COMMUNICATION PROCESSES IN E-LEARNING DESIGN AND DEVELOPMENT: AN INTERACTION ANALYSIS APPROACH

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ABSTRACT

The present dissertation has as a main goal to identify and describe relevant design and communication processes taking place during co-design meetings, in a way suitable to inform practice in similar settings in the field of eLearning design and development.

The need for such a research emerges from the inadequacy of prescriptive models that can guide professionals in their communication during the design of on-line courses. This inadequacy has been evident also in other design fields, thus a tendency towards empirical team design research has been recently established. In the margins of this research tendency, several different methods of analyzing how a team actually interacts during design have been hitherto proposed. Our research applies an Interaction analysis approach, akin to take into consideration various aspects of both the design and communication processes taking place in parallel during a professional co-design meeting. Such an approach allows for the study of the team's double focus during task-oriented interaction: the realization of the task on which interaction focuses on, and the task of communicating about it.

Thus, on the basis of viewing team design activity mainly as a socio-cognitive interaction activity, a method of corpus construction and analysis is proposed, namely DROMEAS. DROMEAS takes its name from the coding dimensions to which it refers, namely: **D**esign activity, **R**epresentational act, **O**bject, **M**eta-**e**pistemic reference, Dialogue **a**ct, and dialogue **s**equence. The selection of these dimensions over others is based on the theoretical constructs this dissertation addresses, which are: design co-construction,

dialogicality, deliberativeness, intermediary representations, design-related arguments, and user experience.

Applying DROMEAS to an extended dataset (7625 interaction units) derived from 15 co-design meetings of two teams – as representative of high reputation European Distance Universities – has led to several insights and observations regarding both the team design practice in the field of eLearning, and the adequacy of DROMEAS as a method to gain such insights. As far as the former is concerned, our results refer to the structure of design and communication processes, in terms of activities, acts, and objects involved, the content "put on the table", the arguments produced, and the task-related emerging roles. Regarding the latter, methodological considerations such as the adequacy of dialogue acts, instead of speech acts, to describe interaction, the argumentation schemes emerged, and the merging of semantic-cognitive and dialogical aspects regarding communication acts are discussed.

As a conclusion, it is found that the design and the communication processes are mutually dependent, and both depend of the team goal appearing as predominant at each instance of interaction. The selection of an Interaction analysis approach has been proven adequate to richly describe team interaction at various levels and through different focuses. Finally, the identification of argumentation schemes in a naturally emerging dataset has been possible, and also the relation between arguments and design-relevant representations – such as proposals, constraints, and requirements.

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To my mother

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"Never leave for Tomorrow what you are able to do Today…"

«Ο δρόμος του Αύριο οδηγεί στην πλατεία του Ποτέ...»

COMMUNICATION PROCESSES IN E-LEARNING DESIGN AND DEVELOPMENT: AN INTERACTION ANALYSIS APPROACH

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1. INTRODUCTION

The present dissertation lies in-between two research fields, team communication and instructional design, and selects as context of application the eLearning design and development.

The focus of instructional design (ID) is "to plan, develop and implement an effective and efficient learning environment for certain educational goals and for certain learners" (Latzina & Schott, 1995; p. 131). The complexity of ID and its differentiation from other types of design is mainly rooted in the following aspects: a) it implies the design of a process, and going further, the design of an *experience* (McLellan, 2000), rather than the realization of a product; b) this process is cognitively, socially, and emotionally complex (Garrison & Anderson, 2003), and, as such, is experienced differently by each user-learner; and c) the ID process forms part of a broader institutional strategy, and thus, it is guided, shaped, and, often, constrained by it (Kessels, 1999; Bates, 2000; Rothwell & Kazanas, 2008).

To be added to this complexity, the use of "new multimedia technologies and the Internet to improve the quality of learning" (CEC, 2001; p.2), also known as *eLearning*, has entered the ID scenery during the last 50 years. The first so-called "computer-based system used in the engineering of education" became operational in 1964 (Bitzer & Johnson, 1971). eLearning design shares the same focus as ID, as it is mainly an education-guided practice (Goodyear, 2005). However, a number of additional aspects need to be taken into consideration, such as: a) the use of multimedia technologies and the Internet *also* during the design process; b) users-learners become even more

"unknown", as Distance Education (Peters, 1988/2004) is offered to an amplified range of people, with different needs, expectations, and familiarization with this mode of teaching-learning; and c) innovation is always a desired – and sometimes required – outcome, regarding the most efficient and effective combination of technological solutions with learning goals.

Given such complexity, it is easily understood why most of the eLearning design nowadays is done in *teams* (van Merrienboer & Martens, 2002; Bates & Poole, 2003). Different technology, pedagogy, and management-based backgrounds and expertise are needed in order for efficient and effective solutions and decisions to come up, in response to a ranged variety of problems, requirements, and constraints. Such multidisciplinarity and cognitive multifacetedness render the eLearning design process a very rich and creative process. At the same time, as decisions need to be taken collectively, *communication* becomes a key aspect of eLearning design and development.

Having said that, the focus of the present dissertation is on *team design communication* in the eLearning design context. More precisely, our main interest is on how communication and the design process intermingle one with another. To do that, various dimensions and aspects of team members' interaction are taken into account, in accordance to the richness and complexity of the subject as treated by the literature (Chapter 2). After framing the research with concrete goals, questions, and hypotheses (Chapter 3), and presenting our theoretical background (Chapter 4), we continue with our second main interest: the construction and application of a multi-level coding scheme, akin to embrace the double complexity of team design as both a communication and a design process (Chapter 5). Results (Chapter 6), Discussion (Chapter 7), and Conclusion (Chapter 8) continue with this double focus: the practice-oriented, and the method-oriented. Therefore, our observations regard both how eLearning designers communicate while designing in teams, and how such communication can be analysed.

The present chapter is composed of four Sections. In Section 1, we present our main theoretical perspective of communication as a social activity, taking place in various forms. Subsequently (Section 2), we treat in detail the main macro-form of communication, namely *dialogue*, and its various *types,* i.e. possible faces with which it can appear in every-day interaction. The section ends with a constraint of the dialogue analysis approach, which gives place to the selection of Interaction analysis as our main approach. Section 3, titled "Interaction types", is a brief account of this theoretical paradigm, presented in detail in Chapter 4. Finally, Section 4 is dedicated to "Context", its conceptualization and influence on any interaction, and subsequently, on the eLearning, team design interaction.

1.1 COMMUNICATION FLOWS

> Being completely involved in an activity for its own sake. The ego falls away. Time flies. Every action, movement, and thought follows inevitably from the previous one, like playing jazz. Your whole being is involved, and you're using your skills to the utmost.
>
> —CSIKSZENTMIHALYI, 1991

As Clark (1996) notes, "to communicate is, according to its Latin roots, *to make common*, to make known within a group of people" (p. 153). Kreckel (1981) adds that "etymologically, the concept of communication stems from the two roots *communicare,* i.e. a one-way process of transmitting information and *communion*, i.e. a two-way process of sharing information" (p. 20). And he continues by making explicit the main research problem in any study of communication: "not everything that is available or transmitted is taken up, and not everything that is taken up is shared" (p. 20).

According to some authors, this process of making common or known is subset to criteria of efficiency, also known as "communication requirements" or "maxims". Hereby, we present two main theoretical accounts of such criteria, the one proposed by Grice (1975) and a more recent, proposed by Allwood, Nivre, & Ahlsèn (1992). Grice (1975) proposes 4 maxims, namely Quantity, Quality, Relation, and Manner. As he explains:

> the category of Quantity relates to the quantity of information to be provided, and under it fall the following maxims: (1) Make your contribution as informative as is required (for

> the current purposes of the exchange). (2) Do not make your contribution more informative than is required. (…). Under the category of Quality falls a supermaxim –"Try to make your contribution one that is true"- and two more specific maxims: (1) Do not say what you believe to be false. (2) Do not say that for which you lack adequate evidence. Under the category of Relation I place a single maxim, namely, "Be relevant". (…). Finally, under the category of Manner, which I understand as relating not (like the previous categories) to what is said but, rather, to how what is said is to be said, I include the supermaxim –"Be perspicuous" (…) (p. 45-46)

From their part, Allwood et al. (1992) give their own account of communication requirements, as following:

> First, communication requires that at least two agents are willing and able to communicate. Second, communication requires that the receiving agent is willing and able to perceive the behavioral or other means whereby the sending agent is displaying or signalling information. Third, communication requires that the receiving agent is willing and able to understand the content that the sender is displaying or signalling. It is also often helpful if the receiver can perceive and understand various types of indicated information. Finally, communication requires that the receiving agent is willing and able to react attitudinally and behaviorally to various aspects of the content that the sender is displaying or signalling. Again, it is sometimes beneficial for communication, if the receiver also reacts to indicated information (p. 4).

Both accounts describe communication as a sender-receiver situation: the first focusing on the sender, and the second focusing on the receiver. In one way or another, the dynamic and systemic aspects of team communication are not adequately expressed.

In this respect, the view of group communication process as a systemic function gives some replies. In general, four criteria-factors apply as group communication requirements according to this approach (Mabry, 1999): (1) group coordination and

integration, expressed either as *distributional structure*, i.e. array of messages across different content classifications, or as *sequential structure*, i.e. the ordering of observed messages; (2) group regulation and stabilization, and especially the role of the task as both *constitutive*, in the sense that it provides a common frame of reference for the group members, and *normative*, as tasks are also collective representations of how group members perceive their action; (3) group learning and motivation, as entropy and ambiguity causes the system to engage in information-seeking activities, even when those activities require the system to redefine is goals or restructure its internal relationships; and (4) group innovation and change, predetermined by structural constraints, which derive from the fact that group systems are *morphostatic*, "in the sense that a thermostat will turn on or off a furnace only at preset temperatures" (p. 80).

Even though such dynamics are akin to describe communication, when it regards *teams,* they are still too general at the time of prescribing, pre-defining, or just framing how teams should communicate in an efficient way. In other words, no requirements or maxims of group communication exist, even when it refers to a specific team, based at a specific institution, working on a specific project, and for a specific period of time. If this is one possible definition of a workplace community, then the Activity system triangle (Figure 1), proposed by Engestrøm (1987) can give us a closer account of how a team communication system functions.

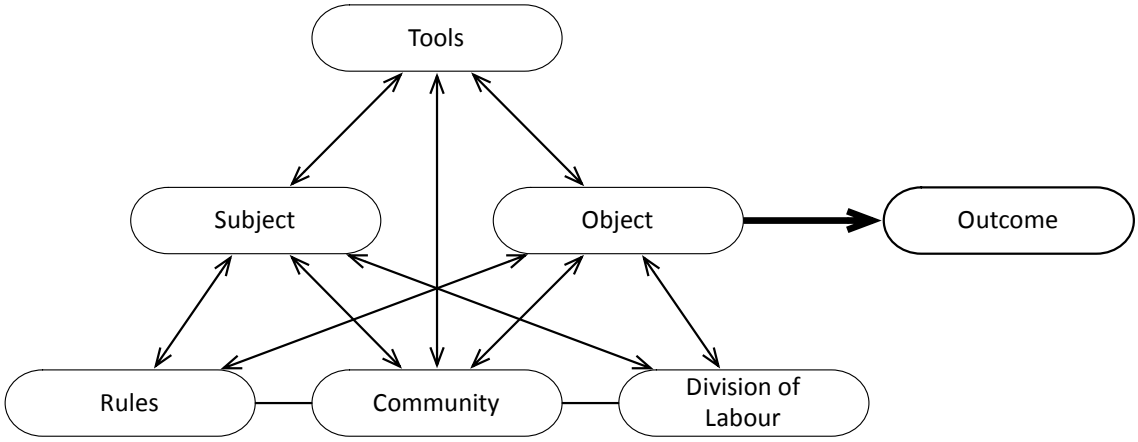

FIGURE 1. THE ACTIVITY SYSTEM TRIANGLE (ENGESTRØM, 1987)

According to Activity Theory, a community-based system, such as an institutional working team, is composed of: a) the *object*, which corresponds both to the problem space, and to the goal towards which the whole activity is oriented (Leont'ev, 1981); b) the *subjects*, i.e. the people engaged in an activity, who are the focus of a study on the activity; c) the *tools*, which are the physical objects and systems of symbols (like language) that people use to accomplish the activity; d) the *rules*, referring to the community culture rules influencing the activity; e) the division of labour or *roles* regarding how the work is divided, e.g. institutional and task-oriented roles; and f) the members of the broader *community*, in which the activity system is embedded, meaning people and groups whose knowledge, interests, stakes, and goals shape the activity.

Two important implications, influencing the present study, derive from the Activity system theory, as introduced and expanded by Engestrøm. The first is that "An Activity system contains a variety of different viewpoints or 'voices´" (1994, p. 46), deriving both from the "subjects" and the "community" components of the system. The second is that the object-goal motivates and shapes the activity system, and more precisely its

communication flow (Engestrøm, 1992), i.e. the relations expressed between the activity components. In workplace activities, three types of communication flows are possible, namely: *co-ordination*, *co-operatio*n, and *reflective communication*. The third one is also known as *reflective co-construction* (Bardram, 1998), or *collaboration* (Campos, 2003). Table 1 shows the main differences between these three flows, in activity terms.

TABLE 1. THE THREE COMMUNICATION FLOWS (BASED MAINLY ON ENGESTRØM, 1992)

	Co-ordination	**Co-operation**	**Collaboration**
Object	Individual task	Shared	Re-conceptualized
Roles	Scripted	Beyond scripted	Re-conceptualized
Rules (Script)	Unquestioned	Unquestioned (at least not explicitly)	Questioned
Goal	Successful performance of the assigned actions	Find mutually acceptable ways to conceptualize and solve the problem	Re-conceptualizing interaction in relation to the shared objects

The three flows described above normally co-exist in the same work activity system. Therefore, what matters at the time of describing a system's communication processes is the internal organization of each flow along time and the transition from one flow to another. In both cases, mediational tools, especially language, and their use by the system's actors play a determining role.

In sum, considering communication as an activity, the following implications need to be considered: a) team's goal, b) object status, c) actors' behavior, and d) concrete actions and activities. The type and intensity of relation(s) between these four can allow the analyst to distinguish among *good* or *less good* co-ordination, co-operation, and reflective

communication. Thus, such *dynamic relations*, apart from describing the team as a system, also have a predictive – and subsequently prescriptive – potential power upon it. This assumption forms the main rationale of this research.

In this section we argued that Engestrøm's Activity Theory (1987, 1992, 1994) can provide us with a valuable descriptive framework of analyzing team communication, possibly more valuable than pre-established maxims, requirements, or generic dynamics. Viewing team communication as an activity system allows for various components and their behavior to be taken into account simultaneously, and to describe the whole system's behavior based on the components' dynamic relations. The most powerful of these relations, in which all components are participant, is the so-called *communication flow*. Distinguishing between various "levels" and "degrees" of this flow constitutes our main view of analyzing communication.

1.2 DIALOGUE TYPES

All dialogue arises from a problem, difference of opinion,
or question to be resolved.

—WALTON, 1989

Considering only the verbal dimension of a communication system, the main unit of analysis is a *dialogue*. Dialogue is defined as "a goal-directed conventional framework in which two speech partners reason together in an orderly way" (Walton, 1998; p. 3). Seven main types of dialogue have been hitherto defined and formalized, as identifiable systems: persuasion dialogue, information-seeking dialogue, negotiation dialogue, inquiry dialogue, eristic dialogue, deliberation dialogue, and discovery dialogue (Walton, 1989; Walton & Krabbe, 1995; Walton, 2011). Table 2 shows the main goal and characteristics for each dialogue type.

Another very common type of dialogue is argumentative dialogue. As Patterson (2011) observes, for scholars such as Johnson (2000), van Eemeren and Grootendorst (2004), Goodwin (2007), and Walton (2008), argumentation has not a function itself. This means that argumentation does not appear among the dialogue types presented above, because it does not form a normative type of dialogue itself; its quality depends on the quality of dialogue it is embedded in. This also means that argumentation is a potential part of any dialogue (Walton, 1998). Given the importance of argumentation in the context of co-design, as we will see later on, our position regarding whether it is a dialogue type or a dialogue function will be briefly exposed hereby.

