so as not to distract or help them. Two of the participants were questioned concerning their process of individual argument construction, while the other two were observed while building rebuttals/counter-arguments.

The talk aloud sessions were then transcribed and analyzed for this study.

5.4. Context and participants

The activity was carried out within the undergraduate course on "Interactive technologies" at the School of Informatics, University of Manchester, (UK) in the spring semester 2007 and was counted for credits within the course activity.

The purpose of this module was to introduce students to key ideas concerning how to design multimodal interactive technologies that are compliant with constraints imposed by human needs and bounds. The students were expected to develop an appreciation of how to analyze the cost/benefits of novel interactive technologies given particular task domains and to critique proposals for the design of interactive technologies.

The course aimed to (1) develop students' understanding of novel uses for multi-modal interactive technology, and (2) develop abilities in using a research literature, constructing argumentation, collaboration, and writing.

The course started with an introduction into how to research a topic and how to write a sound argument.

The experimental group included all course participants: 17 undergraduate students, among which 11 males and 6 females. The ages were ranging from 19 to 23. The area of origin of the students is shown in Fig 30 below.

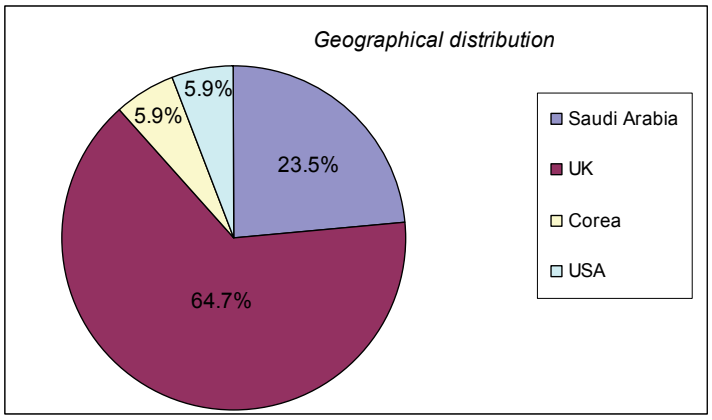


Fig 30 –Geographical distribution of students

Since the course was interdisciplinary, the participants had a variety of backgrounds: engineering, business technology, philosophy and religion. Participants did not have previous experience in collaborative argument construction, nor in the use of wikis.

The activity lasted 10 weeks, 2 hours per week.

5.5. Procedure

The activity was introduced by some lectures on 5 different issues, on each of which the students were expected to debate. In each lecture, the lecturer introduced a topic and assigned students to one of two groups ("for" and "against") for each of the debates. The main body of the activity involved a practical exercise aimed at developing skills in argumentative knowledge construction on the subject of new interactive technologies. The architecture of this experimental situation is depicted in.

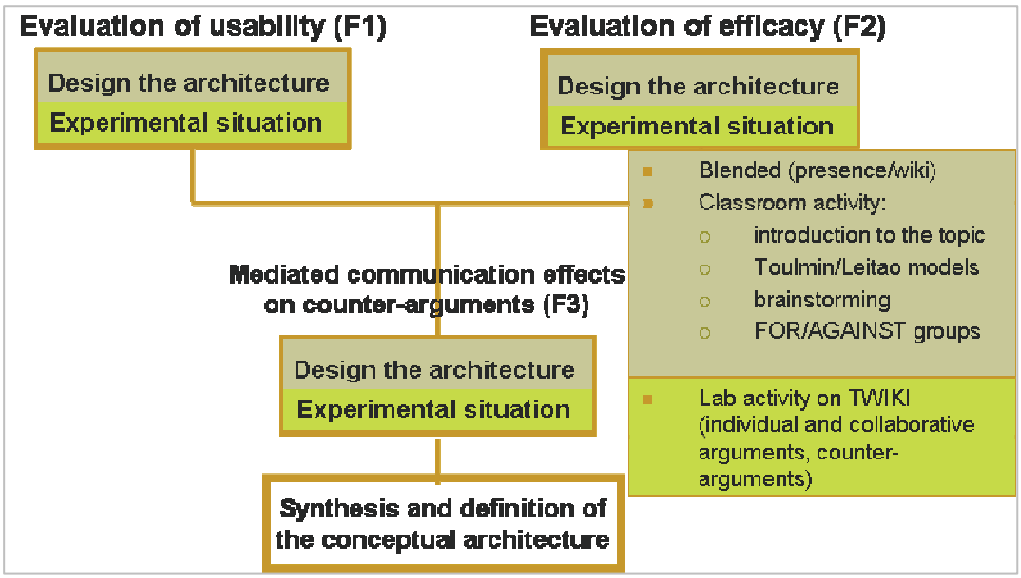


Fig 31 - Architecture of the experimental situation for case study 2 (phase 2)

The Toulmin's model was explained and the students were requested to adopt it to structure their arguments/counter-arguments.

Common tasks for all the considered issues were:

- Class brainstorming session to identify a list of relevant "pros" and "cons" arguments (1h)
- Individual literature search (by means of Google Scholar), to find relevant references for constructing arguments (1 h).
- Group meeting and comparison of notes (1 h).
- Each student chooses one point from the argument list, creates a wiki page (visible to the whole class) and writes an individual contribution/arguments on it (1 h).
- Creation of counter-arguments/rebuttals and edit of arguments posted by others; response to rebuttals posted by others (1 h).

The assessment was articulated in two stages with the same structure, each contributing 50% to the coursework mark. Each assessment consisted of an individual essay answering one of the 5 questions addressed in the lectures and practical argument construction. Each essay had to be based on the arguments constructed during the practical activity.

Five topics were proposed for discussion:

1. Virtual reality for e-commerce
2. Bi-manual interfaces
3. Ubiquitous learning
4. Distance matters
5. Cinematography

5.6. Data sources and analysis procedures

The data collected included:

- Students arguments on wiki pages
- Transcripts of video recording of face-to-face sessions.
- Transcripts and observer's notes on students' think aloud sessions.
- Course essays.
- End-of-course questionnaire.
- Module-feedback questionnaires.
- Lecturer's journal.

The analysis of student's argument developed through wiki technologies was made based on Toulmin's model, following the interpretation schema by Verheij (2006) described in Chapter 2.

The analysis of rebuttals followed the analytic scheme by Felton and Kuhn (2001), which comprises three broad categories (summarized in Table 12):

- *transactive questions*, if the rebuttals attempts to engage others in discourse either by referring to a peer's previous utterance or by prompting a response. These often take the form of question or request a peer to give some information.
- *transactive statements*, which do not imply a direct response. These are expressions of the student's thoughts in response to a peer. They are called 'transactive' because they refer directly to the peer's previous utterance.
- *non-transactive statements*, if utterances fail to connect to a peer's preceding utterance; that is, they neither address the partner's preceding utterances nor prompt the partner for a response.

Table 12 – Felton and Kuhn's analytic schema

Transactive questions	
Agree?	A question that asks whether the partner will accept or agree with the
Case?	A request for the partner to take a position on a particular case
Clarify?	A request for the partner to clarify his or her preceding utterance
Justify?	A request for the partner to support his or her preceding claim with evidence or
Meta?	A question regarding the dialogue itself (vs. its content).
Position?	A request for the partner to state his or her position on an issue
Question?	A simple informational question that does not refer back to partner's preceding
Respond?	A request for the partner to react to the speaker's utterance
Transactive statements	
Add	An extension or elaboration of the partner's preceding utterance
Advance	An extension that advances the partner's preceding utterance
Agree	A statement of agreement with the partner's preceding utterance
Aside	A comment that does not extend or elaborate the partner's
Clarify	A clarification of the speaker's own argument in response to the
Coopt	An assertion that the partner's immediately preceding utterance
Counter-A	A disagreement with the partner's preceding utterance, accompanied by an
Counter-C	A disagreement with the partner's preceding utterance,
Disagree	A simple disagreement without further argument or elaboration
Dismiss	An assertion that the partner's immediately preceding utterance
Interpret	A paraphrase of the partner's preceding utterance with or
Meta	An utterance regarding the dialogue itself
Refuse	An explicit refusal to respond to the partner's preceding question
Substantiate	A utterance offered in support of the partner's preceding
Non-transactive	
'Continue'	A continue or elaboration of the speaker's own last utterance
Unconnected	An utterance having no apparent connection to the preceding

5.7. Outcomes

All students successfully completed the course. The teacher was very satisfied of the work done, and pointed out that students' argumentations were better than those observed in any other edition of the same course; he attributed these good results to the activity structure and the support provided by the wiki environment.

The analysis of the characteristics of the argumentative network created by students after 10 weeks of course provides an indication of its operation. In particular, the permanent, browsable network is composed of about 108 nodes (a *node* is any new argumentative act) with a growth rate of 100% over the first period. Fig 32 shows that students' contributions constantly doubled during the first weeks.

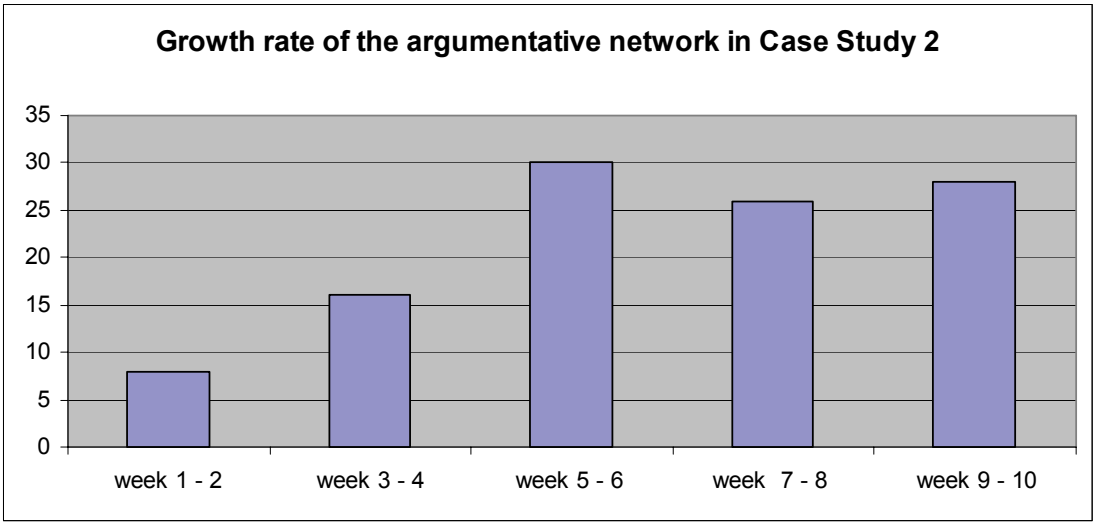


Fig 32 – Growth rate of the argumentative network created by students

It is interesting to remark that the growth dimension of the network shows, independently of quality, an advancement in students' argumentative practice and confidence (see Fig 33).

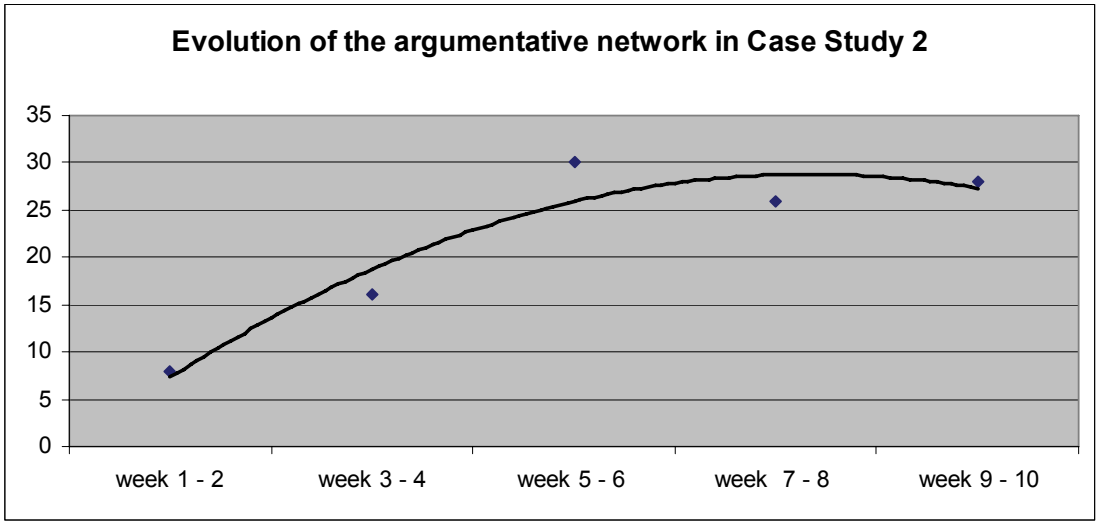


Fig 33 – Evolution of the argumentative network created by students in Case Study 2

As concerns behaviours emerged, each student contributed to the development of the argumentative network with about 7 new contributions and over 26 contributions to the other existing network nodes as showed in Table 13 .

Table 13 – Student's contributions to the argumentative network

Period	N. of nodes created	ToT of contributions	N. of individual contributions	N. of contributions to the argumentative network
week 1 - 2	30	121	63	58
week 3 - 4	28	149	59	90
week 5 - 6	16	71	19	52
week 7 - 8	8	32	13	19
week 9 - 10	26	147	67	80
	108	**520**	**221**	**299**

Fig 34 shows the total number of argumentative components developed by the students during the whole course, following the cited Verheij's approach. The component of Toulmin's model that was developed most often appears to be "Data", i.e., groundings of the given claim. It is interesting to note that also the number of backings is relevant. Backings are elements supporting warrants; their high number suggests that the students supported suitably also the warrant which, in Toulmin model, is the element connecting data and claims. A high number of backings justifies the more limited number of rebuttals, as the warrants were well supported by many backings.

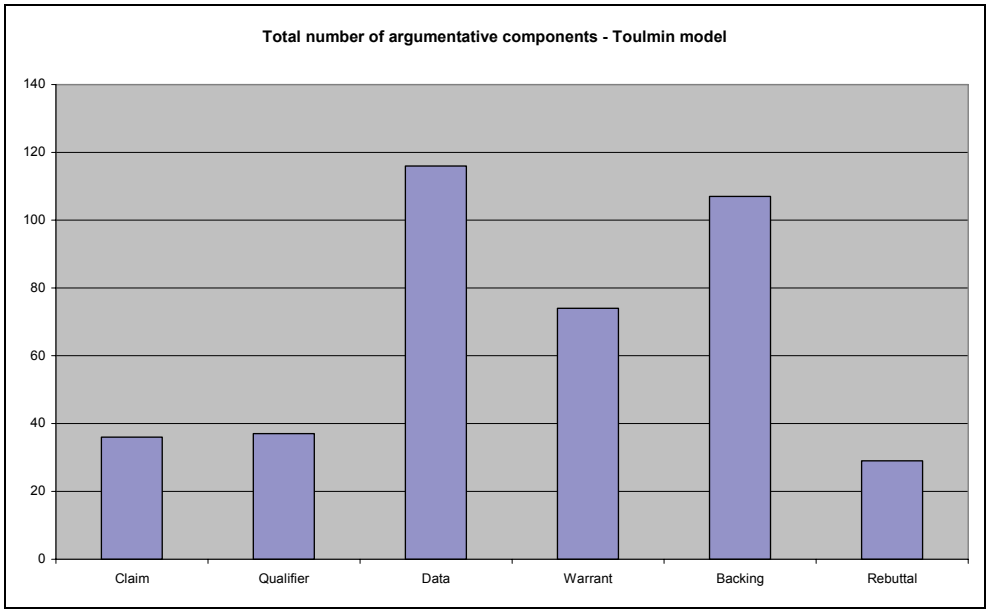


Fig 34 – Total number of argumentative components (based on Verheij's schema)

Entering in details on the nature of rebuttals, the diagram in Fig 35 (made applying Khun & Felton's coding schema) shows a high number of "justify" and of "advance". This means that, making rebuttals, the students concentrated more on adding knowledge to arguments raised by their colleagues, than finding counter-arguments. This behavior is called "conjunctive argument".

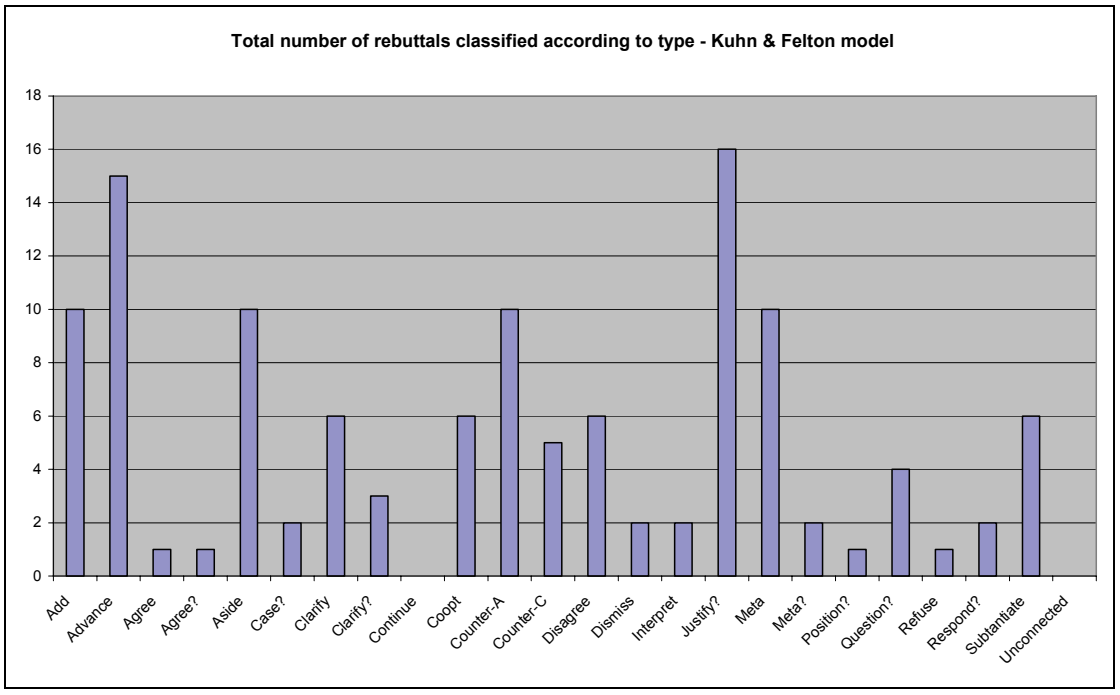


Fig 35 – Total number of rebuttals (based on Khun&Felton's schema)

Fig 36 shows two examples of the relations among argument elements created by the students in the wiki environment (macrostructure). The acronyms over the boxes correspond to the elements of Toulmin's models that constitute the argumentative unit according to Verheij's model: C= claim; D= data; W= warrant; B= backing; Q= qualifier; R= rebuttal.

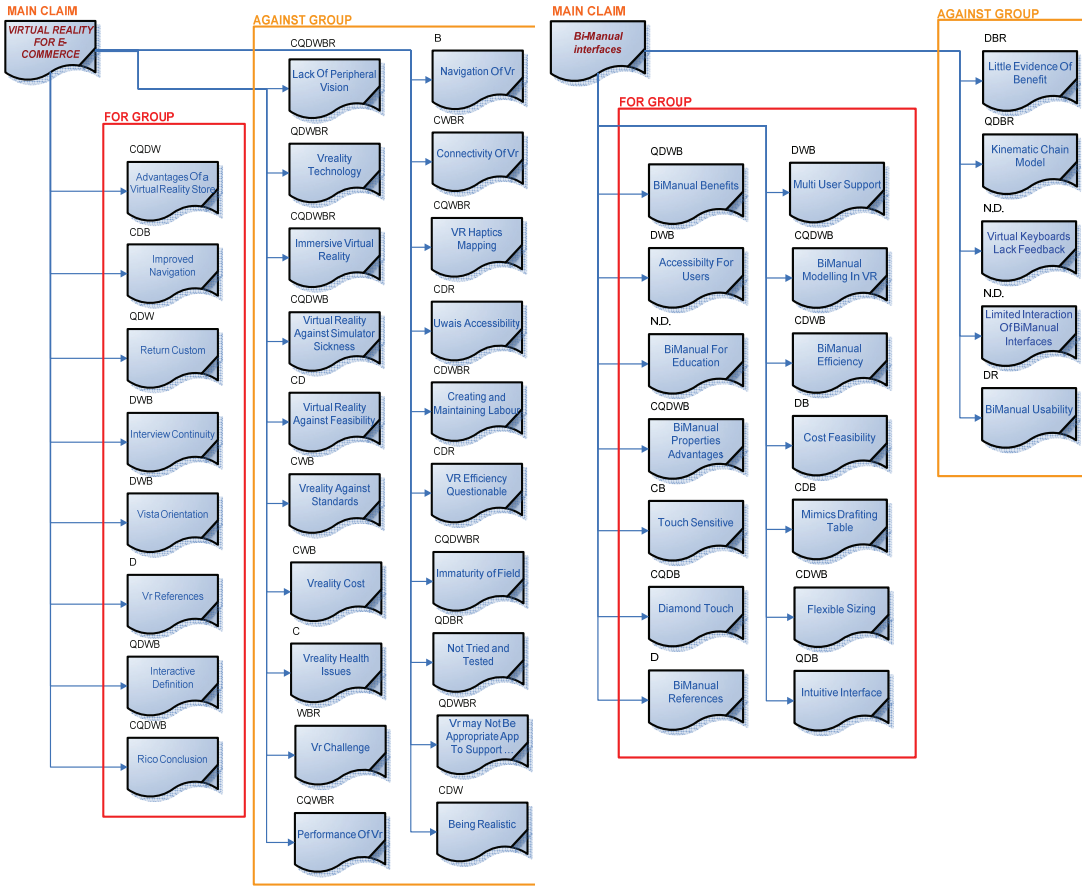


Fig 36 – Components of argumentations for two of the topics addressed in the course

These examples show a different amount of work in the two groups for the two topics. This was likely due to the nature of the considered topics for which different amount was available to construct arguments and counterarguments, as well as by the personal inclination of the student involved, as for each topic the group composition was changed. It is interesting to note, moreover, that each wiki page (represented in figures by the blue boxes) contains a sequence of contributions of different natures. These were usually contributed by different students, as emerged by an analysis of the history pages. This underlines that actual collaboration in argumentative knowledge construction took place during the activity. The presence of contributions of different nature all grouped in one environment turned out handy when the students had to write their individual essays.

This was made possible by the characteristics of the wiki technology used, which therefore appears to have supported the argumentative knowledge construction.

The diagram in Fig 36 well represent the network of argument elements and data that groups constructed in their wiki spaces and from which each student constructed his/her essay by extracting and sequencing from this network the elements that he/she considered more appropriate.

The quality of the arguments and argument components was evaluated by the course teacher. The skills gained in argument construction influenced the quality of the essays worked out during the course. Fig 39 shows the grads obtained for these essays by each student. In all cases except two, the quality of the essays improved over the course.

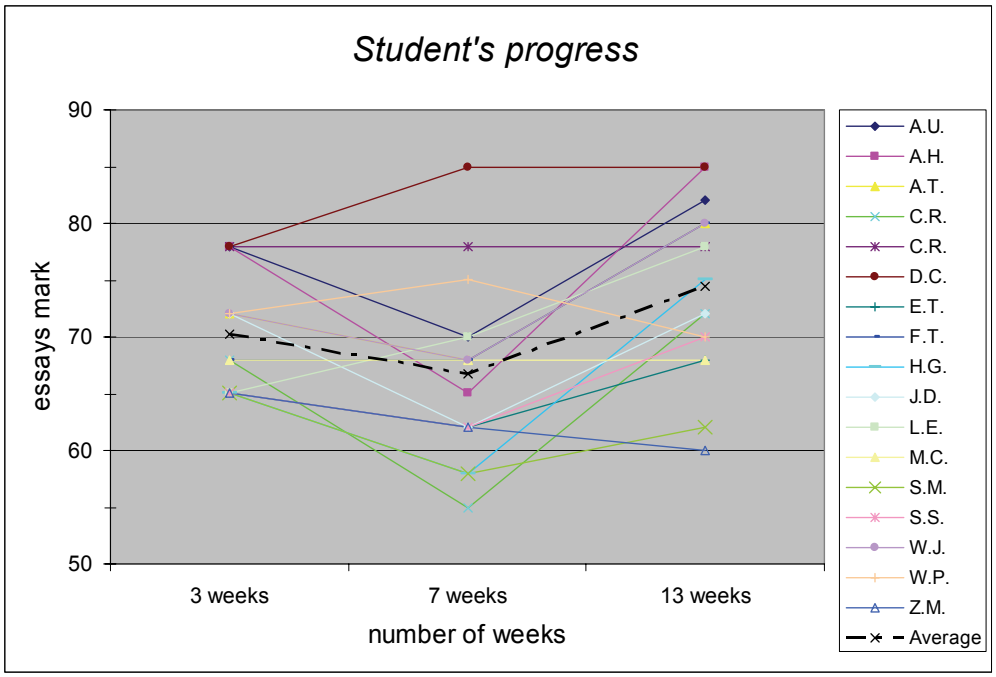


Fig 37 – Student's essay progress

The end-of course questionnaire was answered by 15 out of 17 students. This questionnaire, which consisted in closed questions to be answered on a Likert scale 1 to 5, aimed to collect students' opinion on the good development and fruitfulness of group work as well as on the support given by the wiki environment to collaboration. The answers show that over 70% of respondents appreciated the support provided by the wiki environment to the collective argumentation activity (see Fig 38). An equally high percentage of respondents found argument construction easier on wiki than in face to face (see Fig 39). Students, as a matter of fact, mostly choose to collaborate on the wiki rather than in face-to- face even though they were allowed to do it (Fig 40).