TABLE 2. MAIN DIALOGUE TYPES
(ADAPTED FROM WALTON, 1991, 2011; WALTON & KRABBE, 1995)

Dialogue Type	Goal	Main notion(s)	Special type(s)
Persuasion	Test the comparative strength or plausibility of arguments on both sides of a controversial or contentious issue	Commitment Burden of proof	Critical Discussion (van Eemeren & Grootendorst, 1984)
Inquiry	Collect and organize all the relevant evidence on some particular proposition	Cumulativeness	Scientific Inquiry, Empirical Inquiry
Negotiation	Get to a deal	Wise agreement Interest Commitment to action	Distributive/Integrative/ Intra-organizational Bargaining, Attitudinal Structuring
Information-seeking	Information pooling	Search-find	Interview, Expert Consultation
Deliberation	Reach a conclusion on how to act prudently in a given situation in order to realize specific goals	Practical reasoning, Burden of proof	Public and Political Deliberation
Eristic dialogue	Win a verbal victory by any means	Irrelevant *ad hominem* attack	Quarrel
Discovery	Choose best hypothesis for testing	Risk assessment, Novelty	Chance Discovery (McBurney & Parsons, 2001)

Argumentation has been mainly treated in relation to persuasion dialogue contexts (Walton, 1989; Walton & Krabbe, 1995). In these contexts, there is usually an issue to argue about, and two contrary positions generated by this issue, namely the *thesis* and the

antithesis. The person who proposes the thesis, called the *proponent*, tries to rationally persuade the other party, called the *opponent*, to become committed to her propositions. In such dialectical settings, the *probative function* (Walton, 1989) of argument is what counts. Also, argumentation can be more or less successful or an argument may or my not be won regarding the controversial issue-at-hand. Other dialogue contexts in which argumentation may be strongly manifested are the inquiry, negotiation, and deliberation contexts. The argumentation stage of an inquiry dialogue transforms inquiry into a discovery dialogue, in which some hypotheses are selected for testing. Argumentation during negotiation of interests is mainly person-based and arguments ad hominem or even threats may appear. Finally, deliberative argumentation is very similar to persuasion, in terms of shifts of the *burden of proof* (Walton, 1988) until a final statement is made. On the other hand, deliberation dialogue is more collaborative in its nature compared to persuasion dialogue, which is more conflict-based. To be more specific, deliberation has been defined as this type of dialogue "in which parties collectively steer actions towards a common goal by agreeing on a proposal that can solve a problem affecting all of the parties concerned, taking all their interests into account" (Walton, 2010a).

Going now to the team design situation, and more precisely to a *meeting* setting, it can be said that the dialogue macro-goal is that of deliberating on issues where the team's opinion is needed. A first issue to consider is that the predominance of deliberation as a team design goal does not mean that the whole interaction taking place during a meeting is deliberative. Thus, analysis on the basis of the 'deliberation' type of dialogue is not possible. Regarding the other three types of dialogues, relevant to team design because of their relation to argumentation, a special interest has been paid to *negotiation*, as main process of a collaborative task-oriented interaction. However, how negotiation has been

defined as part of a collaborative practice is different than how it was proposed as a dialogue type. Here is what Dillenbourg & Baker (1996) observe in respect to this:

> in task-oriented interactions, negotiation can occur on three main levels : (1) communication (meaning, signification of utterances, words, ...), (2) task (problem-solving strategies, methods, solutions, ...) and (3) management of the interaction on previous levels 1 and 2 (coordination, feedback on perception, understanding, attitudes) (p. 188).

During the task-oriented type of negotiation, two main types of argumentation are possible to take place (Baker, 1996): a) regarding the epistemic status of the object, and b) regarding its epistemological nature. The first one refers to the transformation of an object "s1" either to an object "s2" or to an object of another type, for example "p1". In design terms, this means that a proposed solution can either be negotiated in the face of an alternative solution, or it can be revised and considered as a problem. As far as the epistemological nature is concerned, argumentation takes place in the form of different perspectives belonging to different types of personal and disciplinary knowledge. The same object "o" can be seen either from a perspective "P1" or from a perspective "P2". When both perspectives are made explicit, the object is negotiated, without the goal being the persuasion towards one perspective instead of another, although this may also happen.

As far as the inquiry dialogue is concerned, a noncore type of argumentation known as exploratory argumentation (Goldman, 1994) can be identified. During this,

> a person may often experiment with an argument, or "try it on for size", without meaning to commit herself to its premises or conclusion. The speaker invites the audience to consider premises and conclusion as possible truths, not only for the audience's possible enlightenment, but because the speaker can test their credibility for herself by seeing whether they survive the audience's critical scrutiny (p. 33).

When such exploration takes place in teams, emerging interaction is very similar to what Dewey (1941) calls a "joint inquiry". Dewey defined inquiry as "the set of operations by which the situation is resolved (settled, or rendered determinate)" (p. 181). But, as Koschmann (2003) observes, the problem or aspect of the situation that renders it indeterminate is not given; it must be discovered through the processes of inquiry.

What happens in co-design situations is that participants have to deal with a double ambiguity: one that has to do with the ill-defined nature of design, and the other that has to do with the fluidity of ideas being communicated in a creative context (both aspects will be explained later on). The combination of these ambiguities renders the co-design meeting a space of argumentation itself: participants continuously try to better define and convince themselves and the others of the superiority of certain constraints, requirements, and solutions against others. Values and perspectives play a major role in the formation of design judgments and their negotiation, in the sense described above. In such a context, even though the team's macro-goal is design deliberation, no specific types of dialogue are a priori prescribed as to be the best functioning for certain decisions.

In this context, persuasion is possible to take place as an embedded-in-deliberation dialogue. However, the probative function of the arguments may be difficult to identify, mainly because the issue does not normally have a Y/N nature, but a multiple criteria-choices nature. Secondly, the dialogue agents, i.e. the team participants, are all experts in the issue discussed, and in most cases their expertise is also complementary. Finally, team deliberation is more similar to a *polylogue* rather than a dialogue (Kerbrat-Orecchioni, 1997, 2004; Lewinski, 2011). Given these particularities of the team design setting, we would argue more in favor of team design argumentation as a type of co-constructive interaction (see also Baker, 1999), during which different types of dialogues may emerge.

1.3 INTERACTION TYPES

Parler, c'est communiquer, et communiquer,
c'est inter-agir.

—KERBRAT-ORECCHIONI, 1990

Interaction can describe reality more closely than dialogue, for the simple reason that it is not necessarily oriented towards a concrete communication goal. Thus, when we speak of naturally emerging talk, the main unit of analysis is "talk-in-interaction" (Schegloff, 1987). Both of these components, i.e. *talk* and *interaction* will be defined in this section.

As far as the latter term is concerned, the present study is focused on a specific macro-type of interaction, known as *institutional interaction*. This type of interaction is characterized by two principal characteristics: a) it is goal-oriented, and b) institutionally relevant and often constrained (Drew & Heritage, 1992). *Goal-oriented* means that interaction "involves an orientation by at least one of the participants to some core goal, task, or identity (or set of them) conventionally associated with the institution in question" (Drew & Heritage, 1992; p. 22). The involvement of the institution in goal, task, and identity definition allows the institutional setting to influence on interaction, and more precisely on the "shape, form, trajectory, content or character of the interaction that the parties conduct" (Schegloff, 1992; p. 111).

At the same time, although institution seems to define interaction in a "top-down" approach, participants seem to negotiate their role in it in a "bottom-up" way, using Drew and Heritage's (1992) metaphor (p. 23). This means that although the goals, tasks, and/or identities of the participants are already known, as being pre-defined by the

institution, participants' understanding and contribution to them may differ. Even when these goals promote co-operation, as in team design, it is not said that participants will truly collaborate. In other words, pre-defined co-operation does not necessarily imply emerging collaboration. This depends on the type of *talk* participants will be enrolled in.

When speaking of institutions, *team talk* is a main "situated action" (Suchman, 1987). As such, "it is used both to construct versions of what the team is currently doing and constitutes ways to act that respond to those versions" (Middleton, 1998; p. 236). In team talk, two levels of analysis emerge: the *individual practice*, meaning the type of participation and contribution of each participant, and the *team practice*. A main differential aspect between these two, regards the fact that *team practice* reflects team work, both as a task and as a topic. In other words, people through *team talk* try to solve both the uncertainties regarding their work-at-hand (e.g. design task), and the uncertainties regarding how their communication process should be, in order to reach their goals. Let's call the latter *communication task*.

In both cases of institutional talk-in-interaction, the notion of *object* plays an important role. This object, following the double sense of task presented above, can be either a design object or a communication predicate. In most of the cases it is both (see for example Darses, Détienne, Falzon, & Visser, 2001). To define whether an interaction, or a *piece* of interaction, is object-oriented, and thus task relevant, the criterion of *constructiveness* has been proposed (Miyake, 1986; Baker, 1999). According to Baker (1999), for an interaction to be constructive, two criteria need to be fulfilled: firstly, "if it literally leads to the (co-)construction or building of something –meaning, understanding, solutions to problems and sometimes knowledge"; and secondly, "if it generally contributes in some way to cooperative goal-oriented activity" (p. 180).

A main condition of any interaction is *interdependency* (Kerbrat-Orecchioni, 1990; Lave, 1991). This means that an interaction is an essential interpersonal activity, in which actions of agents are mutually dependent (Baker, 1999). Nevertheless, for an interaction to also be *co-constructive*, and subsequently collaborative, additional conditions need to apply. Among them, two are distinguished in the relevant literature, namely *sharedness* and *dialogicality*.

Three main constructs can and need to be shared during an interaction: *conceptions, knowledge*, and *perspectives*. According to Roschelle & Teasley (1995), "collaboration is a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception" (p. 70). Such shared meaning is established and continuously re-established "via the construction and accumulation of a common ground, a body of shared knowledge" (p. 75), or the "degree of conceptual convergence between communicants" (Kreckel, 1981; p. 26). Finally, *shared perspective* refers to the disposition of the communicants for both converting their individual experience and/or knowledge into shared knowledge and for participating in future interactions (Kreckel, 1981).

Moreover, according to the definition previously given, all interaction is interpersonal, thus dia-logic (from Greek *διά-λογος*, meaning "through discourse") in the sense of based on word exchange (Bakhtin, 1977). Nonetheless, not any dialogic interaction is also *dialogical* (the distinction in french in Kerbracht-Orecchioni, 1990 is between *dialogal* and *dialogique*). In the same way, a monologue is mono-logic, in the sense that it expresses one speaker's words. But it is not necessarily *monological*, meaning that it potentially contains dialogical characteristics (see also Billig, 1987).

The main unit of analysis in a communicative interaction is the *communicative action*. In order for a communicative action to be co-constructive, it needs to be composed of

dialogical acts contributing to some sort of sharedness, of the three defined above. An act is dialogical either when it constructs on another person's utterance, or when it encloses at least one, other than the speaker's, voice. Such *multivoicedness* (Wertsch, 1985) is an important aspect of any collaborative interaction, as it promotes *intersubjectivity* (Bakhtin, 1929), and with that, *dialogical learning* (Flecha, 2000). The presence of other voices is expressed though the use of enunciative subjects in discourse. If sharedness and dialogicality are fulfilled, we can speak of *joint actions* in communicative interaction (Clark, 1996).

1.4 CONTEXT

To know an object is to lead to it through a context which the world supplies.

—WILLIAM JAMES, 1911

In written communication, context is anything that goes with the text in order to form a discourse (Adam, 1992). This amplified definition of context justifies Rigotti & Rocci's (2006) position that "there is no context that is not the *context* of something else" (p. 158). The expansion of this position gives place to a two-fold definition of context, both as a *context of* and as a *contextualized*. In other words, "context is not a container but a constituent of the communication process" (Perret-Clermont, 2006; p. 181).

Continuing in the line of Rigotti & Rocci (2006) and Muller & Perret-Clermont (1999), communication context is constructed on two main dimensions: the institutionalized and the interpersonal dimension. The interpersonal dimension can be translated into two main components: the *inter-individual context*, and the *cultural context*. The latter refers to the myths, rites, and models (Cantoni, 2004), which participants "carry" with them as part of one or more cultural communities. On the other hand, inter-individual context concerns the interpersonal level of communication, i.e. that part of the interaction not focused on the task, but on communication itself. This context is either intra-personal, referring to the personal stories (Rigotti & Rocci, 2006), or *frames* (Goffman, 1974), through which a person perceives the communication context and re-acts to it. In other words, it is the "social organization of individuals' experience of the situation" (Drew & Heritage, 1992; p. 9). At the same time, inter-individual context is highly interpersonal, referring to the

continuous "conversational negotiation", in Kerbrat-Orecchioni's (2005) terms, in which communication partners are involved.

The institutionalized dimension of communication context, or the *activity type* in Levinson's (1979/1992) terms, is composed by the "actual" social reality, known as *interaction field*, and the "virtual" one, defined as *interaction schemes* (Rigotti & Rocci, 2006). The interaction field corresponds to what is usually referred to as *context* in everyday language. It mainly refers to the type of institution, in which the interaction takes place, but also to its *general frame* and its *specific spots* (Rigotti & Rocci, 2006), forming essential part of a communication analysis. On the other hand, interaction schemes are culturally shared "recipes" for interaction (Rigotti & Rocci, 2006), corresponding to a specific interaction field, but not defined by it. This means that the types of interaction and their internal organization form a type of context for the activity they are "contained" in. Together with the interaction field, they give life to two dynamic aspects of communication context, namely *communication roles* and *communication flows*. Figure 2 represents the main components of communication context and the relations between them, as we briefly described above.

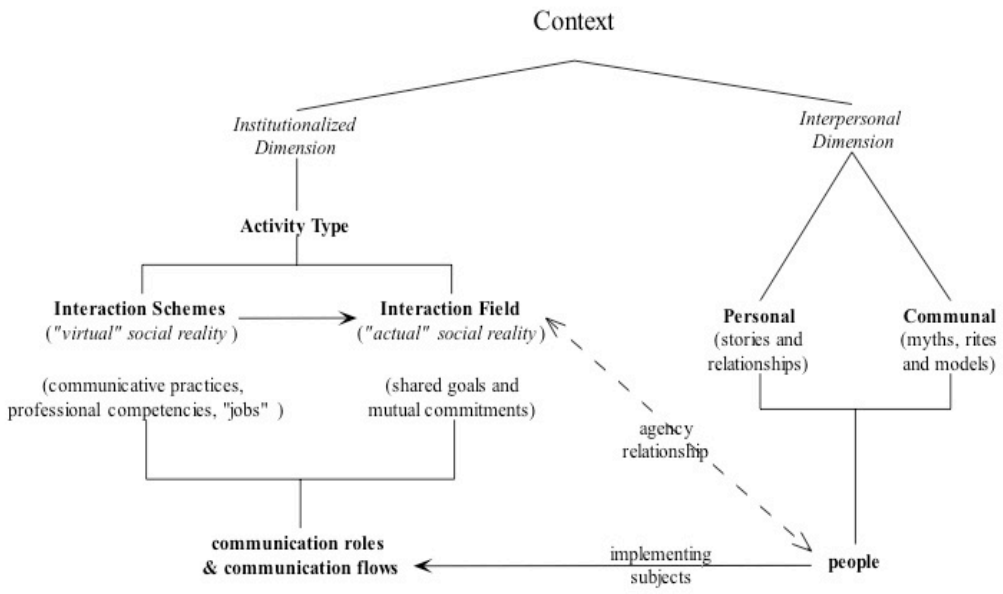

FIGURE 2. THE COMMUNICATION CONTEXT (IN RIGOTTI & ROCCI, 2006; P. 171)

The present study focuses on a specific aspect of interaction schemes, namely the *joint, task-oriented, content co-ordination actions*, as it was previously defined in Section 1.3. These actions take place in and, the same time, influence on concrete, interaction-field based *joint activities*, relevant to the macro-activity frame of communication (in the present case, *design meeting*). The way such joint activities are organized, in institutionalized, task-oriented communication flows, defines the quality of communication. In summary, the present study has three main focuses: the relation between joint actions, the relation between joint actions and joint activities, and the relation between joint activities and the *meeting* activity type (Allwood, 2000).

2. STATE OF THE ART

As it was made clear in the Introduction, context is an essential part of the communicative interaction. However, there is another type of context, not necessarily related to the communicative type of context, treated in this dissertation, which is the *research context*, also known as *field of application*. As the dissertation's title indicates, the field of application treated is *eLearning design and development*. This field forms part of a broader field of application, namely Design Research. The phenomenon observed in this context, i.e. *communication processes*, implies another characteristic of the field, which is *team-based*. In total, the general field of application of the present study is *Team-based Design Research*.