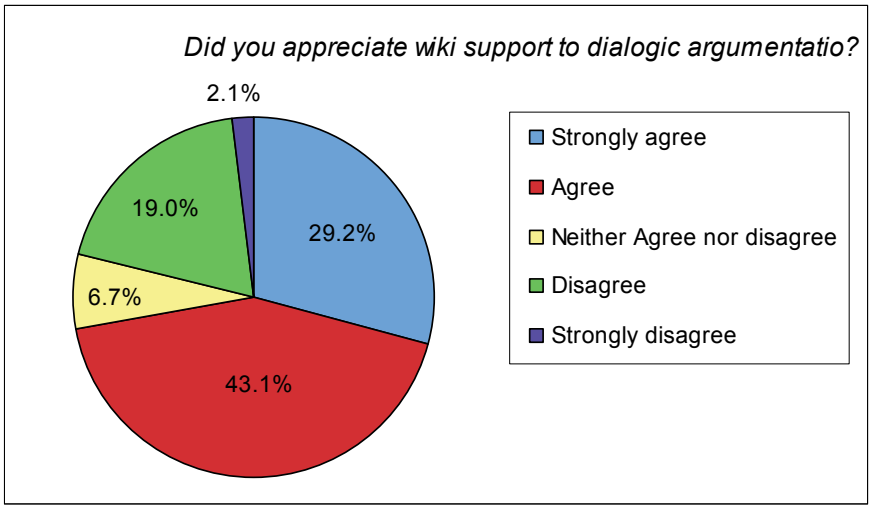


Fig 38 – Student's appreciation of wiki support to dialogic argumentation

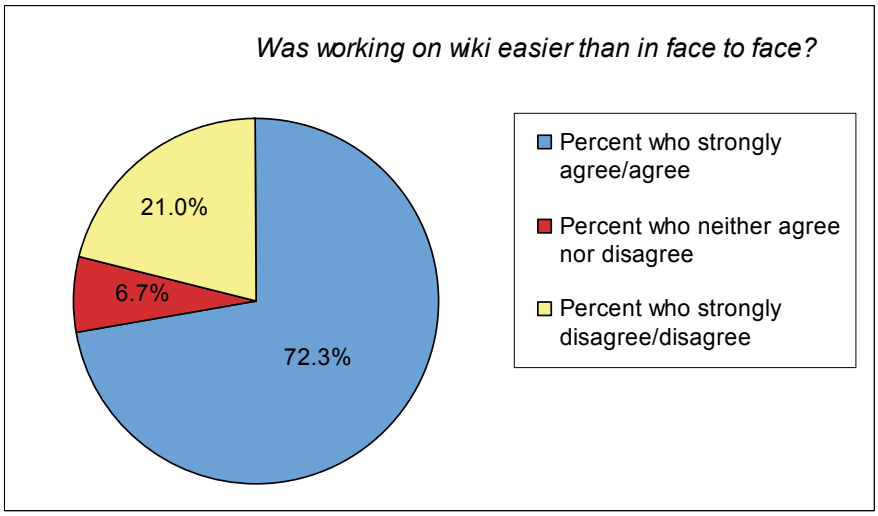


Fig 39 – Student's appreciation of ease of use

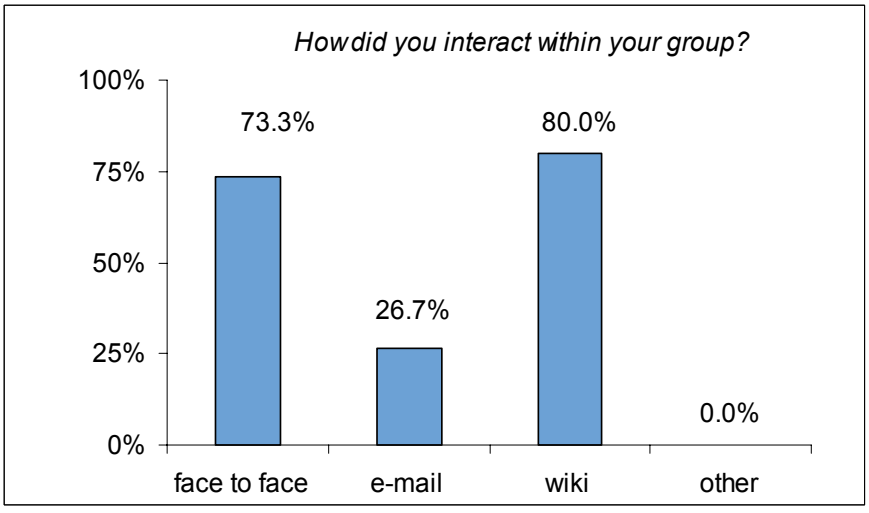


Fig 40 – Student's interaction method; often students used more than one interaction modality.

Finally, the Module Feedback Questionnaire, which consisted of closed questions to be answered on a Likert scale 1 to 5, aimed to investigate student satisfaction of the course. It was responded by 12 out of 17 students, confirming appreciation for this activity. As shown in Fig 41, 35,78% of respondents awarded the module the highest possible rating averaged across all questions, while 99% awarded the module either the highest or the next highest rating averaged across all questions.

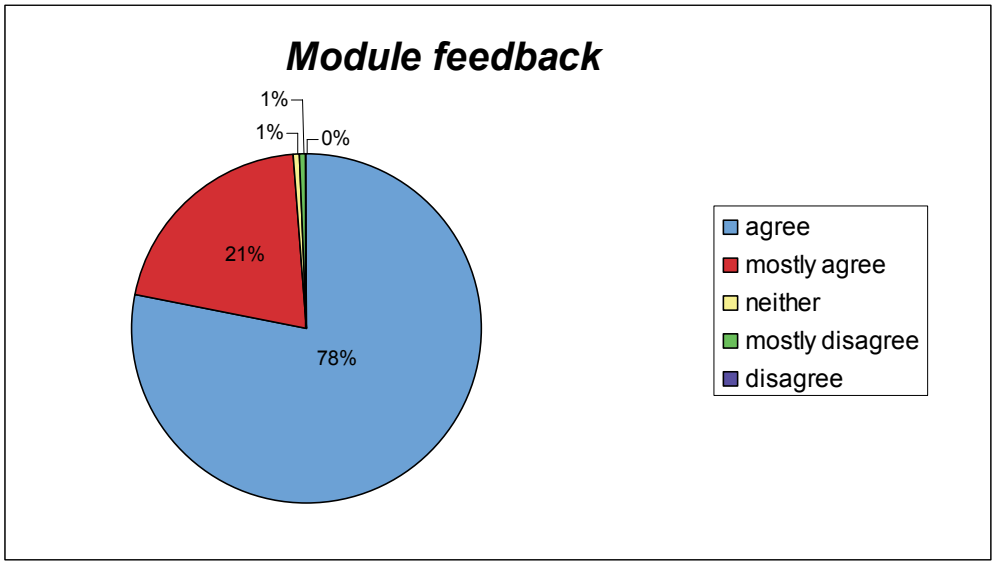


Fig 41 – Student's final feedback

5.8. Discussion

The data presented here provide evidence that, with a suitable methodology, wikis could facilitate dialogic argumentation, in particular the creation of good rebuttals. Concerning the structure, all arguments constructed by the students resulted well formed, and closely followed the model proposed by the teacher (Toulmin's model). Although these data confirmed the hypothesis that social constraints pose limits to student's engagement in effective counter-argument/rebuttals, they also show that the environment well support the construction of 'conjunctive arguments' and also the production of suitable rebuttals. The lower occurrence of rebuttals in comparison with other actions was likely influenced also by the fact that the teacher-assigned claims were compound and well-defined ones, which made it hard for the students to find suitable counterarguments.

The technology used appeared to help argument construction, at both micro and macro level. Because of its reticular nature, wikis naturally lead to split the arguments in micro-units related to individual points, and help the students to keep logical consistence in their arguments while following the conceptual model. This fact allowed the students to overcome what is reported in the literature as the major drawback of Toulmin's model, that is the difficulty to structure work on large documents, since this model, which is extremely valid in other respects, requires working on micro-structures.

This is a point in favor of using wiki environments for this kind of task, since it allows an easier application of an important conceptual model. As concerns rebuttals, data confirm students' inclination to engage most often in collaborative processes, developing conjunctive arguments more than rebuttals.

The highly modular structure of the wiki environments may prove useful also to this end, since it clearly highlights the variety of points that need to be addressed in the rebuttals.

Chapter 6 Social Technology Effects in Peer Argumentation - Case Study 3

6.1. Introduction

This chapter describes the third and last case study of this dissertation.

The following sections present the objectives of this study, the specific methodology adopted, a description of the context and participants, an outline of the procedure and activity sequence, a summary of the data sources and main outcomes. The chapter concludes with a discussion of the outcomes.

6.2. Objectives

Case Study 3 was a controlled experiment designed to test if social technology enabled a greater number of student's responses in debate (counter-arguments). Based on the outcomes of Case Study 2, this study aimed to perform a comparison between student engagements in face-to-face discussion *vs.* social technology mediated debate, that is, checking if it is hypothesis $_{E}$ or hypothesis $_{0}$[8] that holds true.

Hypothesis $_{E}$: Students respond to peers more in social technology environments than in face-to-face discussions.

Hypothesis $_{0}$: There is no difference in student's response in social technology environments or in face-to-face discussions.

In particular, this study was underpinned by the following statements of purpose concerning the objective of the research:

- Since Case Study 2 shows that a major problem is the unwillingness of students to engage in debate, there is a causal role of the communications medium on engagement level between peers.

[8] The methodology adopted in this study is single-subject design (see next section). This approach entails that two complementary are formulated: Hypothesis $_{E}$ (experimental hypothesis) and Hypothesis $_{0}$ (null hypothesis).

- The proportion of students' responses to their peers in social technology mediated debates is major than in face-to-face discussion.
- Wikis, as a social technology tool, may support peer argumentation. Hence, other social technology tools allowing similar functions may effectively support peer argumentation as well as wikis.

In order to test the influence of social technology tools other than wiki on collaborative argument construction, Google Docs and Instant Messaging tools were used to support peer argumentation. This allowed to observe the potential of social technologies vs. wikis in collaborative argumentation. It also provided useful indications on the specific contribution of wikis in supporting argumentation, which can inform the design of Wiki*DiA*.

6.3. Methodology

This study is based on single-subject designs paradigm. Mainly applied in clinical practice, single-subject designs has been used to evaluate social work practice since the late 1960's. Single-subject designs is applied to demonstrate the effectiveness of various forms of casework, types of treatment and modalities of intervention. It's also used in social research as a way to track the effects of treatment in individual cases.

Single subject research is a rigorous, scientific methodology used to define basic principles of behavior and establish evidence-based practices (Backman, 1999). Educators building individualized educational and support plans have benefited from the systematic form of experimental analysis permitted by single subject research (Wolery, 1982). The ability of single subject research methods has been of special value to provide a level of experimental rigor beyond that found in traditional case studies. Because single subject research documents experimental control, it is an approach, like randomized control-group designs (Kazdin, 1982), that may be used to establish evidence-based practices.

Traditionally single subject researchers have relied on strong internal validity of designs and use of visual analysis to document intervention effectiveness (Marascuilo & Busk, 1988).

The systematic and detailed analysis of individuals that is provided through single subject research methods has drawn researchers from a growing array of scholarly disciplines. The general paradigm for single-subject designs involves first collecting data for a baseline activity of the target problem, and then collecting more data after the introduction of a treatment intervention. The baseline activity phase is referred to as *A* and the intervention phase as *B*. The baseline phase is basically a control phase (serving the same function as control groups do in group experiments). To infer that an intervention is effective requires a comparison of shifts in the pattern of the data which coincides with shifts between the baseline and intervention phases. Extraneous events are much better controlled when there are several shifts between baseline and intervention phases.

In this study, the apparatus for each of the four episodes was the same: stimulus presentation and process control, data collection and storage, data reduction and statistical analysis. The procedure for the four experiments was identical, except for counterbalancing the order of activities (i.e. Topics 1 *vs.* Topic 2; face-to-face discussion *vs.* social technology-mediated discussion).

6.4. Context and participants

The study involved an opportunity sample of 8 undergraduate students grouped in pairs (all previously involved in Case Study 2). The experimental study has been carried out within the context of a second-year module in Interactive Technologies at the School of Informatics, University of Manchester (UK). Participants agreed on a voluntary basis and their participation was counted for an extra credit within the course activity.

Each pairs' session consisted of two distinct phases and lasted 2 hours.

The demographics of participants are shown in Table 14 below.

Table 14 – Demographics

	Gender		Age range		Ethnic Origin				
Participant	Male	Female	19-21	22-25	Arab	Asian	White	Chinese	Pair Number
1	✓		✓				✓		
2	✓			✓			✓		Pair 1
3	✓		✓				✓		
4		✓	✓				✓		Pair 2
5	✓			✓	✓				
6	✓		✓					✓	Pair 3
7	✓			✓		✓			
8		✓		✓	✓				Pair 4

6.5. Technological means

As mentioned above, two different social technology tools were chosen to support participants' debates in this study: MSN Messenger and GoogleDocs. Main features of the technology used in this study are briefly outlined here.

MSN Messenger is a freeware instant messaging tool that allows synchronous communication. Participants in Study 3 used it to negotiate and debate during the social technology mediated discussion.

GoogleDocs is a free web-based word processor and spreadsheet, which allows users to share text and to write collaboratively online. When one user edits the documents, the other sees the changes immediately. In Case Study 3, participants used GoogleDocs to summarize in a shared document the outcomes of their discussions carried out either in face-to-face (F2F) or via instant messaging (IM). Fig. 42 shows a screenshot of GoogleDocs on participant's desktop while creating the shared summary.

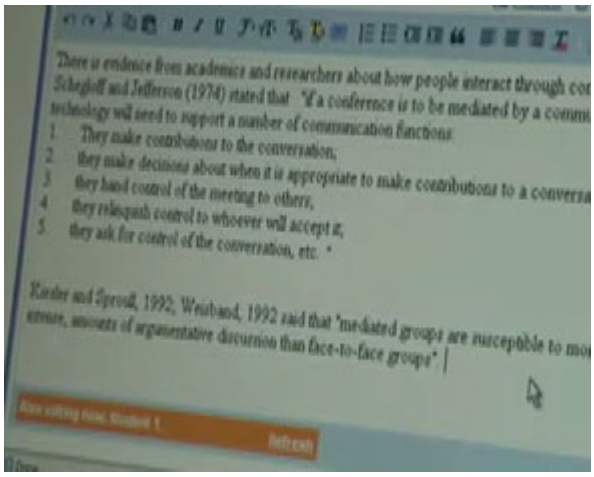


Fig. 42 - Google Docs from a participant Desktop from Case Study 3

6.6. Procedures

A repeated measure design was adopted, so that each participant took part in discussions either in face-to-face and via social technology-mediated environment.

The participants discussed two topics (**T1, T2**):

- **Topic 1**: "Distance Matters: computer-mediated communication can make distance irrelevant to business".
- **Topic 2**: "Virtual Reality in e-Commerce increases the cost of interaction".

It was assumed that these topics were on a similar level of complexity and alter sufficiently familiar to participants who had already discussed and analyzed both within the context of Case Study 2. To stimulate counter-argumentation, one of the two participant was from the For group (in Case study 2), while the other participant was from the Against group.

Table 15 summarizes the experimental design, which consisted of four episodes. All episodes involved two participants (pair) engaged in two distinct discussion ***phases 1*** and ***2***, either in face-to-face (***A***) and via social technology mediated environment (***B***). In order to avoid *order effects,* a different ordering and combinations of topics (***T1, T2***) and settings were adopted (counterbalancing criteria are described below).

Table 15 – Experimental design - Activity sequence phases.