Team-based Design Research focuses on *design activity* as part of the team communication process. Traditional models of design as a more or less staged problem solving process need to be abandoned, in order to adopt such a view. On the other hand, team activity is also *process-based*, but the nature and structure of this process cannot be defined a priori.

What was shortly stated here is explained throughout this chapter in four sections. Section 1 describes the conceptualization of design as a cognitive process, from a problem solving perspective to more context-considering approaches. Section 2 presents the shift from this view and the re-conceptualization of design as an activity, regarding both individuals and teams. Section 3 presents a synthesis of empirical studies in team design research field. Finally, Section 4 focuses on how communication has been hitherto treated in this field.

2.1 DESIGN AS PROCESS

Design is a process, it is not a state and cannot be adequately represented statically.

—CARROLL & ROSSON, 1985

Design has been traditionally considered as a process of formulation, analysis, synthesis, and evaluation (Asimow, 1962; Jones, 1970). This approach is very near, almost identical, to the problem solving approach (Simon, 1969/1996). Limiting design space to the problem space, design process is composed of the following steps (Goel & Pirolli, 1989; Maher, 1990): a) identifying the goal(s) of the design problem; b) exploring and decomposing the problem; c) combining the identified partial solutions into the problem solution; and d) assessing and/or controlling whether the goal(s) have been satisfied. Under this view, the design problem space is largely considered as "a problem space with major invariant characteristics across all design situations" (Goel & Pirolli, 1989; p. 20). In other words, a *generic model* of design process is possible.

A first generation of generic design problem solving models focuses on the design task environment (DTE) as a necessary condition for distinguishing a design from a non-design process. According to Simon (1969/1996), "everyone designs who devises course of action aimed at changing existing situations into preferred ones" (p. 111). However, this definition is quite broad, and implies that the intellectual activity behind design is the same as in many other non-design activities. To respond to this problem, Goel & Pirolli (1989) propose the DTE approach, as it is shown in Figure 3.

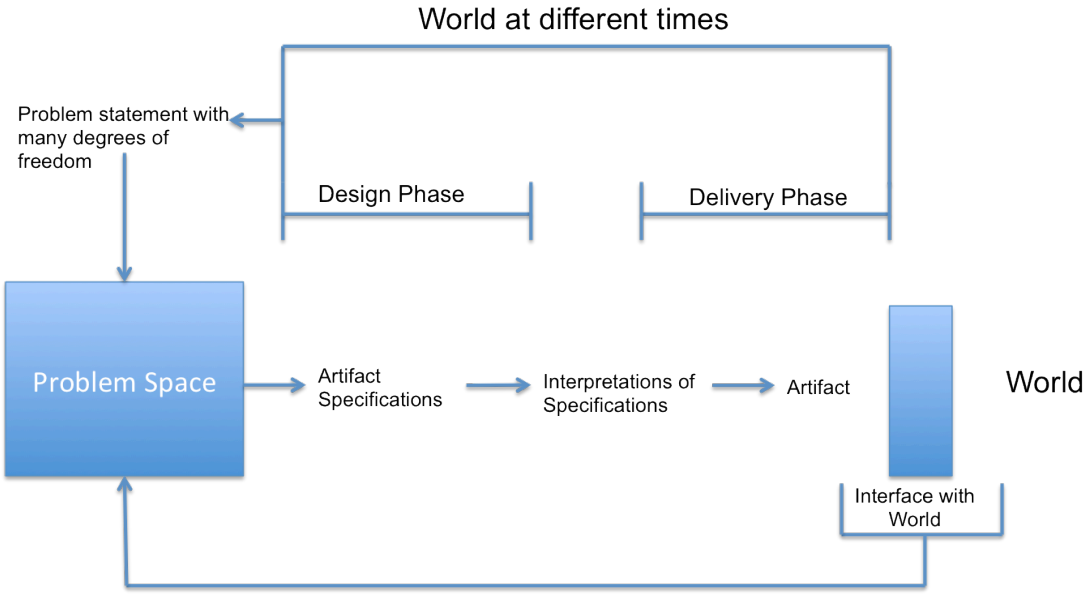

FIGURE 3. STRUCTURE OF A PROTOTYPICAL DTE (GOEL & PIROLLI, 1989; P. 22)

As shown above, the DTE approach introduces two main aspects of the design process: *time*, and *world's feedback*. Those two also are the main characteristics of a more recent approach of the design process, known as *meta-design* (Fischer & Scharff, 2000). The rationale behind this approach is summarized in the following:

> design problems in the real world require open systems that users can modify and evolve. Because problems cannot be completely anticipated at design time (when the system is developed), users at use time will discover mismatches between their problems and the support a system provides (p. 398).

Figure 4 represents the above statement.

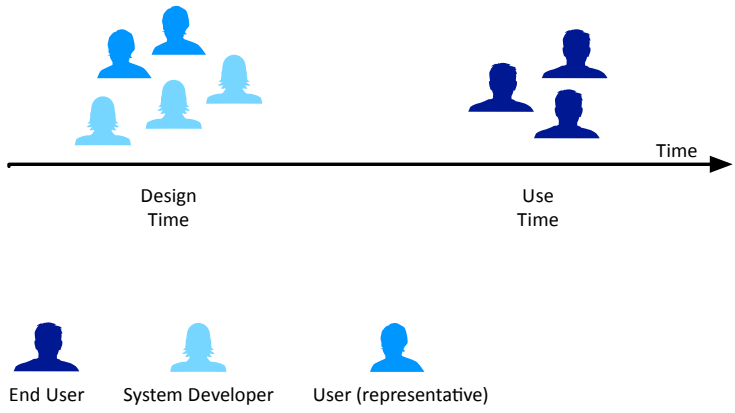

FIGURE 4. (THE PROBLEM OF) DESIGN AND USE TIME
(IN FISCHER & SCHARFF, 2000; P. 398)

The problem described by these authors, namely the problem of design and use time, is mainly encountered in systems' design, where anticipation of outcomes is highly required. A solution is proposed with the Seeding, Evolutionary Growth, Reseeding (SER) model (Fischer & Scharff, 2000; Fischer & Ostwald, 2002):

> In the SER model, system developers and users develop an initial seed, which is a first attempt at creating a tool to support work within a specific domain (…) Because it is impossible to capture any design activity completely, the seed must be able to grow through use. In this way, a seed can be initially underdesigned (…) As the seed is used for real design activity, it goes through a period of evolutionary growth in which the designers make incremental modifications to the system over time (…) Eventually, it will become necessary to do a significant reconceptualization of the system, or reseeding (…) The cycle of evolution and reseeding continues as there are people actively using the system to solve problems (Fischer & Scharff, 2000; p. 399).

Thus, within this approach, *participatory design*, meaning the involvement of users in various stages of design, is very important. Another sub-type of this approach refers to *rapid prototyping*, also broadly applied in the field of Instructional design. The main elements of a rapid prototyping process in the ID field are: set objectives, construct

prototype, utilize prototype, and finally, install and maintain the system (Tripp & Bichelmeyer, 1990). Transferring this approach to *eLearning team design*, rapid prototyping obtains a double function: that of involving students-users as testers who utilize the prototype, as implied from previously, but also, that of a *communication catalyst* between the members of the team, given the team's multidisciplinarity. This is mainly fulfilled through "concentrating on facts and results, and not on theories or prejudices about learning technologies. Enhanced and focused communication fosters the development of mutual understanding among the different professionals involved in the project, and the creation of trust" (Botturi, Cantoni, Lepori, & Tardini, 2006). Figure 5 shows the two main sub-processes of fast prototyping in eLearning design.

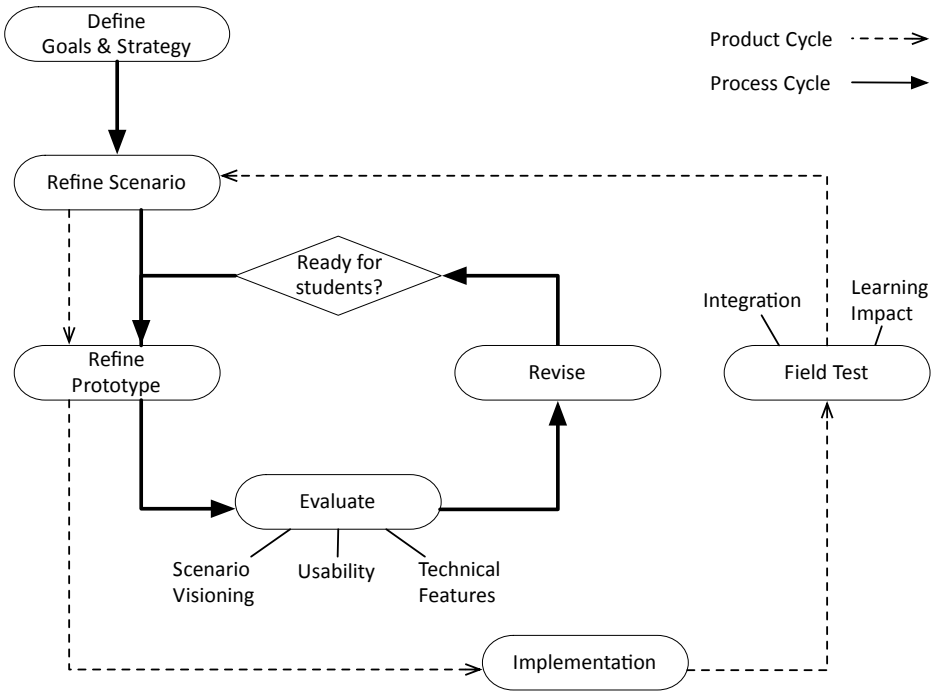

FIGURE 5. REPRESENTATION OF A FAST PROTOTYPING PROCESS (BOTTURI ET AL., 2006; P. 275)

What is common among the presented approaches is that the "pure" design process, however contextualized, is a highly cognitive process. It consists of the construction of a scenario (Botturi et al., 2006), which evolutionary grows (Fischer & Scharff, 2000) with or without the immediate users' participation, leading to a continuous artifact's specification and interpretation (Goel & Pirolli, 1989), until the final version of the product. In other words, design is conceptualized as a twofold process, composed of a pre-development phase or planning, and a design phase or development of the planned artifact.

In all cases, actual design processes seem to be more complex than their conceptualizations. Starting with planning, Rittel & Weber (1973) observe that: a) there is no definitive formulation of a wicked problem. "The information needed to understand the problem depends upon one's idea for *solving* it. That is to say: in order to describe a wicked-problem in sufficient detail, one has to develop an exhaustive inventory of all conceivable *solutions* ahead of time" (p. 161); b) every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial-and-error, every attempt counts significantly; and c) the planners-designers have not right to be wrong, as they are "liable for the consequences of the actions they generate" (p. 167).

Regarding artifact development, empirical studies have shown that it is not exclusively alleged to the problem space, as solutions also intervene (Lloyd & Scott, 1994) or co-evolve (Maher, Balachandran, & Zhang, 1995; Dorst & Cross, 2001) within the process. Moreover, if any process is present, is rather whirling rather than linear (Hickling, 1982), opportunistic rather than hierarchical (Guindon, 1990; Visser, 1994), and dynamic rather than static (Carroll & Rosson, 1985).

Given these constraints, the need to describe the concrete design activities taking place during design and development is more and more made explicit. Section 2.2 presents some main ideas regarding the conceptualization of design as an activity that forms part of a process, and not as a pre-defined process itself.

2.2 DESIGN AS ACTIVITY

Design is not problem solving: design involves problem solving.

—VISSER, 2006

This chapter begins with a valuable observation made by Dorst & Dijkhuis (1992):

> As a designer, you are in a situation that you are continually faced with the very concrete challenges of your perceived design problem, and you have to decide on the kind and content of the action to take in this situation. `What does this situation mean?' and `What action can/should I take in this situation?´ are eternally recurring questions. In most cases, considerations linked to the content of the design situation (the perceived design problem, the designer's goals and the perceived possibilities for the next step) will determine the `kind of action´(process-component) (p. 265).

Thus, describing the design activity forms part of many design methodologies aiming at a better understanding of the design process. As it can be easily understood, there are not many empirical studies under the rational problem solving paradigm. This is mainly because design activity is such a broader entity, thus it is difficult to describe it while staying "limited" by this strict paradigm. However, there are some empirical studies that did so. Here we briefly describe two of them, focusing on both their methods and results.

McGinnis & Ullman (1992) propose five categories for coding the design activities, namely: a) acts, b) goals, c) contexts, d) topics, and e) auxiliary topics. It is worth mentioning that *acts* refer to the "literal" acts designers perform while designing, such as write, think, sketch, take a break, etc. Also *goals* are not a priori defined but correspond to observations regarding the protocol. *Contexts* refer to the various perspectives from which the designers look at the problem. Together with *topics*, they

form the designer's "knowledge state" (Newell & Simon, 1972). Acts, goals, and topics together describe the designer's behavior and lead to the formation of *patterns,* which echo design strategies or heuristics (Dorst & Dijkhuis, 1992). In McGinnis & Ullman's (1992) study, such patterns emerged during designer's routine-like behavior, such as information seeking activity. However, the conceptual phase showed an erratic jumping between activities, with hardly any pattern at all.

Another problem solving based activity method is proposed by Lloyd & Scott (1994). These authors propose the utterance as a unit of analysis, and three main categories characterizing utterances, namely *generative, deductive*, and *evaluative*. The distribution of the type of coded utterance *per designer* and *through time* gives as result a number of *reasoning mode patterns.* This method also allows for a phase segmentation of the protocol, according to the predominance of one activity over the other during a pre-defined period of time. Doing so allows the comparison among cases, in an overall way, and also the description of the design process as a series of emerging phases. Although such macro-perspective could be enlightening to understand the design process, Lloyd and Scott' s study has a small number of participants (5), so their observations are limited to the individual, idiosyncratic level.

Apart from problem solving, another cognitive macro-activity related to design is that of *planning,* as we already mentioned. Planning has been defined as the process of setting goals, developing strategies, and outlining tasks and schedules to accomplish the goals. This general definition makes planning seem quite similar to problem solving. However, the following distinction should be made: when goals are so ill-defined or not well-structured, tasks seems to be "fuzzy", and subjects appear to do "anything and everything" with respect to the goals (Hoc, 1988). In such situations, which are characteristic of most design settings, planning rather than problem solving takes place. In design, this process refers to a representational process in which the external world interacts with the expected world, as the design object refers to what which "does-not-yet-exist" (Nelson & Stolterman, 2006). As Kannengiesser & Gero

(2009) put it, "designers perform actions in order to change their environment. By observing and interpreting the results of their actions, they then decide on new actions to be executed on the environment. The designers' concepts may change according to what they are 'seeing', which itself is a function of what they have done" (p. 3). Figure 6 represents this point of view.

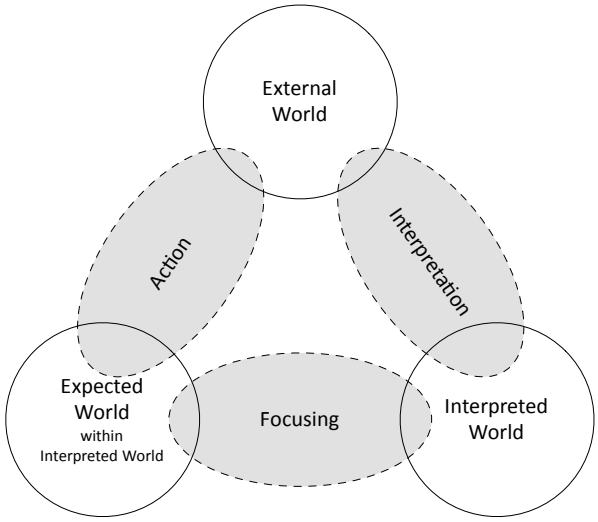

FIGURE 6. THE INTERACTION OF THREE DESIGN WORLDS (IN KANNENGIESSER & GERO, 2009; P. 4)

Planning, when considered as an activity, involves *reflection*, in order for the designer to make the necessary connections between the external and the expected world. On of the most known reflection theories also applied to design is that of the *reflection-in-action* approach (Schøn, 1983). For Schøn, doing and knowing form one unit, that of "doing design". The categories proposed are quite generic, and they are applicable to both individual and team design. As this dissertation focuses on team design, a representative study of applying reflection-in-action theory to team design protocol is presented. More precisely, Valkenburg & Dorst (1998) apply Schøn's four main actions, which are: *naming*, *framing*, *moving*, and *evaluating* (reflecting). Although the authors claim that coding is easy and understandable, given the fact that 9 hours of

interaction were coded, no inter-rater reliability is provided. Another uncertainty arises from the fact that they use the categories in order to describe design episodes, thus sequences of actions, and not individuated actions, as in Schøn's original proposal. Apart from these constraints, the method presented represents a good example of the systematic application of the theory to team practice. Results are still quite descriptive, and they are limited to a comparison of the most predominant activity between cases. No comparison of activity flows is provided, maybe because the level of analysis remains too general.