Pair	Discussion 1 – Phase 1	Discussion 2 – Phase 2
Pair 1	face-to-face / T1 (*AT1*)	social technology mediated/ T2
Pair 2	social technology mediated / T2	face-to-face / T1 (*AT1*)
Pair 3	face-to-face / T2 (*AT2*)	social technology mediated / T1
Pair 4	social technology mediated / T1	face-to-face / T2 (*AT2*)

Fig 43 and Fig 44 illustrate the activity sequences (Phases A and B).

Fig 43 – Pair 1: discussion 1 (Phase A)

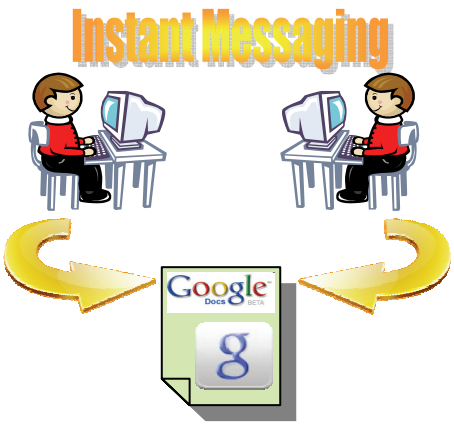


Fig 44 – Pair 1: discussion 2 (Phase B)

Therefore, depending on the design (Table 14) the following was applied.

For each episode of the experiment where the participant took part in a face-to-face discussion first and a social technology mediated discussion (via IM) second:

Each participant was given a topic sheet according to Table 14 (10 min to read) and was asked to engage in face-to-face debate with his/her group mate. A video tape recorder was positioned in the room and participants were left to discuss the given topic for 20 minutes. Each participant was then given another topic sheet (Appendix E) in accordance with the experimental design, and was asked to engage in an online debate through IM for 30 minutes. The pair was the same as in the face-to-face discussion.

Both in Discussion 1 and Discussion 2, participants were asked to integrate their arguments and counter-arguments into an overall final document on Google Docs.

For each episode of the experiment where the participant took part in a debate via IM first and face-to-face discussions second:

Each participant was given a topic sheet according to the experimental design (Table 14). They were then asked to engage in a debate through IM for 30 minutes. Each participant was then given another topic sheet (10 min to read) according to the experimental design and was asked to engage in a face-to-face debate with the same peer for 20 minutes. Both in discussion 1 (phase A) and discussion 2 (phase B) participants were asked to integrate their arguments and counter-arguments into an overall final document on Google Docs.

6.7. Variables

The single subject methodology includes two kinds of variables, independent and dependent.

In the study the *independent variable* was the medium used for argumenting (F2F or IM).

The *dependent variable* was students' engagement (in terms of responses to others).

In order to eliminate potential confounding, due to extraneous variables, the following measures were adopted:

- all face-to-face discussions took place in a designated room (to eliminate the influence of the debate location on discussion level) .
- The same PCs were used by participant pairs for discussions through IM
- Equal time limits (30 minutes) were set both for face-to-face and social technology mediated discussions (in order to ensure consistency).
- MSN Messenger software was used in all technology mediated discussions (in order to eliminate the trivial possibility of the influence of the type of IM software on engagement).
- Google Docs software was used in all F2F and IM discussion to integrate participants' arguments and counter-arguments into an overall shared document (*target document*).
- The same user names (i.e. student 1, student 2) were used in all IM discussions and on Google Docs.
- All participants did both conditions immediately one after the other.

6.8. Counterbalancing

A counterbalancing procedure was employed in order to reduce possible order effects:

- Participants discussed a different topic in each condition. For instance, if they discussed Topic 1 (T1) in the first condition, they discussed Topic 2 (T2) in the second condition.
- Half of the participants took part in face-to-face (F2F) discussions first and in social technology mediated discussions (via IM) second. The other half took part in discussions via IM first and in face-to-face discussions second.
- Half of the participants discussed Topic 1 (T1) first and Topic 2 (T2) second. The other half discussed Topic 2 (T2) first and Topic 1 (T1) second.
- Half of the participants discussed topic 1 Face-to-face and Topic 2 through IM, the other half discussed Topic 1 (T1) through IM and Topic 2 (T2) Face-to-face.

6.9. Data on students' engagement

Data on students' engagement in counter-argument/rebuttals was gathered in terms of four constructs (hereafter *engagement measures*) (Perkins & Murphy, 2006) summarized in Table 16:

Table 16 – Engagement measures

Clarification	All aspects of stating, clarifying, describing (but not explaining) or defining the issue being discussed.
Addition	Adding information to the purpose of explaining
Inference	Showing connections among ideas; drawing appropriate conclusions by deduction or induction, generalizing, explaining (but not describing), and hypothesizing.
Rebuttal	Counter-argumenting, disagree

To the scope of this study, these constructs were adapted to the specific context where "addition" and "rebuttals" were integrated. These constructs are representative of the dependent variable (*engagement*) in that they sought to characterize, at least partially, selected aspects relating to participant's response to others.

6.10. Data Sources and analysis

The sources of data for this case study were:

- the video recordings of all F2F sessions;
- IM logs of discussions;
- Google Docs shared documents.

Video clips were analyzed by means of qualitative data analysis software (ATLAS.ti, see Chapter 3), which allows to use of video files as primary documents (Fig 45).

Engagement measures were used as guides according to the appropriate critical thinking process directly. In some cases, more than one critical thinking process appeared within a given passage, and the passage was coded applying the coding schema in table 15. Only one code was used for each unit of meaning.

While important for creating a social presence, interactions of social nature, such as the personal introductions at the beginning of the session, were not included in this analysis.

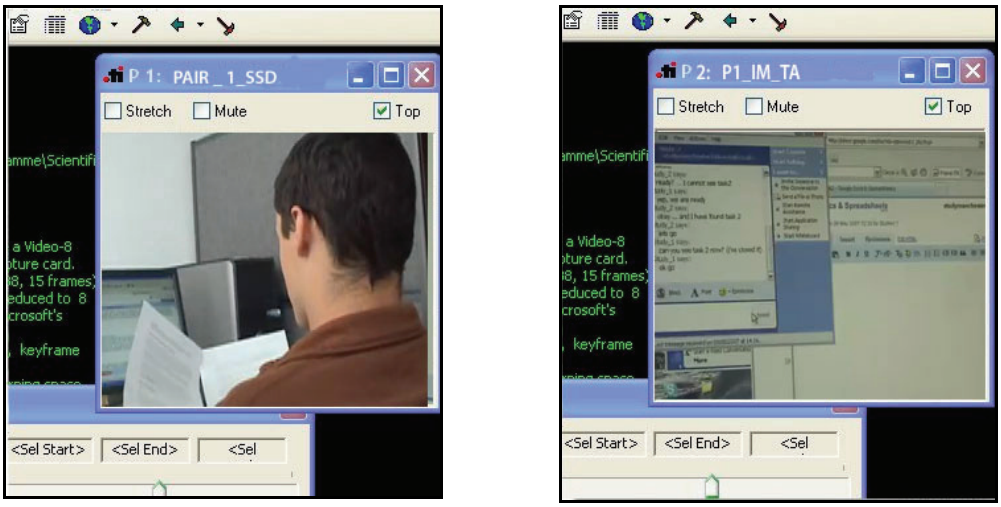


Fig 45 – Coding of recorded sessions by Atlas.Ti. On the left, the participant is examining the task sheet with data given by the teacher in a f2f session; on the right, an IM session in shown.

Qualitative analysis was conducted on the Instant Message (IM) text (logs) recorded at the end of participant's Mediated Communication session and directly on the audio traces of Face-to-face discussions, so that the procedure was not a systematic content analysis, but adequate enough to produce reasonable insights into the differences between IM and face-to-face discussions with respect to *engagement measures*. Precisely, relevant

phrases which appeared to display salient direct as well as indirect implications in relation to counter-argument/rebuttal were extracted.

6.11. Outcomes

All pairs diligently participated in both discussion session and successfully completed a joint, well constructed document.

Table 16 presents a summary of individual participants' engagement, derived by applying the coding schema in table 17. This table shows individual participants' engagement and the alternation of engagement measures for each setting (F2F and IM).

Table 17 – Individual participants' engagement

	Face to Face				Instant Messaging			
	Clarification	Addition	Inference	Rebuttal	Clarification	Addition	Inference	Rebuttal
P 1	38%	15%	23%	23%	43%	29%	0%	29%
P 2	36%	14%	32%	18%	45%	36%	9%	9%
P 3	54%	15%	15%	15%	80%	20%	0%	0%
P 4	36%	32%	23%	9%	75%	13%	13%	0%
P 5	45%	13%	30%	13%	50%	14%	21%	14%
P 6	67%	19%	7%	7%	83%	0%	0%	17%
P 7	69%	23%	0%	8%	50%	25%	25%	0%
P 8	42%	32%	26%	0%	17%	83%	0%	0%

Comparisons between participants highlight individual differences and preferences for engagement in one or the other setting. Individual data sets are shown in Fig 46. For each participant, alternation of engagement measures are represented for both experimental conditions (F2F and via IM). Pink lines in graphs represent F2F engagement actions, while blue lines represent IM ones.

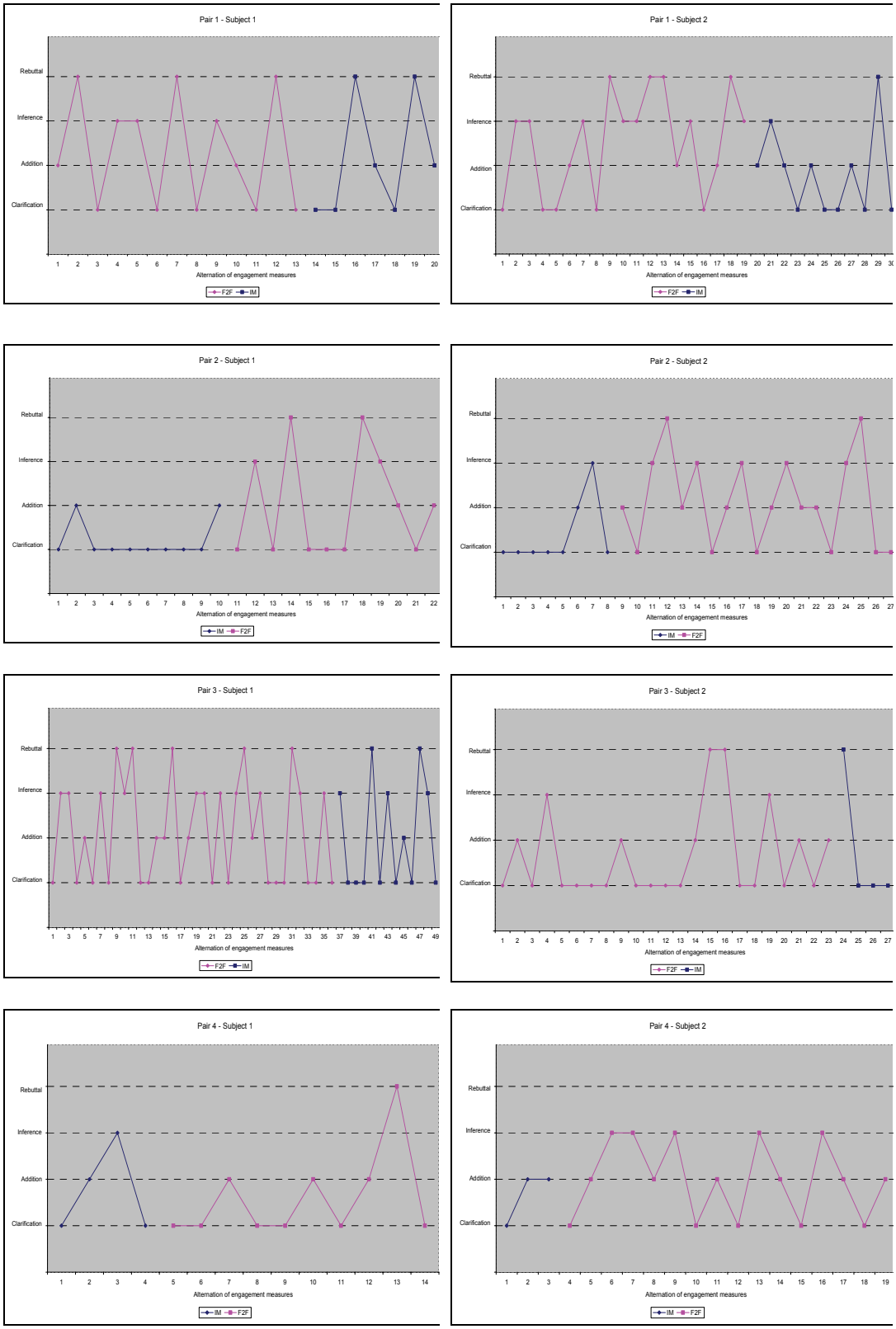


Fig 46 – Comparison of individual participant's engagement in F2F and IM settings

At individual level, beginning with Participant 1, it can be observed that this individual engaged more frequently in *clarification* than in other processes. It's interesting to note that, engagements in '*Additions'* and *Rebuttals* are regularly alternated and appears at same frequency (29%). He also engaged in *inferential* processes but only during F2F discussion.

Participant 2 engaged in *clarification* as well, subsequently moving to *inference*. It's interesting to observe the regular alternation of *clarifications/additions* during the IM session.

Like Participant 1, Participant 3 engaged mostly in *clarification* responses. His engagement in this process was average compared to the trend of his partner (participant 4) in both sessions. He didn't engage in *inference* or *rebuttal* during IM session.

Participant 4's engagement in all processes is average. He entered into the IM discussion by engaging in *clarification*s. He then went on *adding* and *inferring*, then *closing* with clarifications. In F2F session, he engaged also regularly in *additions* and *inferences*.