Both planning and reflection can be considered as parts of a broader approach focusing on the use of *design strategies*. These mainly refer to: a) use of a *limited-commitment-mode control* strategy (Goel & Pirolli, 1992), which means that "when working on a particular mode, it does not require the designer to complete that module before beginning another. Instead, one has the option of putting any module on hold and attending to other related (or even unrelated) modules, and returning to the module on hold at a later time" (p. 422); b) *reuse of past design* (Détienne, 2003; Visser, 2003), referring to the exploitation of different experiences from the past; c) *design fixation*, as a tendency of easy accommodation to re-use rather than new creation (Cross, 2001), as a fixation on "being different" (Purcell & Gero, 1996), or as a "premature commitment to an idea" (Visser, 2003); and finally, d) *ambiguity and uncertainty*, as related to design creativity (Stacey & Eckert, 2003; McDonnell, 2010).

All these examples described so far, either from an empirical or a theoretical point of view, have one common basis: the view of design as an activity that forms the process. Apart from few exceptions limiting this activity to problem solving, such as the studies by McGinnis & Ullman (1992) and Lloyd & Scott (1994), the rest sees design activity as broader. However, the nature of this activity and its interference with the process still remains an issue.

From a Cognitive Psychology perspective, an answer to the above problem is given by considering design as a dynamic and continuous *construction of representations* (Visser,

2006, 2006b). Representations are very important in design, and even more, in team design (Hendry, 2004), as they form the vehicle to communicate ideas. Making explicit designers' representations is a first step in their communication regarding the collaborative task. A second step is to decide which representation is the most valid at a certain time instance and for a specific goal. Two cognitive processes may intervene here: that of *optimizing*, and that of *satisficing* (Simon, 1969/1996). In one way or another, the design process is considered complete when a final specification at a representational level takes place. In the case of team design, if such specification is result of co-conception, it corresponds to some *inter-designer compatible representation* (Visser, 2006, 2006b), which is also the basis of collaborative design.

In this dissertation, we adopt the view of design as construction of representations for several reasons: first, because the dynamic nature of design is respected; then, because it also considers team design situations; and last but not least, because it can shed more light on the nature of design activity, its components, and their relations.

2.3 TEAM DESIGN

> Design work can no longer be adequately conceptualized in terms of individual "intelligence", nor as a linear process with a set of design stages, but rather as a situation in which joint, coordinated learning and work practices evolve.
>
> —PERRY & SANDERSON, 1998

In this section, we offer an overview of team design research in the last three decades. First, we present some general observations regarding the research in the field, from a methodological point of view. In continuation, we draw the focus on the most salient empirical results of selected reviewed studies, organized on three basic lines, namely *actors, contents,* and *strategies* (methods).

It can be said that team design research has started with Bucciarelli (1984, 1988), and his broadly known ethnographic studies in the engineering design field. One of the main problems he faced is that "they [the designers] think about the work on the design in quite different ways. They do not share fully congruent representations" (Bucciarelli, 1988; p. 167). Thus, the analysis of how representations are shared during design has been his main research focus. More precisely, he proposes two main modes of analyzing team design processes, the narrative and the topical mode (Bucciarelli, 1984), and identifies three main types of design discourse observed, namely: constraining, naming and decision discourse (Bucciarelli, 1988).

Apart from ethnography, another main data collection method in design research has traditionally been the think-aloud method (Eastman, 1970), in which the designers are asked to make explicit what they think while they design. The protocol method was also expanded to team design activity, under the assumption that "the

verbal exchanges of members of a team engaged in a joint task do seem to provide data indicative of the cognitive activities that are being undertaken by the team members" (Cross, Christiaans, & Dorst, 1996; p. 3). A first organized effort regarding the launch of the team protocol method is represented by the Delft Workshop that took place in 1994 in the Netherlands. During this workshop, various researchers with different methodological perspectives and backgrounds were asked to analyze the same protocol dataset. This consisted of two transcribed experimental sessions: one with an individual designer, and another with a team of three designers. Both aimed at the design of the same product –a mountain bike device. Half of the studies (10 out of 20) included the team protocol in the analysis. Among them, only seven focused on the team as their exclusive unit of analysis.

Just recently, a shift to the team as the main focus of analysis is observed, mainly from a Cognitive Ergonomics' point of view (e.g. Darses, et al., 2001; D'Astous, Détienne, Visser & Robillard, 2004; Détienne, Martin & Lavigne, 2005), but also in the broader Design Research field (e.g. Valkenburg & Dorst, 1998; Stempfle & Badke-Schaub, 2002; McDonnell & Lloyd, 2009). More precisely, a great part of team design research consists of video recording design teams in natural or experimental settings, and analyzing their interaction using some type of coding, or other case-studies methods. A common aspect between all these studies is the fact that they are empirical, meaning that they describe design as it actually happens. However, a great variety of methods has been hitherto proposed in this regard, reflected in a second shared data analysis effort, as presented in McDonnell & Lloyd (2009). The so-called "DTRS7 dataset" is totally focused on team design meetings, both in Architecture and in Engineering design fields. Also, compared to the Delft protocol, the DTRS7 describes authentic design practice, as it reflects in situ professional design meetings.

At this point, two important distinctions regarding research in design teams should be made. First, between *co-located* and *distant* design. By distant, it is meant not only

design made asynchronously (as in Craig & Zimring, 2000; Lahti, Seitama-Hakkarainen, & Hakkarainen, 2004; Sack, Détienne, Ducheneaut, Burkhardt, Mahendran, & Barcellini, 2006), but also design requiring co-ordination among various teams or departments in a company (as in Bucciarelli, 1984, 1988; Perry & Sanderson, 1998), or in large-scale software development (as in Curtis, Krasner, & Iscoe, 1988; Hendry, 2004). The present study focuses on "close" design situations, which, in general, can be one of the following: co-design meetings, concurrent engineering design meetings, or team design sessions, referring to quasi-experimental settings. A second distinction needs to be made between students and professionals as study participants. It has been shown that expert designers think, and thus design, differently than the novices (Smith & Leong, 1998). Therefore, this aspect needs to be taken into account when describing team design.

In order to give an overview of the most representative studies in team design, deriving from different contexts and methodological perspectives, a literature search was conducted in the most relevant to the topic electronic databases (ABI Inform, Science Direct, and ACM Digital Library). The keywords used were: design/designing, team, activity, process, communication, collaboration/collaborative. The selected studies contained the word "design" and at least one of the other keywords in the title. In addition to that, their focus should be on team design, rather than on individual design processes. The journal articles' search was completed with the references of the studies found, and also, with some representative book chapters, a research report, and two Phd dissertations (Walz, 1988; Minneman, 1991), due to their great relevance to the topic. Conference proceeding publications were not taken into consideration, neither studies focusing on computer-supported collaborative design. A total number of 46 references, corresponding to 40 studies (some of the studies are reported in more than one publications), were reviewed according to their domain, their main methodology, and their main contributions. Appendix 1 presents the results of the review. The studies' selection is representative and cannot be considered as exhaustive.

Regarding domain, we mean the specific design field of application. More precisely, 57.5% of the studies reviewed belong to the general engineering domain, comprising industrial, mechanical and electrical design; the 22.5% are studies in the field of software design; the 15% belongs to the architectural design field; and only an accumulative 5% belongs to other fields, including instructional. Regarding methodology, we distinguish between open qualitative methods, including in-situ observation or grounded analysis, coding methods based on the proposal of pre-defined categories, survey techniques, e.g. questionnaires and interviews, socio-metric techniques, e.g. social network analysis and text mining, and other design-related methods. A vast majority of the studies (58.8%) used coding methods, either exclusively or in relation to other methods, to analyze professional design meetings.

The main empirical results obtained can be summarized into three dimensions, regarding contents, actors' roles, and strategies.

Contents. Designing requires discourse across different object-worlds, a discourse that arches across differences in language, across different priorities regarding performance, different histories of design practice (Bucciarelli, 1984, 1988). Problem-specific terminology, history, interpretations, and designer's measurement systems form what Minneman (1991) calls "designers' recipient design", meaning the content of the utterances being communicated, and appealing to their perception by the listener's knowledge. According to Mabogunje et al. (2009), constraints have a major role in shaping the design conversation and extending the designers' collective memory. Moreover, these authors claim that design conversations might exhibit two different patterns: a) a linear pattern which corresponds to a process driven by multiple potential goals that are pursued in parallel in the absence of a clearly defined goal, and b) a resumption pattern which can be visualized as a spider-web representation.

Actors' roles. Good co-ordination is related to specific communication roles, adopted by the team members. These can be either referring to the internal team

relationships, or to the team's co-ordination with other experts, or the users themselves. Regarding the former, some of the possibly emerging roles are: "Intergroup", "Intertask", and "Interdisciplinary star" (Sonnenwald, 1995, 1996), "expert", "translator", "manager", and "asker" (Walz, Elam, Krasner, & Curtis, 1987; Walz, 1988), "scheduler/time-keeper" (Cross & Cross, 1995), "creative leader" (Kratzer, Leenders, & van Engelen, 2008), and "boundary-spanners" (Curtis et al., 1988). Regarding the latter, it can be either performed "physically", meaning that they are persons who literally move among different teams transferring information about the state of the project (Détienne, 2006) – mostly observed in object-oriented design (Herbsleb et al., 1995) –, or "virtually", in the sense that team participants incorporate, in a way, an external perspective. This second case is described by Baker, Détienne, Lund, & Séjourné (2009) as an enouncing role, when other voices, for example the users' perspective, are adopted.

Strategies. Regarding specific strategies adopted during co-design, these can be distinguished into two big categories, namely verbal and non-verbal. Few studies report on concrete observations regarding the use and function of non-verbal acts, such as gestures or use of tools in team design. Tang & Leifer (1988) for example report that gesture actions constitute over 1/3 of all the workspace activities observed, and they were almost always accompanied by verbal talk. Integration among verbal and non-verbal acts is also the focus in the studies of Détienne & Visser (2006) and Visser (2009). As far as the use of tools is concerned, they seem to be very related to design collaboration, either as intermediary objects (Boujut & Laureillard, 2002), or as catalysts of common knowledge construction (Peng, 1994; Eckert & Boujut, 2003).

2.4 THE ROLE OF COMMUNICATION IN DESIGN

Design is a social process.

—BUCCIARELLI, 1984; 1988

Getting more into detail in design verbal activity, communication is an essential part of team design. According to Sonnenwald (1995):

> (…) communication in design may be characterized as "contested collaboration" (…) Participants must collaborate and mutually explore one another's life-world and specialized knowledge so that they can come to a working understanding of how the artifact will co-exist with and, ideally, support patterns of work activities, social groups and personal beliefs (…) The need to collaborate with other [designers and] groups requires participants to gain an understanding of one another's life-world, including one another's language, expectations and normative behavior" (p. 872-873).

Focusing on the inside-team design communication, two main types of contributions are identified: the ones focusing on "bad" communication and the ones focusing on "good" communication.

Regarding the former, a number of studies focus on communication problems or breakdowns. According to Curtis et al. (1988), communication breakdowns depend on: communication skills of individuals, existing incentive systems, different representational formats, rapid change, local jargon, breakdown of information capture, cultural mores, and norms for individual behavior. Sonnenwald (1995, 1996) found that conflicts in groups consisting of designers, developers, and end-users are mainly based on: a) theme incompatibility, b) language differences, c) incomplete specialized knowledge, and d) power relationships. The same breakdowns in a team consisting only of designers are due to: errors in understanding the design

requirements, misinterpretations of the information, misunderstanding of apparently shared concepts and forgetfulness of requirements (Cross & Cross, 1995; Eckert, 2001).

However, the vast majority of the studies reviewed focuses on "good" communication, and more precisely on those process-based behaviors considered as desirable for team design activity, either because they refer to predominant activities at a team level, or because they are systematically observed in form of "collectibles" (Tang & Leifer, 1991), meaning recurring patterns of activity at a session or project level. The main empirical results considering both perspectives are hereby exposed.

Distribution of team design activities. The evolution over time of shared mental models follows a counterintuitive reduction pattern that indicates that quality of shared views, or salience, and not quantity is the key to effective teamwork (Botturi & Del Percio, 2009). Considering the evolution of the design process, sharedness is more possible to occur during the beginning (of the) meetings (Badke-Schaub, Lauche, Neumann, & Ahmed, 2009). Regarding the process organization, agenda is not always followed (Cross & Cross, 1995), as it is also shown in other types of meetings (Deppermann, Schmitt, & Mondada, 2010). In addition, in design meetings, activities may be initiated tacitly, without a formal decision to undertake the activity; there is opportunistic drifting from the agreed plan (Cross & Cross, 1995). Transitions from topic to topic depend either on team members' actions, on the topics, or on the processes (Brereton et al., 1996). On the other hand, discussed contents when combined with design thinking structures, are shown to be correlated forming efficient design patterns (Goldschmidt, 1996; Goldschmidt & Weil, 1998). Again, though, when considered in isolation, and not in a specific conversational context, design cognition is apparently disordered, without any clear pattern or meaning of organization (Radcliffe, 1996).

Also, it is possible that the level of problem definition and explanations increase over time (Badke-Schaub et al., 2009), as similarly as the duration of analysis (Smith &

Tjandra, 1998). In terms of efficiency, two main observations emerge from team comparison: first, that the more efficient teams are the ones that choose to scrap their initial design and to start afresh with a new design concept (Smith & Tjandra, 1998); and second, the successful teams are the ones that spend more time on coming up with different problem frames, rather than just identifying problem features, instead of potential solutions (Valkenburg & Dorst, 1998). In addition, missing information seems to be the key factor for unsuccessful goal analysis, whereas individual competence is positively related to successful solution search (Badke-Schaub & Frankenberger, 2002). In general, process efficiency has been treated as a relevant aspect in team design, on the basis that how a design team works together is positively linked to what it actually produces (Busseri & Palmer, 2000).

Regarding the distribution of team design activities in time, e.g. throughout one or more meetings, project and meeting management has an important part. In the study by Olson, Olson, Carter, & Storrosten (1992), this occupied about one fifth of the total time, whereas in the more recent study by Stempfle & Badke-Schaub (2002), group process discussion accounted for the one third of the total meeting time. Among the design-oriented activities, not all of them focus on the production of design knowledge: in Design Evaluation Meetings, most of the time (41%) is spent on cognitive synchronization activities (D'Astous et al., 2004), whereas in Object-Oriented Design meetings, more episodes of summary and walkthrough occur in comparison to traditional project meetings (Herbsleb et al., 1995). Finally, regarding the specific emerging design communication acts, a significant amount of those (63%) is related to the solution space (Stempfle & Badke-Schaub, 2002). In this space, alternatives occupy an important place. Olson et al. (1992) report that most issues have an average of 2.5 alternatives offered, and one third of these are never explicitly evacuated. In support of this result, D' Astous et al. (2004) observe that alternative elaboration is almost as frequent (21%) as solution evaluation (26%).

Finally, team's behavior is described regarding its collaboration with external agents, such as users and clients. In their analysis of the architects' case of the DTRS7 dataset, Goldschmidt & Eschel (2009) observe that the utterances contributed by the clients were almost the double (60,4%) of the utterances produced by the architects (39,6%). In the same dataset, McDonnell (2009) observes the following negotiation patterns between architects and clients: a) architects' tentative appeals to building users' perspectives, b) building users as custodians of the design concept and of design integrity, c) collaborating to justify agreed design decisions, and d) deferring to expertise and assertion of expertise. On the other hand, in object-oriented software design, Herbsleb et al. (1995) report the use of metaphors as a main strategy to communicate complex issues to clients.

Team design communication patterns. Beginning from the most general systematic observations of team design behavior, a first pattern concerns the number of participants guaranteeing collaboration. More precisely, it has been broadly observed that design collaboration takes places in small coalitions rather than in large groups (Walz et al., 1987; Kurtis et al., 1988; Détienne & Visser, 2006). A second observed pattern type has to do with the consensus achievement among the participants. In Walz (1988), an interesting consensus pattern among seventeen design meetings was observed and confirmed through a logistical regression method. This pattern refers to an inverted U-shaped curve that characterized acts of agreement, meaning that agreement decreased right after ten meetings, when a first commonly accepted intermediary artifact was produced. The fact that consensus is not the primary goal in team design meetings is also congruent with Cross & Cross (1995), who systematically observe that designers often prefer to postpone agreement, or with Minneman's (1991) observation that negotiations found in these meetings frequently produce only better understandings of the position of other parties, and no marked closure is reached.

Getting more into detail, Medland (1992) observes four communication models emerging in team design: delegation, reporting, awareness, and problem handling. Regarding delegation, the following mechanisms of viewpoint integration are identified: negotiation of constraints, evocation of shared knowledge, and argument of authority (Martin, Détienne, & Lavigne, 2002). More precisely, constraints and arguments play a major role in design delegation. Constraints are the "ends", the utility of which is maximized through the selection and optimization of the right alternatives (Simon, 1969). Their use in design is very important and leads to meaningful patterns of behavior, as the combined assessment mode (Détienne, Martin, & Lavigne, 2005) composed of three steps: 1) Analytical assessment of the current solution, 2) If Step 1 has not led to consensus, comparative or/and analogical assessment is involved, 3) If Step 2 has not led to a consensus, one or more arguments of authority are used. Considering arguments, two main modes are recognized in team design research, namely *associations*, meaning rhetorical argumentation schemes providing links between statements, and *dissociations*, meaning schemes "introduced to overcome an incompatibility by separating an established concept into new concepts" (Stumpf & McDonnell, 2002). Some patterns observed regarding these two modes are the following (Stumpf & McDonnell, 2002): a) association clusters surrounding dissociations, b) more dissociations observed in the first half of the design sessions than the second.

3. RESEARCH FRAMING

As we saw in the previous chapter, a passage from focusing on design as a problem solving process, with pre-defined stages and outcomes, has given its place in the recent years to a more activity-based approach of design. Problem solving is just one of the possible activities to emerge during designing. Other activities, of both cognitive and social nature – in the case of team design – are possible to occur.

In order to understand the nature of team design process, the study the specific activities taking place during it is necessary. This becomes possible by adopting an empirical research methodology, focusing on what designers *actually do*, in terms of contents, roles, and methods or strategies. Such an approach has begun to appear in fields such as engineering, software, and architectural design, but not as much in eLearning design. Thus, the need to further research empirically the team design communication processes in this field emerges as primary.

In this chapter, the empirical part of this dissertation is introduced. In Section 1, the state of the art regarding the ID and eLearning design fields is presented. In Section 2, we present our main research goals in response to the identified problems. These goals lead to a number of research questions, presented in Section 3.

3.1 RESEARCH PROBLEM

Beginning with the nature of ID, and subsequently eLearning design, a first relevant observation concerns the fact that it is more practice-based rather than theory-based (Goodyear, 2005). This means that theories exist to guide practice, but at the same time practice informs theories, given that not one "correct" model of ID exists. Moreover, ID practice is driven by a vast number of theories, which do not necessarily coincide with learning theories, as other complex cognitive and management processes are involved (Reigeluth, & Carr-Chellman, 2009; Richey, Klein, & Tracy, 2010; van Rooij, 2010). This recent observation in the ID field has led some scholars towards the adoption of a design-based approach of ID, rather than a leaning theory approach. However, "a small number of these have attempted to derive a generic model of the design process" (Perez, Fleming-Johnson, & Emery, 1995, p. 324). In addition, these few existing generic models, such as ADDIE (Molenda, Pershing, & Reigeluth, 1996), are shown to be too general (Molenda, 2003), unclear (Bichelmeyer, Boling, & Gibbons, 2006), missing important dimensions, such as culture and interaction (Thomas, Mitchell, & Joseph, 2002), or just serving as conceptual frameworks for practice (Kenny, Zhang, Schwier, & Campbell, 2005).

In general terms, the image of ID research is similar to the one of design research, as we briefly presented it in Section 2.1, at least regarding two main problems: a) the inadequacy of a process-based model, as such process is more complex than what one type of model can prescribe; and b) the inadequacy of a generic model of design, as they remain at a general level. As we saw in the previous chapter, these two problems have led researchers to adopt an empirical approach of design research. In

the ID field, a recent review of what instructional designers actually do (Kenny, et al., 2005) has led to some interesting insights regarding the issue, such as:

- Instructional designers do not systematically perform all the steps in an ID model, but they rather create layers of ID activities based on the specific design situation.
- Rather than exclusively working on ID tasks, instructional designers spend over half of their professional time in other, organizational nature activities.
- ID models are useful to designers and inform practice, but few if any designers actually *use* models to confine their practice.

These observations were obtained from only 10 articles – the only ones that were considered relevant to the topic at the time of the study' publication. Among them, only 3 were somehow related to the team practice, as they reported individual designers' experiences with working in teams. To these three, we add the study of Latzina & Schott (1995), even though it reports results at a theoretical level, and the one by Botturi & Del Percio (2009), which, as we already mentioned, focuses on eLearning design teams. However, most of these studies report the experience of individuals designing in a team; no protocol-based study – at least, in our knowledge – has been hitherto reported in the field of instructional or eLearning design.

The need to empirically study how eLearning designers perform in teams is essential, not only because of the inadequacy or lack of models that guide team design practice. There are at least three other factors that call for a special attention on this issue. The first one has to do with the *cross-disciplinarity* of eLearning design teams. As Epton, Payne, & Pearson (1983) claim:

> There are tasks that require for their objective completion contributions from more than one discipline. Such tasks are defined as cross-disciplinary. Cross-disciplinary tasks can be carried out using either of two different organizational forms: The 'pure'

> multidisciplinary form - in which portions of the task are carried out by organizationally separate units each of which includes practitioners of only one discipline [or] the 'pure' interdisciplinary form - in which the elements of the task are carried out within a single unit that: (a) includes practitioners of all the disciplines necessary for the completion of the task, (b) has an internal structure such that transactions between members can take the form described (...) as consulting (p. 6-7).

We prefer to use the term *cross-disciplinary*, rather than multidisciplinary or interdisciplinary, as it is usually used by other authors, to stress on the double possibility of a team composed of different disciplines to be either *multidisciplinary* or *interdisciplinary*. More precisely, multidisciplinarity refers to a type of cooperation between disciplines that neither readily integrates the findings of different disciplines nor adequately addresses knowledge gaps (Acutt et al., 2000). Braun & Schubert (2003) succinctly define it as "when disciplines work side by side on distinct problems or aspects of a single problem" (p. 185). A desideratum of any multidisciplinary team is interdisciplinarity, which has been defined as the "emergence of insight and understanding of a problem domain through the integration or derivation of different concepts, methods and epistemologies from different disciplines in a novel way" (Rogers, Scaife, & Rizzo, 2005; p. 3).

The second issue refers to the Design Rationale (DR), meaning the reasoning process underlying design (Fischer, Lemke, McCall, & Morch, 1991). DR has been hitherto understood in three ways: a) as a documentation process used by the designers to keep track of design artifacts leading to design decisions (Fischer et al., 1991); b) as a communication process consisting of questions, options, and criteria (McLean, Young, Bellotti, & Moran, 1991); and c) as an argumentation process composed of three basic elements, namely issues, positions, and arguments (Kunz & Rittel, 1970). An integrated approach between these three seems to be needed, because in practice all of these rationales appear, making the adoption of one approach being incomplete (Shipman & McCall, 1996).

Last but not least, uncertainty about the nature and quality of collaborative design is another relevant research problem. The social nature of the design process has been emphasized since early years (Bucciarelli, 1988; Schøn, 1988). However, it is not until recently that collaborative design has started gaining attention as an object of study itself, and not only as the macro-context of a teamwork practice. As we saw in Chapter 2, different methods of analyzing team design activity have been proposed (see, for example, McDonnell & Lloyd, 2009). Among the emerging units of analysis, the most related to the concept of collaboration are: *viewpoints* (Martin et al., 2002), *arguments* (Détienne, et al., 2005), *epistemic roles* (Baker et al., 2009), and *sequences of co-operation* (D' Astous et al., 2004). The presence and role of these mechanisms have not been yet studied in the field of eLearning design and development.

3.2 RESEARCH GOALS

A better understanding of workspace activity could also lead to insights into improving the design process.

—TANG & LEIFER, 1988

As it was already made explicit, the need to describe, analyze, and evaluate team design communication process is still a desideratum in the relevant field. Moreover, this has to be done in a systematic way, which would allow the identification of meaningful patterns of interaction. Such meaningfulness should be at least two-fold: first, for the interaction itself, from a communication analysis point of view; and second, but not less importantly, for the present and future participants of such interactions.

The macro-context of this research is Distance Higher Education, and more specifically, the design of totally on-line University courses. According to Bates & Poole (2003), the following modes of course development are possible: a) the *lone ranger approach*, in which instructors work alone, as for example individual cases of teachers as in-their-classroom innovators; b) the *boutique course development*, in which a professor works together with an instructional designer or technology support person a one-on-one basis; c) the *collegial materials development*, in which several academics work collaboratively to develop online or multimedia educational materials; and d) the *project management* mode, in which a complex project is carried through by a team of individuals, each contributing different skills and assuming clear roles. Although all these four process modes describe ID, only the two latter explicitly refer to team processes guiding design, and only the *project management mode* is considered as representative of Distance Education Higher institutions.

Having said that, our specific context of analysis is an institutional eLearning project *meeting*. Apart from an institutional routine, meeting also forms a type of communicative activity with its own characteristics. Some of them appear on Figure 7, as described by Allwood (2000).

PURPOSE	**Activity structure**	**Subgoals**	**Procedures**	
	Every issue being discussed defines a subactivity, normally consisting of: 1. Definition of the problem or issue or following up on an earlier issue 2. Discussion or try to solve the problem 3. Delegating	4. Try to solve problems that arise 5. Delegate assignments	If there is an agenda, it is followed and issues are being discussed in that order. Otherwise, the chairman usually gives the word to the different participants. Every decision should be written in the protocol by the secretary.	
ROLES		**Compe-tence**	**Rights**	**Obligations**
	Chairman	Familiarity with routines during a formal meeting	Lead the meeting	Lead the meeting Let everyone talk who wants to Listen to problems/opinions
	Project/ department employees		Express problems and opinions	Wait for turn
	Secretary	Knowledge how to write a protocol	Ask for clarification or specification	Write a protocol
ARTIFACTS	**Instruments**		**Media**	
	Agenda (poss.) Protocol		Direct speech (video or tape recorder used for recording purposes)	
ENVIRONMENT	**Social–Cultural**		**Physical**	
	If this is a meeting in a workplace, most of the meeting participants know each other and are probably workmates. In other meetings there is often a lack of familiarity between participants.		Meeting room at work Participants are seated around a table	

FIGURE 7. THE MEETING ACTIVITY TYPE (ALLWOOD, 2000; P. 7)

Considering the design meeting as the main macro-activity to focus on, *co-design activity* becomes the primary unit of analysis. In general, as Sim & Duffy (2003) observe, there are two main types of design activities: those that manage the evolution of a design problem into design solution(s), and those that manage the design process as the design evolves. The former belong to what is defined as *exploration of the design space*, whereas the latter refer to the *task management* aspect of design. Both types of activities, if task relevant, they focus on one or more *design objects*, meaning those components of the design space towards which the activity is oriented. Figure 8 shows a generic representation of any design activity, as an object-oriented system.

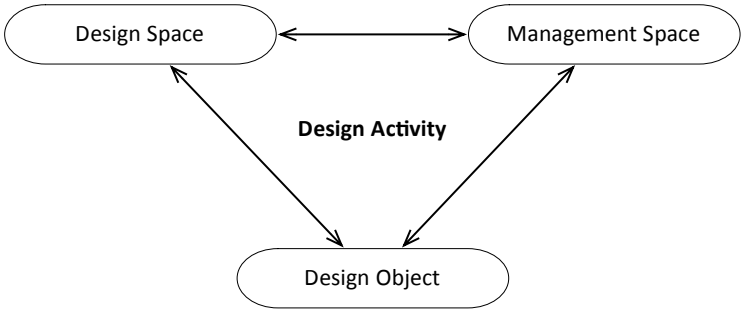

FIGURE 8. A GENERIC REPRESENTATION OF DESIGN ACTIVITY

Transferring the design activity's generic concept to the field of co-design, any transformation of the design space necessarily becomes part of the management space. This is more obvious in the meeting context, in which planning has a primary place, instead of actually designing. Moreover, the nature of eLearning design renders decision-making as the central activity of co-design, as it does not allow for "putting-hands-on-the-product", as in Architectural design meeting, for example (in that case, the actual design of the product takes place during the meetings). Having said that, the two intermingling spaces in team design activity are: design space and the communication space. In other words, designers are confronted with a dual task, that of developing the product, even though at a planning or decision-making level,

and that of communicating their ideas about this development to each other. As the efficiency of ideas development cannot be guaranteed before the product, i.e. the on-line course – gets to the users, communication efficiency has a primary place, as it guarantees that all different disciplines, voices, and concerns have actually been taken into consideration, before it is "too late".

This dual task from part of the participants calls for a dual research goal from our part: one focusing on the design practice, and how it actually takes place during eLearning project meetings; and another, focusing on the communication practice of the designers as main activity of the same meetings. In other words, we are interested in investigating the design-in-communication process, from one hand, and the communication-in-design process, from another. More precisely, our research goals can be identified as following:

Research goal 1 *To identify and describe relevant design and communication processes taking place during co-design meetings, with the aim of evaluating how they interact one with another.*

Research goal 2 *To inform team design practice with empirical conclusions that can render their communication more efficient.*

We can further say that the first goal is method-oriented, and as such, it could apply for any co-design situation, whereas the second goal is practice-oriented, and as such, it focuses on the specific context of team eLearning design. Both goals are equally important for the present dissertation and will be similarly addressed.

3.3 RESEARCH QUESTIONS

As it was already explained in the Introduction, context is an essential component of the communicative interaction. Thus, before concrete questions are posed, it is important to situate ourselves in the specific context we are interested in: eLearning design and development. To do that, a conceptual framework proposed by Cantoni, Botturi, Succi, et al. (2007) is used, as it is presented on Figure 9.

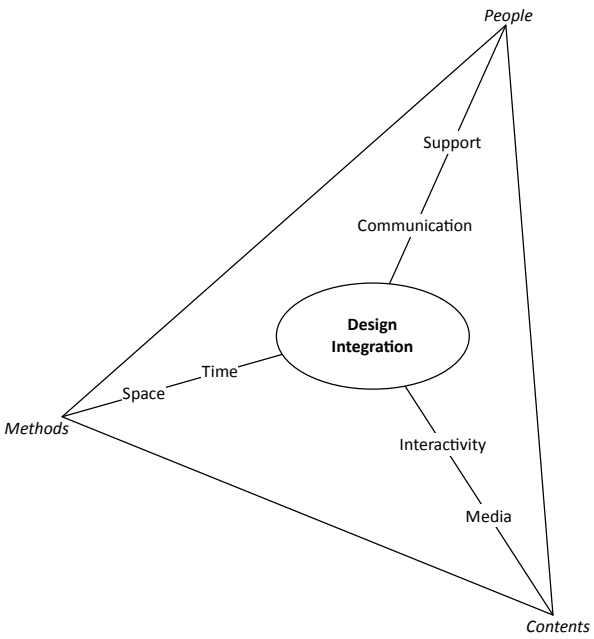

FIGURE 9. THE KEY-ELEMENTS OF E-LEARNING DESIGN
(IN CANTONI ET AL., 2007; P. 149)

The main elements of the framework, namely *people*, *methods*, and *contents*, correspond to the main design activity elements, as se defined them in Chapter 2. However, as it

can be seen from its secondary elements, this framework refers to the whole eLearning design activity, not to the specific team design communication "producing" this activity. Adopting it to the context of co-design meetings, and according to what we have hitherto said, it takes the form shown on Figure 10.