The analysis of Participant 5's revealed very regular alternation of engagement in *clarification* compared to the other participants during the F2F session. At the same time, data revealed the highest engagement in *inference* compared to all other participants. Like others, this participant often proposed *rebuttals*.

Except for the lower levels of engagement in *additions* and *inference* during IM session, participant 6's engagement in all other processes is averaged. He enters into the discussion by engaging in *clarification* and proposing mostly *additions* & *clarification*. Only at the end of the F2F session he engaged in *rebuttals*.

The transcript of Participant 7 presents the highest percentage of units coded as *clarifications* compared to other participants. It is also interesting to note a low level of engagement in both *inference* and *rebuttals*.

Engagement of participant 8 is worth of note. *Rebuttals* are never present, while all other processes appear in equal measure.

In general, it can be observed that all participants carried out more, and in some cases many more, engagement actions in F2F than with IM. This could be explained by the fact that talking is easier than writing. It should also be considered, however, that the simultaneous use of IM and Google Docs created several technical problems, causing the system to get stuck many times. This and the fact the students had just one hour of time to carry out the activity can explained the much more limited number of actions via IM. These data suggest that the communication technology chosen in this case is not as suitable as the wiki used in the previous ones.

An analysis of the GoogleDocs productions shows that documents produced through more active interactions were longer and richer, as it was reasonable to expect.

It can also be find a correspondence in the number of actions carried out by the two members of each pair. This is quite reasonable as the activity was a dialogical discussion. The only exception of Pair 3 can be explained with personal inclinations and abilities of participant involved.

It's also interesting to compare the percentage operations of participant within each pairs. This is shown in Fig 47.

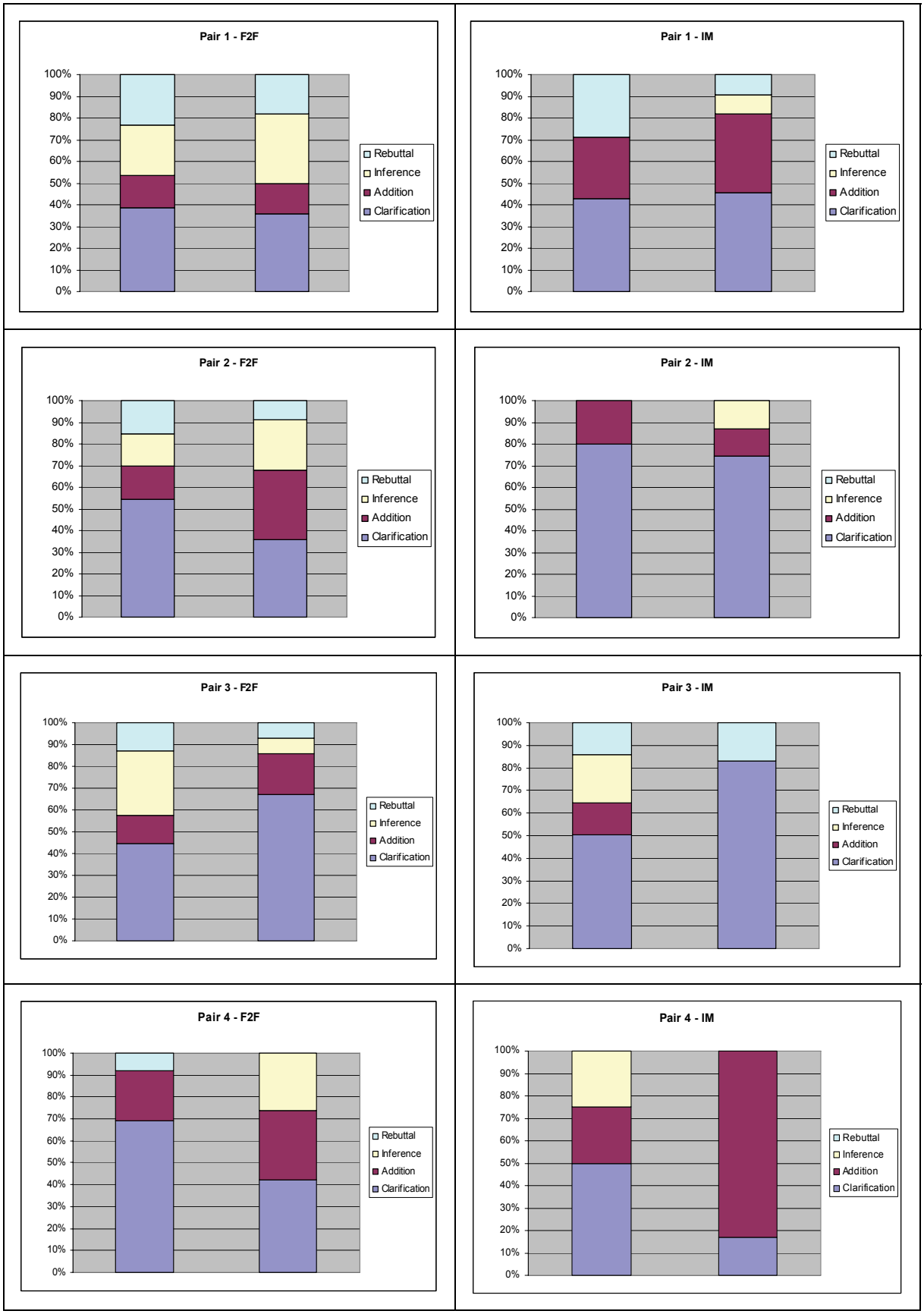


Fig 47 – Percentage engagement actions carried out by pairs in the two modalities

These data highlight that all participants tended to engage most in *clarification* and least in *rebuttals* both in the F2F and IM setting. The least frequent actions, inference and in particular rebuttal, are carried out mostly in F2F and less frequently via IM. As these operations are likely to result more difficult for the student to carry out (rebuttals appeared also scarcely used in Case Study 2), it is very reasonable that students live aside the most difficult operation when using a technological environment that does not facilitate much their work.

6.12. Discussion

This case study aimed to further deepen knowledge on rebuttals dynamics, comparing the amount of rebuttals developed in different situations, i.e., dialogically argumenting, while preparing a shared document, either face-to-face or online. In particular, the aims was to check whether one of these two modalities gave rise to a higher number of rebuttals than the other, or not.

The outcomes of this case study are not directly comparable with those of Case Study 2 in that this was carried out in just 1 hour while the other was developed over several weeks. In this case, however, the students had knowledge and data on the topics under considerations, and simply had to negotiate the content and organization of one shared document.

In most cases there were more rebuttals in face to face than in the technological environment. These findings, which are partially in disagreement with those of Case 2 findings, may be due to the fact that a different technological environment and activity structure was used, and suggest a greater suitability of that setting for carrying out collaborative dialogic argumentation.

Making reference to the initial hypotheses, the experimental hypothesis was not confirmed that is, all pairs interacted more in F2F than by IM. On the other hand, the technological setting in this case did not result as supportive as the wiki environment used in the previous case studies, because of the technological problems that it caused. Moreover, the wiki offers an integrated environment in which discussion, data and document can be accessed, while in this setting these three elements were available separately. This is also likely to have influenced the good development of the discussion.

Chapter 7 Summary and discussion of findings

This chapter provides an overview of the study. It summarizes the theoretical background and the motivation of the study, as well as the main findings, which are discussed against the literature. Finally, the conceptual architecture Wiki*DiA* and its tuning based on experimental outcomes are presented.

7.1. Introduction

According to Scardamalia and Bereiter (2002), engaging learners in collaborative knowledge building is a fundamental aim of education in the knowledge age. Indeed, supporting argumentative knowledge construction is a relevant issue especially in higher education, since engaging students in dialogic argumentation helps develop critical thinking (Kuhn, 1999). Students in higher education are requested to present well-ground arguments, as well as to assess the strengths and weaknesses of other people's standpoints (Leitão, 2000; Orsolini & Pontecorvo, 1992; Pontecorvo & Girardet, 1993; Muller Mirza & Perret-Clermont, 2009; Andrews, 2010 in press). Despite the importance of argumentation, it is repeatedly reported in the literature that higher education students have poor skills in this respect, especially as concerns creating individual contribution to joint argumentation (Kuhn, 1991; Klaczynski, 2000; Stein and Albro, 2001).

Recently, research efforts have also been directed towards understanding and assessing the role played by ICT (Information and communication technologies) in collaborative learning (Köhler & Fuchs-Kittowski, 2005), as well as in practicing argumentation and critical thinking (Steinberg, 1992; Littlefield, 1995; Marttunen, 1997). If paired with a sound methodology of use, ICT, and in particular social technologies, has a good potential to support learning and knowledge building in higher education (Hamid, 2009; Hemmi et al., 2009; Hughes, 2009; Scardamalia & Bereiter, 2002). The present study attempts to add to the knowledge base of technology-mediated collaborative learning environments by investigating the main factors that contribute to successful argumentative knowledge construction in higher education pedagogy. In particular, the use of wiki-based environments to this end is proposed. Although both argumentative knowledge construction and wiki-applications in education are well explored in literature, the use of wiki technologies to support argumentative knowledge construction in higher education has not been reported. This is, indeed, the original contribution of this study,

based on the definition of a conceptual architecture for a sound use of wikis for argumentative knowledge construction in higher education (Wiki*DiA*).

The rationale of the design and development of the Wiki*DiA* conceptual architecture emerged from this study is reported in Section 7.4 to enable a deeper insight into the study's findings and to facilitate a full understanding of the methodological issues described progressively in Chapters 4, 5 and 6. The Wiki*DiA* conceptual architecture was designed and applied by the author over a six-month period, during which the data collection phase of this study was carried out. Constructivist theory and related literature from both the argumentation and CSCL fields informed the creation of the proposed approach.

The research methodology adopted in this study allowed in-depth insights into the participants' perceptions and interactions, avoiding to focus on the technology *per se*. Qualitative data sources and their analysis have shown how students from two university courses used an emerging and innovative technology (wiki) in a collaborative learning environment. The focus of the study was on the personal and social dimensions of argumentative knowledge construction and students' perception of the learning environment set up. Two main hypotheses guided this study (each of which had subsidiary statements of purpose that were introduced in Chapters 4, 5 and 6). These were:

H1: The use of wikis can promote the creation of learning environments conducive to argumentative knowledge construction. In particular:

- Wikis can effectively support collaboration and decision making processes
- Wikis help to structure argumentative discourse at both micro- and macro-level.

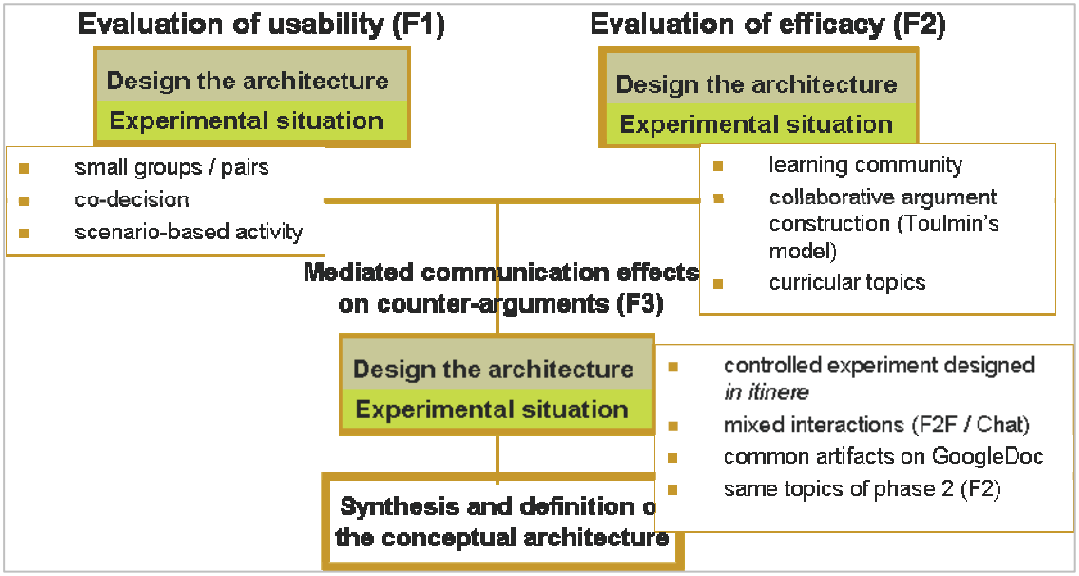
H2. Learners respond (in terms of rebuttals/counterarguments) more to peers via mediated communication than in face to face discussions.

7.2. Summary of experimental results

This research work developed through three exploratory studies aimed to observe different aspects related to technology-enhanced collaborative argumentation. In particular, the first phase of the research (Case Study 1) focused on the co-decision process of small group learning; it aimed to check if a wiki environment provided the functions which are important to carry out such activity in small groups, and if its use was sufficiently easy to facilitate the task.

The second phase of the research (Case Study 2) focused on the collaborative process of argumentative knowledge construction. In particular, the effectiveness of wiki technology to facilitate students' construction of rebuttals/counter-arguments, thus overcoming social constraints, is observed. This phase specifically informed and strongly impacted on the definition of the Wiki*DiA* conceptual architecture (see Section 7.6).

The third phase of the research (Case Study 3) was designed and developed *in itinere*. Based on the preliminary results of Case Study 2, this study aimed to perform a comparison between students' engagement in face-to-face discussion *vs.* debate mediated by other technology instead of wikis; in particular, the aim was to observe whether one of these two modalities gave rise to a higher number of rebuttals than the other one, hence providing information if other kind of communication technology can be as supportive as



wiki for this kind of task.

The architecture of the three experimental situations is depicted in Fig 48.

Fig 48 – Overview of the architecture of each experimental situation in Case study 1 (F1), Case study 2 (F2) and Case study 3 (F3)

Overall, the experience of the three case studies appears highly positive. Their main outcomes are summarized here from the point of view of wiki ease of use and effective support to argumentation and learning, as well as to facilitate counter-arguments.