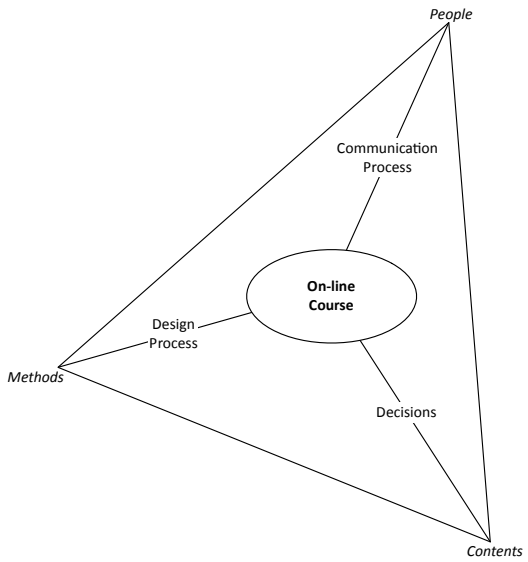

FIGURE 10. THE KEY ELEMENTS OF AN E-LEARNING DESIGN MEETING

Based on this conceptual framework, and on our previous discourse regarding the notion of activity as central in team design process, the following questions are posed:

1. How is an eLearning design meeting structured in terms of design and communication activities?
2. How is the content of team design activity related to the design object, i.e. the on-line course?
3. How do people relate to the design object through their communication process?

4. THEORETICAL BACKGROUND

Analyzing communication in institutional settings is a complex task and not only one method exists to do so. Studies in conversational analysis frequently have institutions as their context of analysis, whereas discourse analysis comes into game each time specific interpersonal verbal dynamics need to be explored. On the other hand, small group communication research has for several years influenced the ways in which such interaction is analyzed in order to inform future practice. In this line of research, various methods are possible and usually a mix of qualitative and quantitative approaches is proposed as the most adequate option.

The perspective adopted hereby of communication as a socio-cognitive interaction calls for a special attention on the *Interaction Analysis* paradigm, as it was mainly developed by the French school (e.g. Trognon, 1999). This paradigm is based on both conversational and discourse analysis (Brassac, 1992), but it is also different from those in various aspects, as it will be explained later on. Its main assumption is that during interaction, an *interlocutory logic* between the participants is created, and discourse is the main agent of its construction. To go further into how discourse promotes construction and co-construction of concepts and relations, several types and classifications of discourse relations have been proposed. A special type of those refers to the ones forming arguments and argumentation sequences. For their identification and analysis, some notions from the Informal Logic field are considered necessary. Moreover, as the interaction we are interested in is object-oriented, the definition of the cognitive aspects of the design object(s) is possible with some help from the Cognitive Ergonomics field.

Chapter 4 provides a more detailed account of what was briefly described here. Section 1 is dedicated to giving an account of the most important inter-personal communication studies and methods applied in the small group communication field. Section 2 describes Interaction analysis and its main assumptions and applications. Section 3 presents some notions from the Cognitive Ergonomics field, also relevant for team design situations. Section 4 focuses on the issue of discourse relations and presents their communication-oriented conceptualization in the margins of Connectivity model. Finally, Section 5 provides an overview of what Informal Logic refers to and its main ideas and applications of analysis.

It is worth noting here that what will be exposed in the following sections is just a selection of the study's potential theoretical background, paying attention at the notions directly applied or taken into consideration in this research.

4.1 INTERPERSONAL COMMUNICATION ANALYSIS

Tout se passe au passage de la parole
quelque chose se passe entre le passeur et l'autre rive
quelque chose arrive
s'il n'arrive rien, la parole est perdue.

—JOSEPH WOLMAN, unknown editions

As it was already made explicit in the previous chapter, the main goal of this research is to describe and analyze the communication processes taking place in a team of people in a task-oriented situation. According to Fisher (1975), "four elements are inherent in a process – *action* or acts, a continuous *change in time*, advancement or *progress* over time, and a *goal* or result" (p. 16). And he concludes using David Berlo's words, saying that "if we accept the concept of process, we view events and relationships as dynamic, on-going, ever-changing, continuous" (p. 16).

The notion of process has been considered of great relevance regarding small group communication research. In this context, group has been assigned the following characteristics (Brilhart, 1967): a) a number of people sufficiently small for each to be aware of and have some reaction to each other; b) a mutually interdependent purpose in which the success of each is contingent upon the success of the others in achieving this goal; c) each person has a sense of belonging or membership, identifying herself with the other members of the group; d) oral interaction, not exclusively but mainly; and e) behavior based on norms and procedures accepted by all members.

Analysis of group communication processes is of interest to this research, mainly in respect of three perspectives: a) the network perspective, b) the communication systems perspective, and c) the group as a decision-making system perspective.

A social network consists of a set of actors (nodes) and the relations (ties) among these actors (Wasserman & Faust, 1994). In interpersonal communication networks, the nodes correspond to individuals forming part of a group, whereas the ties can be both at an individual-individual and an individual-to-group level. The most used measures in network analysis are either qualitative, e.g. sociograms, or quantitative, e.g. through the use of network metrics. As Katz, Lazer, Arrow, & Contractor (2005) summarize, the most frequently used metrics include: a) *actor degree centrality*, i.e. the extent to which actors send or receive direct ties; b) *betweeness centrality*, i.e. the extent to which actors have ties with others who are not directly connected; c) *closeness centrality*, i.e. the extent to which actors are directly or indirectly connected to the rest of the actors in the network; d) *reciprocity*, i.e. the extent to which there are mutual ties between actors; and e) *transitivity*, i.e. the extent to which actors who are connected to one another are also connected to the same other actors.

Empirical communication network studies can be grossly classified into two big categories: the ones that conceive network ties as an input, and the ones that conceive them as an output. In the first category, a major structure component for task-oriented groups is *centrality*. Bavelas (1950) identified five main patterns regarding centrality, namely: all-channel, circle, chain, Y, and wheel patterns (the names correspond to the actual shapes of the network schemes). Their classification is hierarchical, from more decentralized to more centralized patterns ("all-channel" and "circle" are considered to be at the same level). In, mostly, experimental studies, these pre-existing or prescribed (as an experimental condition) patterns have been evaluated in relation to their influence on group performance measures, such as accuracy and satisfaction of group members (Leavitt, 1951/1975; Cohen, 1962; Shaw, 1964, 1971; Sparrowe, Liden, Wayne, & Kraimer, 2001). In all of these studies, more decentralized network structures are related to greater performance and members' satisfaction. On the other hand, studies

considering the network type and quality as an output are more interested in issues related to the question: What conditions do influence the emergence of a centralized pattern of ties? (Katz et al., 2005). Among the potential condition "candidates", low task-complexity (Hirokawa, Ebert, & Hurst, 1996; Brown & Miller, 2000), and high stress and tension (Argote, Turner, & Fichman, 1989) are related to more centralized communication patterns.

The analysis of group communication processes as networks' formation is relevant to the goals of the present dissertation. However, there are a number of limitations that emerge and need to be taken into consideration. First of all, in natural, face-to-face settings, it is not always clear whether group structures should be conceived as the input or the output of performance. Secondly, even if this is the case, group structures cannot be conceived as static and unchangeable entities, but rather as dynamic, continuously changing systems. This is the approach of groups as communication systems, which will be explained subsequently. Thirdly, people's emerging communication roles, rather than their position in the system, are more informative regarding the individual behavior in relation to the group processes. Finally, a last limitation emerges from the fact that in team communication usually each message is directed towards the whole of the team, and not only to one person (McGarth & Altermatt, 2001).

As far as studying groups as communication systems is concerned, both theoretical and empirical perspectives need to be taken into account. According to Mabry (1999), four theoretical perspectives grounded in the systems metaphor deserve attention, namely: *Field Theory, Social Exchange Theory, Developmental Theory*, and *Structuration Theory*. Hereby, we provide a brief account of each one.

Field Theory focuses on explaining the interdependencies of the part-whole relationship, and more precisely the influence of individuals' attributes on group processes and

performance. Its main assumption is that "achieving *groupness* depends on how successful members are at (a) managing and dissipating tensions created by simultaneously attempting to achieve individual and group goals, and (b) moving toward goals in the face of barriers in the group´s external environment or members' countervailing efforts at satisfying their own needs" (Mabry, 1999; p. 81). Some of the most important individual-based factors of group communication performance have been shown to be: sex/gender, communication skills, conflict management style, and culture. As Bonniwell-Hasslett & Ruebush (1999) observe, diversity in group composition has been explored from a number of different perspectives (e.g. demographic, communicative, cognitive, and cultural), and its outcome effects have primarily been on conflict expression and management, creativity, and quality of decision making.

Another group communication theory is represented by the Social Exchange. Its main idea is that "people are motivated to interact because they anticipate obtaining something of value, at the least possible cost to themselves, through their interactions with others" (Mabry, 1999; p. 81). This mechanism is very related to task-oriented interactions, such as group problem solving or decision making, because participants are necessarily interdependent in order to produce valued outcomes (Kelley & Thibaut, 1969). The interdependence among group members calls attention to the significance of members' relationships. As Scheerhorn, Geist, & Teboul (1994) observe, "decision making is merely one type of predominant activity within real decision-making groups" (p. 256). Although few scholars concentrate on the relational content of communication messages, some interesting tools have been provided on how to do so, namely: the Interact System Model (ISM), the System for the Multiple Level Observation of Groups (SYMLOG), and the Interaction Process Analysis (IPA). A brief presentation of each approach is considered methodologically relevant to the present study, even though our focus is on the socio-cognitive dimension rather than the emotional-affective dimension

of interaction (for some recent work on the latter see Baker, 2010; Andriessen, Baker, & van der Puil, in press).

The main unit of analysis of ISM (Fisher & Hawes, 1971) is the *interact*, e.g. the contiguous speaking act of one person followed by the act of another. The main contribution of the ISM method is the operationalization of interaction into three levels: *patterns* of messages and message sequences, *interact phases* composed of clusters of patterns, and *cycles* of interact phases related to specific group task performance.

Similarly to ISM, the precursor IPA (Bales, 1950), describes both the types of messages and patterns of interaction in groups. In addition, it offers 12 categories to describe members' communicative acts, based on the distinction between *task* and *relational* categories. More precisely, *task* messages may be one of the following: give or ask for suggestion, give or ask for opinion, and give or ask for orientation/information. The *socioemotional* (relational) acts are: show solidarity/seem friendly, dramatize/release tension, and agree – for positive member relations; disagree, show tension, and show antagonism/seem unfriendly – for negative member relations.

As an expansion of IPA, SYMLOG (Bales & Cohen, 1979) adds three dimensions with respect to the relational field, namely: dominance/submissiveness, friendly/unfriendly, and instrumentally controlled/emotionally expressive. According to Keyton (1999), "the SYMLOG system is particularly good for revealing polarizations or tensions among group members on the three dimensions" (p. 198).

In the margins of Developmental Theory, two main types of models have been proposed, namely: *phase models*, and *continuous models*. Many phase models of group communication exist; however, focusing on task-oriented group communication, few of them have been tested in practice. A well-known example is the theoretical model of group communication proposed by Bales & Strodtbeck (1951), composed of three

phases: orientation, evaluation, and control. Its empirical testing by Fisher (1970) led to a four-phase model of decision development: orientation, conflict, emergence, and reinforcement. Other stage models of small group development have been proposed by Tuckman (1965), Tubbs (1995), and more recently also in the field of Artificial Intelligence (e.g. McBurney, Hitchcock, & Parsons, 2007). However, unitary sequence stage models have many problems, summarized in Mabry's (1999) observation that "although groups emulate some of the same phases, the exact composition, number, and ordering evolves more particularistically" (p. 83). As an alternative, Poole (1983) proposes the use of *multiple sequence models* instead of unitary sequence or stage models. A major difference between the two approaches is that the first one is top-down, meaning that a priori stages are applied to the data, whereas the second one is bottom-up, meaning that phases are defined in terms of particular patterns of group activities occurring within them.

A series of studies applying the second, multiple-sequence approach have led to some insightful results regarding patterns of group communication in task-oriented groups. To begin with, in the first application of the Multiple Sequence Descriptive System to ten decision-making groups, Poole (1983) examined a series of activities, among which: a) the *ideational content* of each segment, distinguishing between problem analysis, proposal development, and combined mode; b) the *focus units*, namely cooperative idea modification, elaboration, integration, and disagreement; and c) *sequential patterns*, identified as simple confrontation, devised confrontation (*repartée* mode), negotiation, and recurrent conflict. As a result, patterns of idea development, conflict management, and content patterns emerged. A comparison with Group Developmental Stages was also applied (Poole, 1983b), and the study was expanded to 47 decision episodes, deriving from different decision-making groups (Poole & Roth, 1989). The following results have been acquired:

- Although eleven out of the 47 decisions had the traditional unitary sequence path, 22 of them additionally had complex cyclic paths, characterized by two to seven problem-solution cycles. Moreover, those cycles were not unitary for the majority of decisions.

- In 24 of 47 decisions the groups began with a solution focus, rather than with significant problem analysis or orientation periods. Only 10 of the 24 later shifted back to problem analysis; the rest focused on solutions throughout the entire session.

- Some shifts of attention, in terms of group activity, can be translated as critical breakpoints. These are of at least three types (Poole, 1983b): a) *normal breakpoints*, which refer to topic shifts, natural breaks, or "planning moments" in which one or more members "breaks" group discussion in order to propose a plan of action; b) *delays*, also called "comprehension cycles", referring to holding periods during which the group recycles the same development process; c) *disruptions*, meaning either conflict outbreaks or major re-orientations. In Poole & Roth's (1989) study, 34 out of 47 decision paths had recycles, while twenty groups experienced conflict outbreaks. Such breakpoint instances alter one with another in a *punctuated equilibrium* way (Gersick, 1988): "systems progress through an alternation of stasis and sudden appearance –long periods of inertia, punctuated by concentrated, revolutionary periods of quantum change" (p. 16).

- A significant amount of group interaction was classified as *disorganized periods*, showing that not all task-oriented discussion is meaningful regarding decision making. Regarding the amount of such periods, there is a significant variance among the groups. Considering the instance of their appearance, no concrete prediction can be made, confirming again the insufficiency of a stage model.

Some answers to these issues are given by Structuration Theory. Its main concept, *structuration*, refers to "the process by which systems are produced and reproduced through members' use of rules and resources" (Poole, Seibold, & McPhee, 1996; p. 117). According to Giddens (1984), those rules and resources that group members use are the *structures*, or the "recipes" for acting. Systems have patterns because of these structures. However, not only the system is produced and reproduced through structuration, but the structures themselves also do. There is a *duality* of structure, meaning that they are both the medium and outcome of social practices (Giddens, 1984; Poole et al., 1996). Having said that, studies focusing on structuration, mainly search for two things: a) the interdependence between structures and system, or, better said, between individual action and structural factors; and b) a method to do so that does not consider structure as a stable, given aspect of the group and its members, but as an emergent product of member activities.

As it has been already implied, a special attention has been given to group communication as a decision-making system. Based on the overview by Hirokawa & Salazar (1999), the relationship between group communication and decision-making performance has been conceptualized through three main perspectives: the *mediational*, the *functional*, and the *constitutive* perspective.

According to the mediational perspective, communication is a medium through which "the primary group determinants of performance exert their influence" (p. 172). Three main tendencies can be distinguished in the margins of this perspective: a) studies that focus on the superiority of groups over individual decision-makers; b) studies that focus on communication as a means of acquisition, distribution, and pooling of information among group members, and c) studies that examine the effects of different communication techniques on group decision-making performance. The second perspective will be briefly examined separately due to its relevance to our focus on

naturally emerging, task-oriented interactions. Among the studies applying observational coding schemes to examine the relationship between information, communication and accuracy of group decision-making performance, Hirokawa & Salazar (1999) distinguish two studies as representative: the one by Lanzetta & Roby (1960), and the other by Katzell, Miller, Rotter, & Venet (1970). In the first study, four measures were used to do so, namely: a) total number of communicative acts produced; b) total number of messages providing information; c) total number of requests for information; and d) the relative proportion of transmitted information. In the second study, Katzell et al. (1970) applied IPA categories as proposed by Bales (1950). A common result between these two studies is that "information-related communication categories are inversely related to group decision accuracy" (Hirokawa & Salazar, 1999; p. 173), without providing a justification for such an unexpected relationship. On the other hand, a more recent mediational perspective application offered by Hackman (1990) seems to fill in the gap of considering those independent factors that "enable" a group to make high-quality decisions. These conditions, or "process criteria of effectiveness" (Hackman, 1990; p. 9), are: a) *effort* to accomplish the task at an acceptable level of performance; b) *knowledge and skills* relevant to the task; and c) *strategies* appropriate to the task-performance.

Despite this more functional version provided by Hackman (1990), communication from the mediational perspective is still perceived as a *medium*, and not as a *function per se*. Such a functional view is the main idea of the so-called Functional Perspective, in which effective group decision making is functional, in the sense that "it represents the means by which group members attempt to meet the requisites for successful group decision-making" (Gouran & Hirokawa, 1983; p. 170).

According to the Functional Perspective, a group's "final" decision is the result of a series of small steps or sub-decisions, which emerge during interaction as answers to the following questions (Gouran & Hirokawa, 1983; 1996): a) Is there something about the

present situation that requires a choice of some kind to be made?; b) What do we want to achieve or accomplish in deciding what to do?; c) What are the choices available to us?; d) What are the positive and negative aspects of each choice?. The accuracy of a group's answers to these questions is related to the quality of the decision performance. More precisely,

- Consistent with Functionalists' main assumption that it is not the discussion procedure that a group applies in order to reach a decision but the group's satisfaction of certain functions that matters, the following functions have been more related to effective decision-making than the others: analysis of the problem (Hirokawa & Pace, 1986), understanding of the choice making situation (Hirokawa, 1985), and evaluation of alternative choices (Hirokawa, 1985; Hirokawa & Pace, 1986; Orlitzky & Hirokawa, 1997).

- The evaluation of alternative choices can be oriented either towards the positive or the negative qualities of those. However, as Hirokawa (1988) observes, it has been broadly discovered a non-significant main effect for the assessment of positive qualities. This observation "may be a consequence of the fact that groups tend to employ a "negative" (as opposed to a "positive") approach in evaluating alternatives" (p. 499).

In spite of the evidently greater functionality attributed to communication by the Functional Perspective, still its consideration as a structure influenced by the system and not able to influence on the system is predominant. This duality of communication structures as both determined and determinants, highlightened by the Structuration Theory, is re-visited by the Constitutive Perspective in relation to group decision-making systems. Seen from this perspective, "the role of communication in group decision making involves facilitating the *creation and reinforcement of the social structures that give rise to*

decisions" (Hirokawa & Salazar, 1999; p. 172). Its main focus is the socially constructed environment and its influence on group performance. As main social processes, scholars working under this perspective have hitherto underlined the *symbolic convergence*, and the *rhetorical vision construction*. The former refers to the group´s effort to achieve common understanding of the symbols, i.e. concepts and procedures, related to the task. The latter refers to a way of achieving such convergence, through the use of "group fantasies", such as pragmatic, social, and righteous rhetorical visions (Cragan & Shields, 1981). In general, those studies have all focused on the identification and evaluation of inhibited and established group norms that influence on the way decisions are taken. However, more research is needed "to identify and assess the impact of endogenous factors on the structures group members draw on in communicating with one another" (Hirokawa & Salazar, 1999; p. 186).

Finally, it is worth noting that a special attention has been paid to *group argumentation*, in the margins of both Structuration theory and group decision-making. As it was already mentioned in the description of Structuration theory, structures that emerge in group interaction have been considered with a double function, as both means and outcomes of the practice. The same has been assumed for argument structures (Meyers, Seibold, & Brushers, 1991). At a general level, Canary, Brossmann, Brossmann, & Weger (1995) observe that argument structuring has been shown to occur simultaneously through three modalities: as norms for acceptable reasoning and interaction, as facilities enabling the exercise of power, and as schemes for interpretation and sense making. More precisely, regarding the emergence of argument as "result" of the interactional structure, group argument has been defined as a *convergence-producing discourse* (Seibold, McPhee, Poole, Tanita, & Canary, 1981), meaning discourse that reflects others' views (Perelman & Olbrechts-Tyteca, 1969). Also, group argument is mainly characterized by four strategies, namely: *extended elaboration*, *questioning and testing*, *repetitive agreement*, and *tag-team*

arguing, meaning the production of positive position towards a sub-group's proposal, that is, therefore, considered as influential (Meyers & Seibold, 1990). As far as the argument structure is concerned, *simple*, *compound*, *eroded*, and *convergent* arguments are possible to emerge in groups seeking consensus on a decision (Canary, Brossmann, & Seibold, 1987). Finally, concerning argument as a means for group outcomes, Canary et al. (1987) have found that groups reaching consensus have more argument acts and structures than dissensus groups, and the predominant type of those is convergent arguments.

In sum, it can be said that small group communication and decision making has been approached through very different perspectives and methods leading to results of different nature and relevance to the goals of the present study. Focusing our research on the "close" collaboration processes among the members of a task-oriented team, observations coming from the fields of Functional and Structuration Theory appear to be more related to our goals. Such results include the type of discourse and argumentation produced during group communication, the type of communication sequences, and the "cycles" or patterns of such sequences throughout interaction. On the other hand, to confront with these issues at a micro-level, as our focus is on the relations between people, methods, and contents, Interaction analysis emerges as the most adequate method, as it will be better explained in the following section.

4.2 INTERACTION ANALYSIS

Dialogue is not a "window on the mind",
it is a manifestation of minds in operation.

—BAKER, 2003

Group interaction refers to the "simultaneous and sequential behaviors (verbal and motor) of group members as they act in relation to one another and to the tasks that the group is trying to accomplish, over time" (McGrath & Altermatt, 2001). An early appearance of the study of group interaction is identified with Bales' (1950) Interaction Process Analysis (IPA) coding system. As it was already described in the previous section, the initiation of the Harvard School of Interaction analysis, in which the study of Bales is situated, focused on the systematic study of the "whole" group, having as main unit of analysis an *act*, equivalent to a simple sentence or its nonverbal equivalent. Bales focused on four symmetric groups of acts: positive and negative reactions (socio-emotional dimension), and problem-solving attempts and questions (task dimension).

Following Bales' tradition, a considerable number of scholars were interested in examining the relation between exchange structures and other group processes, such as power relations, the emergence and development of status structures, and their relation to emotions. We hereby give a short account of each, based on the review by Burke (2003). First of all, power is defined as being determined by the network of relations, and more precisely, as the inverse of the degree to which a person depends upon another. Regarding status emergence, it is shown that individuals' characteristics, such as initial status advantage and task skill, influence on the structure development. Finally, status processes are highly related to members' emotional reactions, in a mutually dependent

way, and also the latter is connected to task behaviors, such as agreements and disagreements.

Parallel to the Harvard School of Interaction Analysis, the Michigan School, started by Kurt Lewin at MIT (e.g. Lewin, 1946), focused on group cohesion, as result of positive interaction, cognitive dissonance, or identity construction. In the first perspective, successful exchanges lead to positive emotions, which in turn lead to relational cohesion. Sometimes the same is perceived by group members as a result of their effort to reduce their negative feelings, such as task pain, by attributing a high value to their belonging in the group. A similar approach is adopted by the identity theorists who suggest that it is not the exchange process as such that brings about group cohesion, but the process of self-verification in the group context, which also guides to a process of mutual identity construction in the other group members.

In one way or another, the approaches briefly described here define interaction as a relationship between two (or more) entities that influence each other. This has been defined as a *factorial approach* of interaction (Markova, 1997; Grossen, 2010). According to this approach, context is taken into account, at a greater or less degree, but always "as a set of external variables that have certain object characteristics" (Grossen, 2010; p. 4). By contrast, according to a *dialogical approach*, "the unit of analysis is the interaction as a whole, for example the individuals *and* their social and physical environment" (p. 4). As Grossen (2010) also observes, this approach is similar to Lewin's ecological theory, regarding that "the context in which the subject acts is also an outcome of his or her own psychological activity" (p. 4).

The dialogical approach of interaction has been investigated in various disciplinary fields, such as Sociology, Linguistics, and Distributed Cognition (for a recent overview of the interactionist paradigm see Streeck, 2010). Our goal here is not to focus on each one

of the approaches, as different issues and methods apply to each one. Instead, given the author's background in Psychology, an overview of how this approach has influenced various psychological theories until the emergence of "interlocutory logic" as the main paradigm guiding the present research will be given in the following paragraphs.

It can be said that the dialogical paradigm started with Bakhtin, whose work has influenced many social fields, including Psychology. Bakhtin's main contribution was to define language as a dialogical entity. As he said,

> word is a two-sided act. It is determined equally by whose word it is and for whom it is meant. As word, it is precisely the product of the reciprocal relationship between speaker and listener, addresser and addressee (Bakhtin, 1929; p. 86).

The same approach has been adopted by a number of psychologists. According to Mead (1934), each I-position creates a voice, which relates to other voices of I-positions in a relation of dialogicality. This phenomenon is also known as "multivoicedness". Vygotsky (1978) went a step further and defined language as the semiotic tool that "carries" such dialogicality both intra-personally and inter-personally. More recently, Markova (2003) defines dialogicality as "the capacity of the human mind to conceive, create, and communicate about realities in terms of the 'Alter'" (p. 85).

The dialogical perspective has been also expanded to both social and socio-cultural psychology. In social psychology, Billig (1987) introduced the notion of discursive psychology, with a focus on the argumentative nature of human thinking, both in its monological and dialogical form. Wertsch (1991), mainly based on Vygotsky and his mediational theory of language, introduced "a sociocultural approach to mind (that) begins with the assumption that action is mediated and that it cannot be separated from the milieu in which it is carried out" (p. 18). Bakhtin's influence is also evident on

Wertsch's work, concerning the role of context, in its broader sense, on the expression of *voices*. According to Wertsch (1985),

> voices … are not those of isolated, ahistorical individuals; they are the ideological perspectives or 'axiological belief systems' (Bakhtin, 1981; p. 304) that can adequately be understood only in terms of a specific sociohistorical setting (p. 226, citation of Bakhtin is in the original).

A remarkable influence of the dialogical approach has been noticed regarding the psychological theories of thinking and learning (e.g. Rogoff, 1990; Perret-Clermont, Perret, & Bell, 1991), which have led to the theories of collaborative learning (Dillenbourg, Baker, Blaye, & O'Malley, 1999). Some common ideas behind these theories, all of them focusing on what can be called as "meaning co-construction", are the following (based on Grossen, 2010; p. 7):

- Meanings are not inscribed within language; they are constructed through discourse and derive from interaction.
- The interlocutor's possible response is contained within the speaker's discourse, and any piece of discourse has one component made up of responsivity and another of addressivity.
- Human cognition and learning have to focus upon joint activity as it is achieved within a certain context.

Thus, within a dialogical approach of interaction, the unit of analysis is not the individual but the individual together with the other present or absent participants. This assumption creates the need for a method akin to grasp the logic of interaction as a logic per se, not as a sum of individual "logics" neither as a social phenomenon to be observed. Instead, it has to be seen "as an internal reality of any cognitive process and

(as) the observer cannot access the reality of the cognitive evolution, (he can do so) because it [the social interaction] is manifested, is communicated in a socialized way to the interlocutors" (Perret-Clermont & Nicolet, 1988; p. 13; original in French, translated by the author). This method is best described through the *interlocutory logic* (Trognon, 1999) approach.

The main idea of the interlocutory logic analysis – we use the term *Interaction Analysis* (IA) to refer to this approach– is that any element of conversation is both a social and a cognitive fact, and these two aspects are not separated or independent from the conversational element, but they derive, as functions, on the one or the other dimension. This also means that the social dimension contributes to the cognitive and vice versa. Another main idea is that this double nature is manifested at all levels of interaction, from the most micro, i.e. acts, to the most macro, i.e. transactions. Furthermore, it is this nature that defines how, when, and which acts will be considered as an exchange or as a sequence, and not their physical order in interaction, as it is implied by the "adjacency pair" (Schegloff & Sacks, 1973), main unit of analysis in Conversational Analysis (CA). Interaction analysts take into consideration the fact that the acts that are connected in sequences may often be far apart, argue that the notion of pair betrays a CA bias toward two-party conversation, and emphasize that the units forming sequences are not turns, but actions (Kerbrat-Orecchioni, 2010). Furthermore, interaction analysis is always interpretative (Baker, 2010), meaning that its main goal is to describe interaction as it naturally occurs including in this description as many contextual factors as necessary to make such interaction meaningful.

Interaction analysis, being an approach and not a method itself, "borrows" characteristics and resources from other methods, such as CA, Discourse Analysis (DA), Pragmatics, and other theories that are considered relevant to the context of research. This is why some scholars adopt an "eclectic approach" towards it (Kerbrat-Orecchioni,

2010). Even so, there are some main assumptions that guide the present research following this paradigm, and they will be hereby summarized.

From an illocutionary to an interlocutionary logic. Speech acts (Austin, 1962; Searle, 1969) are not sufficient or adequate in order to understand a dialogue or conversation. In order to support his position, not explicitly stated as such in his early works, Trognon (2001) quotes Searle (1992) who himself seems to be aware of this limitation of speech act theory:

> in a dialogue or conversation, each speech act creates a space of possibilities or appropriate response speech acts. Just as a move in a game creates a space of possible and appropriate countermoves, so in a conversation, each speech act creates a space of possible and appropriate response speech acts. The beginnings of a theory of the conversational game might be a systematic attempt to account for how particular "moves", particular illocutionary acts, constrain the scope of possible appropriate responses. But when we investigate this approach, I believe we will see that we really do not get very far (p. 8).

From an illocutionary logic perspective, in which meaning is co-constructed with the Other, a more functional conceptualization of language acts is necessary. As Baker (2010) puts it, if the goal is to analyze collaboration, then the unit of analysis should not be the individual speech act; this is the smallest *monological* unit. Interaction analysts do not propose a "magic" list of new acts to replace the traditional ones; however, they do propose as a minimal level of analysis the *exchange* (Trognon, 2001; Baker, 2010), meaning that an interaction unit cannot be considered outside from its proximate discursive context. A similar approach is found in Clark & Carlson (1982), who propose informative acts as additional to the illocutionary acts:

> In our proposal, the speaker performs two types of illocutionary act with each utterance. One is the traditional kind, such as an assertion, promise, or apology; this is directed at the

> addressees. The other, called an informative, is directed at all the participants in the conversation-the addressees and third parties alike. It is intended to inform all of them jointly of the assertion, promise, or apology being directed at the addressees (p. 332, abstract)

Acts are necessary to define sequential structure. In hierarchical-functional models of conversation or discourse, the minimal unit of analysis is the *act* (Sinclair & Coulthard, 1975; Moeschler, 1989; Roulet, 1981; Roulet, Filletaz, & Grobet, 2001). Maintaining a "traditional" approach of speech acts, the consideration of the exchange as the minimal unit of analysis, as the Interaction analysts propose, is still necessary. However, if a new, more functional approach of acts is adopted, the one in which the Other's response is taken into consideration at the time of defining the act, the CA point of view can still be valid. Nonetheless, from an IA perspective, the nature of these acts needs to be cognitive, because "a speaker can never be sure to have been understood", thus "the speaker's intention should be mutual knowledge" (Trognon, 2001; p. 132). This is also the reason why the cognitive dimension plays a major role in the IA approach. It also has implications at the time of segmentation, as speech acts alone do not always contain all the propositional content that is communicated at the instance of interaction in which they are expressed, and utterances often include more content, in the sense of message units being communicated. We will return to this issue in detail in Chapter 5 (Method).

The importance of task. Interactions are finalized with the realization of tasks, imposed by the external to the participants. Therefore, interaction analysts propose, wherever it is possible, to complement the analysis of the interaction with an analysis of the task the participants are engaged in (this is why IA has been largely adopted by Cognitive Ergonomists, as it will be explained in the next section). The nature of tasks is

highly context-dependent, but it is always focused on a cognitive object (Gilly, Roux, & Trognon, 1999).