As to the *effective support of wiki technology to collaborative argumentation*, the characteristics of the argumentative network created by students provide an indication of its operation. In particular, the permanent, browsable network created after 10 weeks of course (see Case Study 2) included about 108 nodes (a *node* is any new argumentative act) with a growth rate of 100% over the first period (students' contributions constantly

doubled during the first weeks). It is interesting to remark that the growth dimension of the network shows, independently of quality, an advancement in students' argumentative practice and confidence. As concerns behaviours emerged, each student contributed to the development of the argumentative network with about 7 new contributions and over 26 contributions to the other existing network nodes. The nature of students' contributions (most often "Data" and "Backing") confirmed that they concentrated more on "*conjunctive argument*" (i.e. adding knowledge to arguments raised by their colleagues) than on finding counter-arguments. In general, the quality of the essays was good and increased over the experience. Most of the students (over 70%) were satisfied of the wiki support to collaborative argumentation and the interaction modality, as well as of the overall learning experience.

As to the *usability of the wiki environment,* interesting results emerged from observing the evolution of the argumentative network: students rapidly learnt to use wikis' functionalities as showed by the rapid growth of the argumentative network (see Case study 2). Over 70% of students found argument construction easier on wiki than in face to face (see Case study 1) and, as a matter of fact, mostly choose to collaborate on the wiki rather than in presence.

As to *comparing wikis with other interaction environments to support counter-argumentation*, results mainly come from Case study 3, which, as already pointed out above, was implemented to respond to students' demand for synchronous communication tools to overcame social barriers preventing their involvement in counter- arguments. Results showed that students engaged more in counter-argumentation during face to face activities than in IM-mediated discussion (Instant Messaging). Counter-arguments remained limited and, thus, the hypothesis that any technology can facilitate the overcome of social barriers in student's counter-arguments was not proved. As a matter of fact, the technological setting adopted in this case (which included a separate location for discussion (IM), data (local file) and shared document (GoogleDoc) did not result as supportive as the wiki environment used in the previous case studies.

Results emerged from the case studies are discussed in the following sections against the initial hypotheses and the literature in the fields.

7.3. The effective support of wiki technology to collaborative argumentative knowledge construction

This section of the study focused on the workflows and ease of use conducive to students' dialogic argumentation in small group learning supported by wiki technology. A set of objectives framed in the existing literature were the starting point (Kuhn et al, 1997; Marttunen & Laurinen, 1999; Chong & Yamamoto, 2006). Claims here were supported by the content analysis of students' productions and the usages of wiki-based functionalities to create and develop their collaborative arguments. These also were supported by data from interviews and class observations.

Most students pointed out that the type of operations they choose to perform on their documents was often affected by social rules more than by the ease of use and the functionalities of the wiki space. The students tended to consider "inconvenient" to delete or modify their peers' arguments and for this reason they did not use much such functions. While students were comfortable individually adding new contents, they felt the need to negotiate decisions about corrections and deletions with the peer. The set up of the wiki environments appeared to be a valid support to accomplish the task. The opinions expressed by the students and course teacher on the effects of wiki-supported discussion were mainly positive: the majority felt that technology had a positive impact on dialogic argumentative process, and that they were comfortable with using the environment. Other students expressed appreciation for the facilities offered, in particular for the possibility to have always at disposal the work of their peers, which helped them to elaborate their own contributions. They also expressed appreciation for alternating individual work with peers' interaction as a way to make up and get enriched by the ideas of their peers. These considerations suggest that sharing ideas on the wiki helps the students to learn from each others.

These findings are important from a number of perspectives. The set up learning environment (i.e. wiki space and coursework activities) was a vehicle for students' development of critical thinking skills. In particular, considering the work of the group mates (i.e. identifying weaknesses of other pair's standpoints) and the co-decision, peers' negotiation process appear to be powerful catalysts. Hence, the experience confirms the need of giving the students a sound methodology to structure their work (Johnson & Johnson, 2005), in order to lead them to deeply get involved in the activity (Kobbe et al., 2007). This experience makes a contribution to the literature relating to CSCL (Collis&Moonen, 2008), by adding information to the body of knowledge about wikis'

potential for decision making process, hence complementing the literature in this respect concerning collaborative learning (Parker & Chao, 2007; Notari 2006; Wheeler et al, 2008; Ebner et al., 2008) and debate-based learning (Chong & Yamamoto, 2006). These finding are also in agreement with Mason (1996, 2001) and Leitão's (2000) observations that the engagement in argumentative small- or large-group discussions has been found to improve conceptual understanding and knowledge building. Finally, the findings provide some answers to the important question raised by Roth et al. (1996) who asked *how technologies can facilitate collaborative sense-making*. The set up learning environment used in this section of the study appears to facilitate student articulation, reflection and (to a lesser degree) meaning-making. The positive results reported in this section of the study were relevant to the design and refinement of the Wiki*DiA* conceptual architecture.

7.4. Characteristics of the argumentative network and emerged behaviors

This section of the study explores the very process of collaborative knowledge construction. Its aim is to show the effectiveness of wiki-based activities to facilitate students' creation of an argumentative network which give rise to many arguments and counter-arguments as depicted in Fig 49. Claims in this section of the study were mainly supported by data from students' written arguments and rebuttals, as well as responses to teacher surveys and talk aloud sessions.

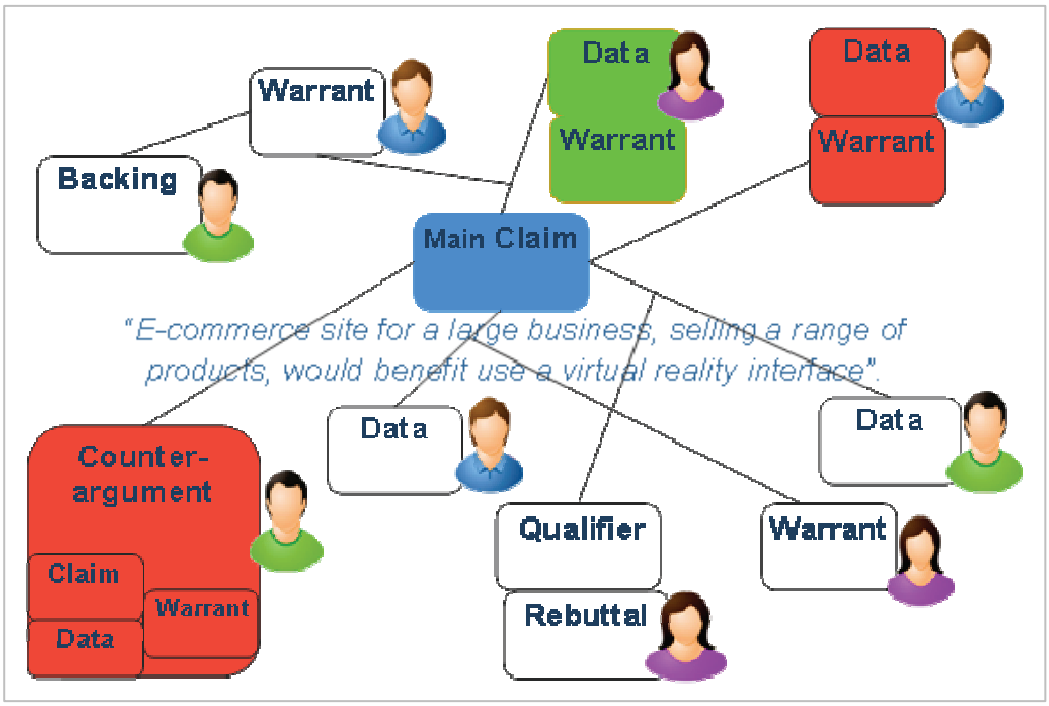


Fig 49 – Schema of the argumentative network

The teacher perceived the activity structure and the wiki-based environment as providing an efficient and effective way of supporting students' argumentation. Indeed, in all cases except two, the students' essays constantly improved in quality during the course. Concerning the argument structure, a relevant number of *data* and *backing* components were revealed by the analysis of students' arguments. Approximately 100 utterances were identified where students, by including backings, suitably supported the *warrant* (which, in Toulmin's model, is the element connecting *data* and *claims)*. Hence, the lower occurrence of rebuttals, in comparison with other actions, was likely influenced by the high number of backings, as the warrants were adequately supported. The tasks involving students' creation of rebuttals/counter-arguments also revealed the students' strong preference to engage most often in collaborative processes, by developing 'conjunctive arguments' (as opposed to counter-arguments).

These findings make a contribution to the literature relating to collaborative argumentation in electronic environments. By facilitating the split of arguments in micro-units related to individual points, the highly modular structure of the wiki-based environments proved useful to help students to keep logical consistence in their arguments, while following the Toulmin's model (Muller-Mirza et al., 2007; Leitão, 2000; Schwarz and Glassner, 2007). In particular, the set up wiki-based environment promoted a dialogic dimension which facilitated oppositions between views (Leitão, 2000), rather than between individuals (Pontecorvo and Pirchio, 2000). Hence, the experience is in agreement with Andriessen's (2006) observations that, in learning contexts, argumentation contributes more effectively to learning when it is not competitive ("students need to balance an *assertiveness* in advancing their claims with a *sensitivity* to the social effects of their argument on their opponent peers" p. 449). This experience also adds information to the body of knowledge about the process in which shifts in knowledge are undertaken in argumentation contexts (Leitão, 2001). The students' frequent use of "*conjunctive arguments*", that is, adding knowledge to peer's previous utterances, was in agreement with relevant literature (Resnick et al. 1993; Nathan et al. 2007; Orsolini and Pontecorvo, 1992; Suthers, 2006). This last point appears particularly relevant in that it highlights an increased possibility for the students to learn from each other, hence playing for each other, each to his/her own extent, the role of "more competent peer", capable to stimulate the *proximal development zone* (Vygotsky, 1978). This suggests that experiences of this kind can actually improve the learning environment of higher education in a constructivist sense. Hence, this section reveals the successful use of a wiki-based environment to effectively and conveniently support students' learning through collaborative argumentation.

7.5. Comparing wikis with other interaction environments to stimulate counter-arguments

This section of the study focused on the comparison between students' engagement in face-to-face discussion *vs* social technology mediated debates. The findings shed lights on the role of social technologies in the Wiki*DiA* conceptual architecture. Indeed, the educational technology focus in this section attempts to provide some answers to Kozma's (1994, p. 16) question about " in what ways" the capabilities of media can be used to support learning for particular students, tasks and situations. Three main issues emerged from the video recordings of the face-to-face (F2F) discussions, the shared documents on GoogleDocs and the recorded text (logs) of students' instant message (IM) discussions. These issues concerned the role of the communications medium on students' engagement level in debates, the different number of students' responses to their peers in social technology mediated and in face-to-face discussions and the functionalities of social technology tools that can effectively support peer argumentation.

Firstly, the instant messaging communication afforded students to carry out a more limited number of 'engagement actions' than in face-to-face discussions. This could be explained by the fact that it was easier for students to include the other's view in their F2F talk (Pontecorvo and Pirchio, 2000), rather than in "synchronous" writing. Moreover, it should be observed that several technical problems occurred and students had just a very limited time (one hour) to carry out the activity; this can likely explain the much more limited number of 'engagement actions' via IM. Hence, these findings suggest that the communication technology chosen in this section of the study were not as suitable as the wiki used in the previous ones.

Secondly, students' responses in social technology-mediated debates more often tended to provide *clarifications* and *additions*. The same findings were from the F2F settings. *Inferences* and in particular *rebuttals* were carried out mostly in F2F and less frequently via IM. As these two operations are likely to result more difficult for the students to carry out (Voss & Means, 1991), it is very reasonable that students tend to live aside the most difficult operations when using a technological environment that does not facilitate much their work.

Thirdly, the documents produced by students through more active interactions were longer and richer. In this section of the study, however, the set up technological environment did not facilitate students' engagements in rebuttals as in face-to-face.

From a constructivist perspective, many of the affordances emerged from this part of the study were useful in helping students engage in peer debates and rebuttals with confidence.

7.6. The Wiki*DiA* conceptual architecture

The main contribution of this study is the definition and testing of an original conceptual architecture for the organization of argumentative knowledge construction using wikis. The key idea is that argumentation skills can be facilitated by social-technology tools, through the discussion in peers' small group. Social technology, like wikis, enables and improve the collaborative and social dimension of argument construction.

The Wiki*DiA* conceptual architecture aims to help structure collaborative activities of dialogic argumentation, cooperation and decision-making, thus enhancing and supporting their development.

The added value of the argumentation process activated in a wiki-based community of learners comes from increased possibilities to share knowledge and know-how generated by the community involved. Students are facilitated in jointly constructing compelling arguments and generating multiple points of view. The argumentative knowledge construction results as a shared effort to produce new knowledge, rather than being the mere discussion of information. Toulmin's layout of argument is adopted here and students are specifically trained on this argumentation model.

Grounded in Case Study 2, this conceptual architecture takes advantage from all the experiential situations involved in this research study.

The WikiDia conceptual architecture offers professors, lectures, and researchers informative guidance for teaching effective argumentation skills to their undergraduate and postgraduate students using wiki environments.

To fully take advantage of the possibilities offered by wiki to collaborative argumentation, the proposed conceptual architecture consists of 4 main steps, as summarized in Fig. 50 and described below.

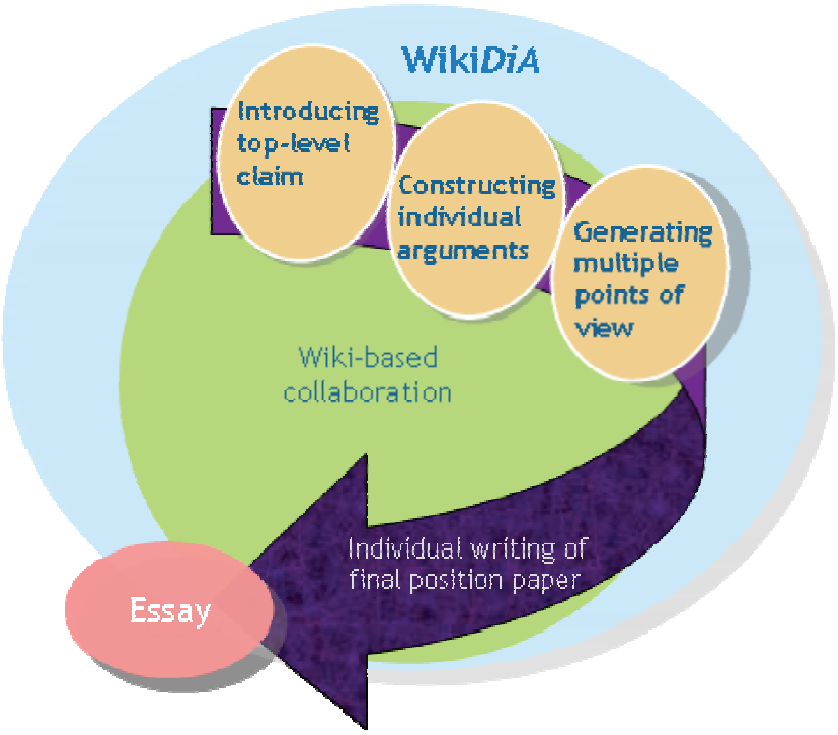


Fig. 50 - WikiDiA conceptual architecture

This structure of the Wiki*DiA* conceptual architecture was worked out based on the experience of case studies developed so as to extract from each of them the features that appear more conducive of good argumentation.

Step 1: Introduction to topic and top-level claims

In this initial stage, students are introduced by the teacher to the overall debate topic and provided with a set of recommended readings. After being assigned to one of the two groups ("for" and "against"), students are given a top-level argument, which they are requested to support or contrast in the working group. To help students identify what kind of arguments might be relevant, a brainstorming session is carried out with the class. This early discussion allows teacher and students to share their initial ideas and generates a list of meaningful and worthy points of views for or against the proposed claim.

Step 2: Constructing individual arguments

Working individually, each student is responsible for developing a small number of consistent, relevant and justified contributions to the debate. When individually developing their arguments along one of the points of view emerged in the previous step, students are requested to carry out the following basic steps: a) search the topic for

material to be used in the debate (start by finding one of the recommended reading on Google Scholar and then use the "cited by" link to review more recent articles); b) define terms and concepts that are central to the proposed claim; c) base arguments (for and against) on the considered literature and cite it where appropriate. During this phase, the teacher participates in the process as an advisor, giving suggestions and pointing out concerns when appropriate. This step produces a number of micro-arguments which reflect individual views of the considered points, completed by supporting data. These micro-arguments will be organized, in the next step, into an exhaustive and compound discourse. In this step students start collaborating at knowledge building by sharing materials that they consider of interest either of their group mates or of the other group.

Step 3: Generating multiple points of view

Within the "for" and "against" group, students share their elaborations and collected data. Moreover, in order to meaningfully engage into the argumentation process, they need to agree upon definitions, evidences, and claims/counterclaims. To do so, they need to work collaboratively rather than competitively: they are required to contribute to the other members' work, by checking consistency, adding information, clarifying positions, linking elements. Then they start collaborating with the other group by developing counter-arguments (rebuttals) to their positions. This leads students to examine opposite points of view, and this further stimulates them to search data supporting their argumentative challenge, in order to develop counter-arguments and respond to their peers' counterarguments. This helps develop a more complete perspective on the topic. Rebuttals are considered the creative stage of the dialogic argumentation and need to be facilitated by suitable tools. By engaging in this activity, students "shift" from personal understanding and 'sided' perspective of a subject to a wider understanding by comparing the points of view of all mates.

Step 4: Individual writing of a final position paper (essay)

Once all contributions are made, each student produces a final position paper giving a consistent account of "pros" and "cons" emerged from the debate.

Alternating individual and collaborative steps aims to give each student the possibility to work out his/her own ideas while taking advantage of the multiplicity points of view and data contributed by the whole class. At the same time, each student is compelled to get fully engaged in the activity since he/she is responsible of his/her final production.

7.7. Tuning the Wiki*DiA* based on the experimental outcomes

The insight gained through the case studies worked out constitutes the basis of the Wiki*DiA* conceptual architecture, which concerns the organization of argumentative knowledge construction in wiki-based environments. In particular, the experimental situations have strongly influenced the understanding on *how* to implement the several steps of the WikiDiA conceptual architecture (eg. by introducing an initial classroom brainstorming or encouraging students to link the various contributions to the argumentative network).

Wiki*DiA* relies on Toulmin's model as a reference framework for the microstructure of arguments and to Leitão's (2000) sequence model to shape the argument sequencing (macrostructure). In the Wiki*DiA*, these theoretical approaches have been paired and complemented with a number of practical dimensions, giving rise to a conceptual architecture in several steps. In the following, the various elements emerged from the experimental situations which mainly informed and guided the refinement of the conceptual architecture are listed.

1) The importance of both micro- and macro- structure, as well as knowledge on how to create them, is clearly explained to the students.

2) An issue and a related top-level claim is introduced by an expert (the teacher or other competent person), who suggests an initial set of recommended readings. The production of a final essay is assigned, based on the collaborative argumentation that will be carried out; the assigned essay may be individual or collective, depending on the teachers' current educational aims.

3) Students are divided in two groups (*for* and *against*), each of which will concentrate on developing arguments for or against the given claim. This aims to support the formation of multiple points of view, which is considered important in knowledge building (Scardamalia and Bereiter, 2002; Baker, 2003).

4) An initial brainstorming among all the students is carried out, to establish a shared understanding of the key elements of the considered issue, so as to provide a common ground. Establishing a common ground is considered a crucial step to give raise to successful collaboration (Clark, 1996).

5) A suitable wiki working environment is set up. It is important that the social technology platform chosen offers a number of features apt to support the collaborative elaboration of arguments, such as:

- the possibility of discussion strictly connected with the argument produced, by adding, for instance, comments in the text pane, besides general comments; this support more punctual discussion on elements of the arguments/counter-arguments;

- the possibility to upload in the work environment file of different format so as to collect in the same place students' production and the data which they are basing their arguments; this helps the students to have all the relevant materials (data) always at disposal, easily shared them among peers, providing opportunities to explicit knowledge (Baker, 2003);

- the possibility for the students to create new pages for their production as according to their wishes; this allows them to give the structure they prefer to their macro-arguments;

- the possibility to connect different text pages and files, so as to create a reticular structure among arguments and data; this is very practical for the creation of compound argument sequences.

The wiki platform should be configured before starting the activity by creating a main page with the top level claim and initial materials given, as well as initial pages for the two groups; the commands for the creation of new pages, comment and links among elements should be evidenced, so as to highlight the available facilities and encourage their use.

6) Encourage the students to formulate rebuttals/ counterarguments, so as to further support the creation of multiple points of view.

Chapter 8 Conclusion

This study aimed to investigate the potential of wiki technology to support collaborative construction of argumentative knowledge in higher education.

Specific objectives of this study were the evaluation of effectiveness and usability of wikis in collaborative argumentation, and the definition of a conceptual architecture for wiki- and argumentation-based learning processes.

This study involved an experimental activity consisting of three case studies carried on with undergraduate and postgraduates students at the University of Manchester (UK). The case studies was also an occasion for tuning the WikiDiA, the above mentioned conceptual architecture.

In the following sections, the main findings, limitations of the study and the directions for future research are summarized.

8.1 Results obtained

The analysis of experimental data, particularly those regarding Case Study 2, confirms that the use of wikis can effectively support university students in collaborative argumentative knowledge construction.

This mainly results from the richness of the argumentative network, which stems from the articulation and quality of its various *nodes* (a permanent, browsable network of about 110 *nodes* has been created by students). From a qualitative perspective, teacher positive ratings of student performance also confirm this results. It is interesting to note that, when confronting with a more complex task, the quality of students' performance (i.e. individual essays) slightly decreased (on an average of 5 marks) to then quickly rise again.

Another encouraging result comes from the good level of satisfaction that the majority of students (over 70%) expressed, both for the learning experience and for the support offered by the wiki. They all engaged in argumentative knowledge construction mostly concentrating on the collaborative realm, thus adding 'piece' of knowledge to others arguments (that is *conjunctive argument,* see Case Study 2).

Case study 3 was organized to compare different social technologies and, specifically, their potential to foster "students' 'argumentative freedom', especially counter-argument. Technologies other than wikis showed no values in fostering counter-argumentation (see Case study 3). As a matter fact, the technological setting adopted in this case (which

included a separate location for discussion (IM), data (local file) and shared document (GoogleDoc) did not result as supportive as the wiki environment used in the previous case studies.

Drawing on results obtained, the conceptual architecture Wiki*DiA* has been mainly defined and implemented in Case study 2, which also provided many elements for tuning it (as discussed in Section 7.7). This architecture offers academics, and researchers informative guidance for teaching effective argumentation skills to their undergraduate and postgraduate students using wiki environments.

As a result of the present study, a good level of confidence has been reached regarding the actual potential of wikis to foster collaborative argumentative knowledge construction. Moreover, a tested conceptual architecture is available which can be applied as a basic structure for learning processes in analogous contexts and content areas.

8.2 Limitations of the study

A number of unrelated issues, which were not explored in this study due to time constraints, represent possible limitations in this study. These included: *socio-cultural influences, the amount of collected data and technical limitations.*

Socio-cultural influences.

Socio-cultural issues such as the students' previous studies, gender, socio-economic or ethnic background, were not considered in the results of this study. The two university courses, which provided the contexts of this study, were chosen within the same School and because of the interest expressed from the teachers. Associated influences from these were not accounted for in this study.

The amount of collected data.

During the study, the researcher collected anecdotal proof of students learning and developing of their discipline-specific discourse skills. Moreover, data on direct observation and video recordings of individual students interacting with the wiki-based environment while constructing their arguments/rebuttals were also collected. Unfortunately, the time constraints of the study limited any reports of these observations. Although this represents a limitation on this study, this particular issue will be a focus of future investigations.

Technical limitations.

There were naturally some technical limitations during the study. For example, a student incidentally over-wrote a certain number of wiki pages of his group (Task 2, Case

study 1), which included peers' arguments. However, the versioning feature available in the wiki platform allowed recovering the closest final version of the documents. Students also verified and further integrated where needed. Fortunately, only in another occasion (Case study 3), one pair out of the 4 experienced some technical problems during the study with their computer. This particular pair was using 2 laptops, interacting via IM and creating on GoogleDocs, and it 'froze' on them twice. However, minimal time was lost and the students coped well with this unexpected delay.

Likewise, the lack of opportunities to use an alternative wiki platform and to combine it with other social technologies represented another (minor) limitation in the study. In fact, this opportunity would have proved additional information on pair's negotiation process and some significant insight on students' interactions. However, these fall outside the immediate scope of the study, which was designed to investigate argumentative knowledge construction in higher education pedagogy.

8.3 Directions for future research

This study focused essentially on developing a conceptual architecture to support the argumentative knowledge construction in wiki-based learning environments, leaving aside other interesting correlated issues. Possible directions for future research that appear particularly interesting at the light of the results obtained are: *a wider scope for the WikiDiA conceptual architecture; a metrics for the quality of arguments, how to foster students' argumentative skills, how to foster students' 'argumentative freedom'.*

A wider scope for the WikiDiA conceptual architecture.

In this study the proposed conceptual architecture Wiki*DiA* had been applied to organize wiki-based argumentative processes in courses at university level (both under- and postgraduate) in the field of Computer Science (Human Computer Interaction). A first open issue concerns the application of the proposed conceptual architecture in a variety of learning situations (e.g. in continuing professional development courses) on different topics (e.g. Educational Sciences), so as to widely test its general applicability and effectiveness.

A metrics for the quality of arguments.

Particularly important appears evaluating on a formal basis the quality of the arguments produced. In the present study, the evaluation addressed the structure of the (micro and macro) arguments, while the quality of the argument contents was the object of a traditional evaluation by the teacher who marked the students' work. Further research in this field should focus on the development of a holistic approach to the evaluation of

argumentation in wiki-based environments, keeping into consideration both structure and content of arguments at the same time. This could be realized by exploiting an important feature of wikis, that is, the history of all the versions of the pages produced by the students. Another useful support to address this task would be developing a unified coding schema which takes into account the variety of coding schemas currently available in the literature (Forman et al., 1998; Orsolini & Pontecorvo, 1992; Pontecorvo, 1987; Pontecorvo & Girardet, 1993; Coffin et al., 2005; Felton & Kuhn, 2001), as well as the kind of operations that are peculiar of working in wiki-based environments, such as the use of formatting as a means to "clean up" thoughts. It would also be useful to elaborate a formal approach to evaluate by defining measures to evaluate the contribution of the individual students to the argumentative network.

How to foster students' argumentative skills.

A complementary meaningful issue to be tackled is how to help students improve the quality of their argumentative productions, exploiting the availability of wiki-history by means of meta-cognitive reasoning on their development paths. It would also be useful to further support students' self improvement augmenting the functionalities of wiki environments by means of facilities to represent "all in a glace" the reticular structure of the arguments produced and data collected.

How to foster students' argumentative 'freedom'.

Finally, another open issue to be considered in order to advance knowledge in this relevant field is the development of strategies to support the social and affective aspects of argumentative knowledge construction (in other words, helping students to feel 'free' to constructively engage in counter-arguments). As a matter of fact, this study has highlighted, in agreement with the literature (Khun, 1999), that social and affective constraints play an important role in facilitating or hindering students' argumentative skills.

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Appendix A

Informed Consent Form

We would be very grateful if you felt that you could participate in a study of the use of wiki technology in small group learning. Your participation is important to us and will help us assess the effectiveness of the technology. As a participant in this study, we ask you to consent to:

- audio/video recording group meeting sessions you participate in
- completing a questionnaire or being interviewed (your views on the technology and the quality of the learning activities are important to us).

We will keep all of your answers confidential. Your name will never be included in any reports and none of your answers will be linked to you in any way. The information will not be used for assessment. The information that you provide will be combined with information from everyone else participating in the study. The recordings will be viewed by Stefania Bocconi and by Dr A. H. They will not be viewed by anyone else. They will not leave the University of Manchester.

Even if you agree to participate now, you may stop participating at any time or refuse to answer any question.

By signing below, you confirm that this form has been explained to you and that you understand it.

Please check one:

__ Agree to participate

__ Do not agree to participate

Name _____

Signature_____

Appendix B

Coursework Assignment of "Human Computer Interaction (HCI) and Web User Interfaces"

Imagine a scenario where you (or your friend/relative) arrive for the first time to Manchester through Piccadilly train station, and you want to know what attractions Manchester has to offer. Your project is about designing a 'targeted' advertisement for Manchester as a touristic destination. There are 3 possible formats of ad that you can choose. In any of these 3 formats, a stranger should be able to tell you what the ad is about and which group of people you are targeting within 3 minutes. These 3 formats are:

- Big screen ad (like the one in the Triangle or Piccadilly train station)
- Touch screen ad (there is one where you wait for the city centre free shuttle number 1 outside Piccadilly station, there is another one in the waiting room before you go to Platform 13/14)
- Paper-based ad (which can be a booklet or a poster, go to Manchester Tourist Board behind the Town hall to get a sample of this paper-based ad)

You MUST also choose a specific 'target audience' that your design aims to focus on. The possibilities are endless, you can think of Manchester as a place of people who are interested in gastronomy, outdoor sport, history, science and industry, culture and arts, etc.

To help with group discussions and putting all of the facts you gather in one place, we are going to use Wiki in this coursework. These facts will be useful when it's time for you to write the report, which I am not going to bother you with the detail yet. To help you focus your work, please find the structured activities for the first two weeks. Please do not deviate from the scenario given below.

8-Feb-2007

10:00-10:05: This package is handed out, waiting for the late arrivals
10:05-10:15: Reading this page and asking any questions related to the coursework
10:15-10:25: Reading the Guardian article and discuss which arguments are subjective and which are objective
10:25-10:30: Groups 1-4 stay where you are, groups 5-7 go to H13
10:30-10:45: Read Twiki – Get started and connected. Register yourself following the instructions there and play with it.
10:45-10:50: Your group will be split into 3 pairs for the exercises in the next 2 weeks. Choose your pair.
Homework before next week: go out and check out the three formats.

15-Feb-2007

10:00-10:05: Waiting for the late arrivals, explaining about referencing literature

10:05-10:15: You and your pair must choose a **format** you think the group should pursue. Please do not discuss with the other two pairs.

10:15-10:25: Now convene as a group of 6/7. See which pair chooses what format. As a group you must gather information about the three formats, so if more than one pairs choose one format, as a group you need to agree which pair does what (it's called **negotiation skill**).

10:25-10:50: Work in pairs. Go on the Internet. One of the best sources for 'reliable' information is http://scholar.google.com. Find out what other people had studied/said about the format that you are responsible for finding more information on. Try to summarize all of the strong points of the format you propose in 250 words. Start using your group's wiki, by creating your pair's page (see example called BigScreenFormat (edit the page to reflect your format). You don't have to finish now. As you can see in your group's wiki, you have until Monday 10:00 to finalize your 'defense'

Homework before next week: check tourism websites that cater for various target audience. Remember that you need to comment on the other two pair's formats by highlighting their weaknesses and to compose a table to summarize the strengths and weaknesses of your format before next week.

22-Feb-2007

10:00-10:05: This handout is given out, waiting for the late arrivals
10:05-10:15: Agree as a group which format you are going to choose, basing objectively on the tables produced.

10:15-10:20: Moving to H13 for those in J10
10:20-10:50: Presentation on behavioural observation and interviewing techniques. You will need to know these techniques for several reasons:

1. To observe how people use the format you have chosen (and what problems they experience)
2. To ask people what topics they would like to see in an advertisement about Manchester
3. To ask for feedback and comments on various stages of your design

Homework before next week: you have the same timetable as last week, but this time it's all about target audience or focus (e.g., gastronomy, sport, gaming, culture and arts, history, natural beauty etc). Make sure you verify with the other 2 pairs that you are not covering the same target audience. Specifically these are the things you have to do before next week:

- ***1 position paper (max. 250 words) which explains why that particular focus. Deadline is Monday 10:00.***
- ***1 comment (max. 100 words) to each of the other pair's paper, highlighting their weaknesses. Deadline is Tuesday 17:00.***
- ***1 table to summarize the strengths and weaknesses of your focus based on your position paper and comments from the other two pairs. Deadline is Thursday 10:00.***

1-Mar-2007

10:00-10:05: This handout is given out, waiting for the late arrivals
10:05-10:15: Agree as a group which target audience you are going to choose, basing objectively on the tables produced.
10:15-10:20: You know need to agree as a group which pair does what. There are 3 activities that you will need to do in parallel in the next half an hour (and continuing at home through wiki). These activities are:

1. Choosing colour scheme for the website. Use http://www.colorsontheweb.com/thecolorwizard.asp
2. Choosing screen template. I had laid out the various screen templates in your lecture notes, but in case you don't have it, here is the summary of the templates you can choose from (work for all 3 formats):
   - **The inverted 7 grid** is useful for sites that contain numerous graphical elements and lots of information. The top and left columns are used for navigational or advertising elements, and the centre is reserved for primary content. Example: http://www.clayplanetdesigns.com
   - **The L-shaped grid** is useful for text-heavy pages. The entire page has a visual marker on the left margin, the primary text is in the middle, and the chief navigational elements are at the bottom of the page. Example: http://english.ttu.edu/kairos/9.2/binder2.html?coverweb/bridge/0001.html
   - **The double track grid** draws attention to the centre of the page and usually includes hyperlinks on the left side and featured news on the right. Few or no major elements are at the top, except a logo or title. Example: http://chronicle.com/infotech/
   - **The open grid** is useful for sites that will change from day to day or moment to moment, such as search results pages. There is no set structure in the page, it's open and flexible. Example: http://www.sfmoma.org/
   - **The invisible grid** is specific to sites that depict graphical treatments of content, usually a splash page to start. Example: http://www.theremediproject.com/indexSetLow.html
   - **The visible grid** is useful for sites where many hyperlinks or lots of advertising are major components of a node. Very structured rows/columns. Example: http://www.aldaily.com/
3. Choosing font types and pictures. Font types – my suggestion is to go to Microsoft Words and try all the fonts they have. For pictures, my suggestion is to go to http://images.google.com and pick the images from there.

Homework before next week:

- *1 position paper (max. 250 words) which explains why your choice. Deadline is Monday 10:00.*
- *1 feedback (max. 100 words) to each of the other pair's paper. Deadline is Tuesday 17:00.*
- *1 summary of justifications for the final choice in terms of colour scheme, screen template, and the images and fonts to use, taking into account feedback from other pairs. Deadline is Thursday 10:00.*

Appendix C

Case Study 1 - Interview Guide

Name_____Age____ _____Course Group n. _____

University Year _____

Degree_____

Topic area 1: Dialogic argumentation, negotiation process

1. *What are your views or feelings about your skills in constructing arguments on specific topics (before/after this experience)?*
2. *Do you find working in pair/group was supportive in developing your abilities to construct arguments?*
3. *What do you think constitute a good evidence to substantiate an argument?*
4. *Are you happy with the comments/feedback you received by the other pairs of your group?*

Topic area 2: Organizational strategies

1. *What was your personal strategy for dealing with the course assignment?*
2. *How did you organize decisionmaking activities both in pair and in group?*
3. *Are you happy with the costs of time of the activities performed and the training you received?*

Topic area 3: Social interactions

1. *How did you choose your pair?*
2. *Do you find it easier working in pair?*
3. *Did you enjoyed to work with the same person during all the 3 sessions?*
4. *How did you decide to organize the collaboration with your pair?*
5. *How did you interact with your pair? Mainly by face to face, or by email, or by wiki?*
6. *Do you find your pair put enough effort on your common deliverable?*
7. *How did you make your topic easier to understand to the other pairs of the group?*
8. *How did you review other pair's position papers in order to send out your comments?*

Topic area 4: The role of wiki technology

1. *Have you ever used wiki technologies before (es. Wikipedia)?*
2. *How did you use Twiki with your pair?*
3. *What did you edit of the work done by your pair (only doing changes, or adding stuff or even deleting)?*
4. *Have you clearly discussed and established the norms of editing your common page with your pair?*
5. *Do you think there was anything lacking about this technology?*
6. *Do you find that using wiki technologies can change the negotiation process among groups of peers?*
9. *What do most people think of using wiki technologies in learning context is that student's focus on selection of contents rather than developing ideas (there is no sense of group nor knowledge construction). Is that the way you feel too?*

Catch-all questions

10. *If you were advising the university on using wiki technologies in small learning groups with students, what are the main changes and improvements you would recommend?*

Appendix D

Case Study 3 – Introductory notes for Single-Subject Design sessions

Below you will find a set of notes that may help debate on a typical question for Interactive Technologies 2015. The notes provide some basis for good arguments, some not so good arguments, and perhaps some bad arguments.

Example 1 (a)

Question: Distance Matters: Critique the claim that computer-mediated communication can make distance irrelevant to business.

Note 1

Sellen (1995) compared groups using three video conferencing systems (PIP, HYDRA, LiveWire). They differed in how many participants were visible at once, the control of who was seen, and the spatial arrangement. She also compared these systems to same-room and audio-only conferences.

- PIP (or CAVECAT) - used one video screen for all participants, and one video camera per participant. The single screen shows all images at once (e.g. it might be split into quadrants).
- HYDRA - used one video screen and one video camera per participant.
- LiveWire - only the current speaker was displayed. Switching the image was achieved automatically by voice-activation.

Intuitively HYDRA should be better than PIP because it supports mechanisms of non-verbal communication that are used to co-ordinate conversations between participants. But this claim needs empirical verification. The following sections precise Sellen (1995).

Note 2

Sellen (1995) demonstrated that the particulars of the design of a video conferencing system can affect the success with which communication functions are achieved. However, the study failed to find evidence that problems with conferencing technologies were a barrier to conferencing at distance. (More recent results (Finn, Sellen, Wilbur, 1997) support the conclusion that video conferencing may work as well as face-to-face for established groups.

Note 3

Olson & Olson (2000) review literature on how work is conducted when people are maximally collocated, when they work in 'war-rooms'. They contrast to literature on how people work in remote teams. They focus on synchronous work. Olson & Olson reviewed studies of people who shared a single office space in order to work on a single project. The projects included software design and sales. They claim that in one study workers scored twice as highly, on a productivity test than the US national average (though note that the details of the analysis are not reported). Importantly however, the teams were at a stage of work where it was deemed appropriate for intense effort; their time was not shared with other projects.

Example 2 (b)

Note 1

An important aspect of conferencing is turn taking. Here we will focus on situations where the task is to reach some decision or write a report and a small number of individuals < 20 can all make contributions to the discussion. E.g. council meetings, examiners meetings etc. The task is a function to be performed by the group and not by an individual within the group. According to Sacks, Schegloff and Jefferson (1974) if a conference is to be mediated by a communications technology then the technology will need to support a number of communication functions:

1. They make contributions to the conversation;
2. they make decisions about when it is appropriate to make contributions to a conversation;
3. they hand control of the meeting to others;
4. they relinquish control to whoever will accept it;
5. they ask for control of the conversation, etc.

In face-to-face meetings a number of these tasks are achieved non-verbally e.g. by eye-contact. A series of studies of human communication have established that are well established rules for how they are achieved (Sacks, Schegloff and Jefferson, 1974). Kendon (1967) found that a speaker looks away at the beginning of a turn and will terminate the turn with a sustained gaze at the member of the group who is expected to take a turn.

Note 2

Argumentative exchanges among net group members are quite prevalent. The intensity and deviancy of such disembodied exchanges can become heated. The apparent acceptance, if not cultivation, of argumentative discourse in computer-mediated discussion groups stands in sharp contrast to the conventions of ordinary social conversation. Conversation theorists and researchers convincingly demonstrate that conversants typically display a "preference for agreement" in social interaction (Brown and Levinson, 1978; Holtgrave, 1986; McLaughlin, 1984). This paradox is compelling. Mediated groups are susceptible to more extensive, and often more intense, amounts of argumentative discussion than face-to-face groups (Kiesler and Sproull, 1992; Weisband, 1992). Conversely, routine social practices governing conversation are grounded in taken-for-granted assumptions of agreement and conciliatory behavior. And there is little reason to doubt that computer mediated messaging emulates primary linguistic characteristics of face-to-face interactions (Selfe and Meyer, 1991; Spitzer, 1986). The question arises as to how mediated groups manage this more adversarial communication context while retaining the coherence and cohesiveness necessary for enacting socially appropriate rational discourse.

•This may be a consequence of the low level of social information in email messages.

•The sender lacks reminders of the audience.

•Email seems ephemeral - okay to email obscenity but not to print it out and post it on a board. In fact email is not as ephermal as it at first seems.

•Sproull and Kiesler: "The phenomenon of flaming suggests that through email, actions and decisions, ..., might become more extreme and impulsive."

Some mood cues are available (e.g. (-:) but they are insufficient.

Electronic group dynamics and status

•Sproull & Kiesler have conducted a number studies, typically using groups consisting of one graduate student (high status) and three first year undergraduates.

•They found that: the amount a person talks in face-to-face meeting has a high correlation prestige and social status (p 60) but this difference is reduced when email is used; in face-to-face only the high status member could advocate a position early in the meeting, using email, anyone could.; the influence of the high status member on privately held views (of the undergraduates), as measured by comparing views before and after a meeting, was reduced when using email.