There is not only one way of analyzing interaction. As Baker (2010) explicitly puts is, "there is in fact, no unique object of scientific study called 'interaction' (…) if there is no unique phenomenon called 'interaction', there can be no unique methodology and method for studying it (…) new methods will have to be elaborated for achieving precisely this objective" (keynote speech quotation). This undoubted fact leads some interaction analysts to be "eclectic", in Kerbrat-Orecchioni's (2010) words, some others to invent their "own" methods, that finally belong to one or another approach such as CA or DA, and many to be encountered in the middle: always focusing on *interaction* as the main object of analysis, in contrast to other approaches, but considering various aspects on different dimensions.

One of the most recognized efforts of a systematic approach to analysing interactions is Baker's (1999, 2003, 2010b) dialogue analysis approach, which combines analyses along seven theoretically separate dimensions, namely: *dialectical*, *rhetorical*, *epistemological*, *discursive* ("conceptual" in Baker's early works), *dialogical* ("interactive" in his early works), *affective* (emotional), and *socio-relational*. In this approach, the argumentative dimension is also present and especially treated, and it is related either to the dialectical or the rhetorical dimension. An explanation of each one of these dimensions and how they have been hitherto treated in some of the most representative works will be hereby given.

The dialectical dimension. In task-oriented collaborative interaction, dialectical analysis more often refers to "negotiation" of the epistemic status of a cognitive object, e.g. a solution, than to "real" persuasion on a viewpoint. Or better said, persuasion may exist, but it refers to a task-related *thesis* or position, rather than to a pro or contra viewpoint. In any case, dialectical analysis has been shown to be a useful tool at the time

of analysing and guiding students' problem-solving interactions (e.g. Baker, 1996; Ravenscroft & Pilkington, 2000), as students' attitude changes, when they occur, seem to obey to rules of *dialogical rationality* (Baker, 2003). Such rationality is explained on the basis of dialectical moves, consisting of: a) the propositional content, and the attitude (pro/contra) towards such content, when it is made explicit; b) the speech act type, which defines if the proposition is interrogative, assertive, exclamative, or a "foul move" (Baker, 1999) such as the "Ipse dixisti!" (i.e. you already said it yourself!) defined by Barth & Krabbe (1982); and c) the pragmatic character of the move (M), referring to its function (e.g. "attack", "request", "concession", "defense", etc.) in respect to the debate. Figure 11 presents an example of a dialectical analysis applied to an interaction corpus.

N.	**Utterance**	**M**	**John**	**Mary**	**Pragmatic character**
180	There are several to be done. One there. Should another one be put there?	a	A		John's solution
181	Pprrrttt !	b		A?	Attack: how do you defend A?
182	You see it leaves from a reservoir and it comes back to a reservoir	c	B		Direct defense of A
183	It's true!?	d		B?	Attack: how do you defend B?
184	A reservoir to start and a reservoir to finish	e	B'		Defense of B
185	Have we got two batteries John?	f		C	Attack on B/B'
186	No!	g			Concession of C
187	Have we got two batteries!?	h		C'	Attack on B/B'
188	No	i			Concession of C
189	Then why do you talk nonsense!	j		GR!	Explicitation of dialectical outome: B refuted
190	What have we forgotten then?	k			Concession of dialectical outcome

FIGURE 11. EXAMPLE OF DIALECTICAL ANALYSIS BASED ON BAKER (2003) AND BAKER (IN PRESS). EXCERPT FROM BAKER (IN PRESS)

The rhetorical dimension. In task-oriented interactions, the term "rhetoric" refers to any *epistemic effect* that is produced as a result of an argumentative interaction. Baker (1999) defines "epistemic effect" as following:

> Epistemic effects are concerned with the status of representations from the point of view of individuals, their attitudes with respect to them – being in a state of knowing, believing, suspecting that something is the case, viewing it as plausible, certain, or as a defensible opinion, etc. In interactions, these attitudes can shift, or be revised (p. 189).

In students' collaborative interactions, three types of attitude shift have been hitherto identified and studied (Baker, 2003; Jermann & Dillenbourg, 2003): attitude weakening (the most frequent), attitude strengthening, and no attitude change. Figure 12 presents an example of attitude weakening (from "YES" to "NO").

T(m:s)	*L*	*Linda*	*Elaine*
			Statement 3: "Since the groups of A and B mol arrive towards the C mol, they make an impact with the tam"
		Attitudes before:	
		NO	**YES**
9:36	36	it was nice of you to have put yes to everything for me, but for the 3, I think that the "a" mol aren't in contact with the "c" mol	
14:40	37		of course they are, because if you have a wave all the molecules, like billiard balls, will be displaced because the hit on the tambourine it's as if we'd pushed them all the mols will mix up and hit on the tam no,
17:39	38	ah! after all perhaps you're right, but I ask myself whether they'll mix together as much as all that, don't you think that the "b" will create a barrier between the "a" and the "c"	
20:36	39		i don't know maybe i'm wrong so i'm going to chang[e] and after we change question to go onto the 6
		Attitudes after	
		NO	**NO**

FIGURE 12. AN EXAMPLE FOR ATTITUDE CHANGE FROM 'YES' TO 'NO'

(IN BAKER, 2003; P. 60)

The epistemological dimension. As it has already been made explicit, in collaborative interactions the epistemological dimension plays a major role, especially if it is about a complex cognitive problem. The following epistemological aspects have been hitherto taken into consideration (Baker, 1999): a) the *intrinsic properties of knowledge*, and more precisely whether it is *on-task* or *off-task* discourse (De Vries, Lund, & Baker, 2002; Weinberger & Fischer, 2006), and, in case it is on-task, whether it focuses on the

construction of problem space, the conceptual space, or relations between the two (Fischer, Bruhn, Gräsel, & Mandl, 2002), as in the case of concepts representing constraints (Baker et al., 2009); b) the *knowledge domain*, meaning a body of knowledge as possessed by a recognised social group of experts, and its *sub-domains*, for example eLearning design has three main knowledge sub-domains, namely Technology, Pedagogy, and Management/Organization (Jochems, van Merrienboer, & Koper, 2004; Seufert & Euler, 2004; Sangrà, Vlachopoulos, Cabrera, in press) and c) the *source of knowledge*, referring to whether it is *direct* or *indirect* (Pomerantz, 1984), and in the case of indirect if it "belongs" to other individuals (e.g. experts), teams, or also a whole institution.

The discursive dimension. In contrast to the other dimensions, not as much work has been proposed regarding the nature of collaborative discourse in task-oriented interactions. Apart from its characterizations at a general or macro-level –e.g. meaning negotiation (Baker, 1999; 2003), negotiative argumentation (Andriessen, Erkens, van de Laak, Peters, & Coirier, 2003), exploratory talk (Mercer, 2000) and so on– few efforts exist regarding how smaller discourse segments relate to each other in order to "produce" meaningful collaborative sequences. Baker's (1993, 1995) early efforts to combine rhetorical relations with his analysis of interactions have been abandoned, mainly because of difficulties in applying the predominant model of such relations, Rhetorical Structure Theory (Mann & Thompson, 1988), to *oral* interactions (instead of

texts that are the focus of this theory). The same difficulty has been faced by many researchers in Artificial Intelligence and Natural Language Processing who tried to apply rhetorical relations to agent communication (Chris Reed, personal communication, Chile, 7/10/2010). The present dissertation, focusing mainly on the discursive dimension of interaction, provides a solution to this problem, using a more recent model of discourse relations, the Connectivity model (Renkema, 2009), which seems to be very promising at the time of analyzing communication. We will return to this issue in Section 4.4.

The dialogical dimension. Moreover, knowledge co-elaboration processes have been described in terms of types of cognitive-linguistic operations, or ways of doing cognitive work with language exchanged in dialogue. Based on empirical works of Baker (1994, 2010b) and Mephu-Nguifo, Baker & Dillenbourg (1999), there are four main classes of such operations: a) generalisation—specialisation (exploring degree of generality of application of classes); b) additive—subtractive (conjoining, agglomerating or else subtracting propositions); c) foundational (arguments, justifications, verifications, explanations); and d) language-meaning based (repetitions, reformulations, negotiation of meaning). Subsequently, according to Baker (2010b), there are four types of dialogical thinking, namely: extensional, cumulative, foundational, and interpretative. Table 3 shows the main characteristics of each one of them.

TABLE 3. DIALOGICAL THINKING AND COGNITIVE LINGUISTIC OPERATORS (BAKER, 2010B; P. 59)

Dialogical thinking	Definition, cognitive-linguistic operators
Extensional	Generalizing or restricting scope, defining set inclusion of propositions; giving specific examples or instances
Cumulative	Conjoining, agglomerating, synthesizing, making inferences from propositions, exploring other alternatives (disjunction)
Foundational	Expressing (counter-)arguing, justifying, explaining, verifying
Interpretative	Repeating, reformulating, defining, negotiating meaning

The affective dimension. The affective dimension in task-oriented interaction has been mainly studied in terms of affective regulation regarding the tension-relaxation progress of interaction. On one hand, focus on the task and the (cognitive) diversity of participants are expected to create tension in interaction. On the other hand, such tension should be released during collaboration in order for "deeper" processes such as mutual learning and efficient problem solving to occur. However, studies in students' computer-supported interaction show that sometimes argumentation is deepened precisely because of a high degree of tension (Andriessen et al., in press). Nonetheless, the time needed to "take over" after a verbal conflict and until the re-establishment of a relaxed climate tends to "lag" behind the debate (Baker, 2010b). Apart from context-dependent differentiations, a general observation seems to emerge: the construction of a collaborative working relation that allows affective regulation is a necessary condition for collaboration (van der Puil & Andriessen, in press; Andriessen et al., in press), and it is related to cognitive regulation processes, such as dialogical thinking (Baker, 2010b). An

example of a tension-relaxation analysis, together with the emergent argumentation acts, is given on Figure 13.

N.	Speaker	Utterance	Argumentation	T/R
74	Betty	Which opinion?	Question	T: request
75	Carla	it's true that nature is the work of Madam super nature	Concession	R: concession T: sarcasm
76	Betty	oh oh that's so beautiful		T: sarcasm
77	Carla	that you are against but it would be good if you would still admit that if it worked then it would be beneficial for everybody	Argumentation	T: counterclaim

FIGURE 13. EXCERPT OF AFFECTIVE REGULATION (T/R) ANALYSIS OF ARGUMENTATIVE INTERACTIONS (ANDRIESSEN ET AL., IN PRESS)

The socio-relational dimension. The socio-relational dimension forms the basis of the affective dimension, and also, it can be said, of all other dimensions. As it was implied in the previous paragraph, without a collaborative working relation, no collaborative interaction can be meant. However, social relations should not only be considered from an affective perspective, especially in task-oriented interactions (maybe in other types of close relationships, the affective dimension is the most important). Not much interaction analysis empirical work has been done considering the *expression of power* and the emergence of *task-related roles*, which are two other important socio-relational aspects. On one hand, power refers to the participants' hierarchical status, usually related to their institutional position and role. On the other hand, emergent roles depend upon participants' actions, mainly the discursive ones (Baker, Détienne, Lund, &

Séjourné, 2003; Sonnenwald, 2006). What is interesting from a socio-cognitive analysis point of view is that emergent roles do not necessarily correspond to status roles. In asynchronous, on-line, task-oriented discussions, for example, it has been shown that in general prescribed roles predict participants' involvement in the interaction (Barcellini, Détienne, Burkhardt, & Sack, 2008). However, the way this is done may vary according to the context of interaction. For example, when on-line discussions get too task-oriented, they become quasi-synchronous, and time of reaction plays an important role for the participants' involvement in the interaction. The way power is expressed through task-related roles, e.g. through discourse, needs to be further investigated in synchronous, face-to-face interaction, especially in situations where expertise also plays an important role for the validation of opinions inside a team.

In this section, the main methodological and empirical extensions regarding Interaction analysis, on the basis of interlocutory logic as mainly proposed by Trognon (1999), were presented. Among them, two main conclusions can be drawn: no unique method exists to analyze interaction, and interaction can be approached through at least seven different perspectives, namely: *dialectical*, *rhetorical*, *epistemological*, *discursive*, *dialogical*, *affective*, and *socio-relational*. Our focus on the discursive dimension will be further founded in Sections 4.4 and 4.5. Before that, another field related to task-oriented interaction analysis, *Cognitive Ergonomics*, will be presented in Section 4.3.

4.3 COGNITIVE ERGONOMICS

Cognitive ergonomics, in the way they get approached by this research, form part of the Francophone Ergonomics Society, which follows this general methodological bottom-line, as explained in the web-site of SELF (Société d'Ergonomie de Langue Francaise):

> Throughout the years, Francophone Ergonomics has shown its specificity, insisting on the predominance of Ergonomic Work Analysis as a central method. In this context, laboratory studies have become, over the years, mostly accessory to field studies which are conducted in the actual workplace on real work and actual working conditions. Francophone ergonomists insist on the important differences between task, which they define as a rather theoretical representation by the organization of work to be done, and activity, which is the real, situated work as actually produced by the operators: to be able to intervene and improve the efficiency and comfort of the operator, Francophone ergonomists insist that one has to start with a fine description and understanding of the true activity of workers. Bottom-up approaches are therefore the core of Francophone ergonomics (Desnoyers & Daniellou, 1989; p.3).

According to the same authors, "the demand for ergonomic intervention deals more and more, at least in European countries, with cognitive activities" (p. 4), thus the emergence of the Cognitive Ergonomics as a separate methodological field is not surprising. The main theoretical foundation of Cognitive Ergonomics is closely related to Activity Theory (Green & Hoc, 1991). More precisely, the activity is seen as the interaction between a subject and a task, including the subject's conception of the task and the cognitive processes she performs in order to carry out the task. The basic unit of analysis is the situation, which is defined as a functional subject-task system (Hoc, 1988). The differentiation between task and activity, and the emergence of the second as the main

unit of analysis, is a need rather than an option regarding complex cognitive situations, such as design. The main reason for that is because task goals are usually ill-defined in situations like that; "the more remote a goal, the fewer the possibilities for anticipation, and the greater the necessity to define subgoals to regulate task accomplishment" (Hoc, 1988; p. 19).

Thus, as the focus of Cognitive Ergonomists is the *actual task*, or the activity participants are engaged in, the conception of such task is also of great importance. Two main distinctions, relevant to our study, can be made regarding conception: its *object*, i.e. whether it is focused on the task or the task domain; and its *nature*, i.e. whether it is individual or collective (the component parts of each distinction are not mutually exclusive, as the second components always pre-suppose the first). A brief presentation of each type of conception and its relation to design will be now given.

Task conception. Regarding the conception of the task, two things need to be considered: the specific activity object constituting the cognitive task at the moment of conceptualization. Each task has its own cognitive objects. It can be said that, in general, all design situations treat the following objects (Newell & Simon, 1972; Darses et al., 2001): a) *problems*, referring to the situations that need to be resolved; b) *solutions*, referring to concrete actions or concepts that potentially form part of the final artifact; c) *goals*, referring to general requirements or vision(s) regarding the final artifact and its use; d) *methods*, referring to plans of action leading to a goal satisfaction; e) *domain objects*, referring to any artifact, resource, or task domain concept that serves as *intermediary object* (Jeantet, 1998); f) *domain rules*, referring to existing institutional or task domain related procedures or constraints; and g) *tasks*, when the focus of the cognitive activity is the task itself, e.g. actions' co-ordination, meeting management etc.

Task domain conception. On the other hand, the concept of task domain is broader than that of the task, as it consists of "an organized set of objects, the property descriptors of these objects, and the operations performed on these objects" (Hoc, 1988; p. 22-23). There are two main levels of task domain description: the "epistemologically adequate", which are the lowest and the most constrained, and the "heuristically adequate", which are the highest and the most schematic (Hoc, 1988). More precisely, "the lowest levels integrate more strategic or detailed information for implementing concrete actions" (p. 24). Whereas the upper level refers to the conceptual field as a whole, meaning a well-systemized network of concepts and relations expressed with a specific technical vocabulary or "lexicon" in Clark's (1996) terms.

Individual conception. Individual conception refers to the specific type of representation through which the object is conceived by a specific person. This representation is externalized in form of contributions, reflecting the representational state of the conceiver. In design, representational activities are mainly of three types (Visser, 2006, 2006b): a) *generation*, referring to the construction of "new" representations, meaning those whose main source is one's memory; b) *transformation*, meaning any type of activity aiming at transforming a representation into a slightly or totally different version; and c) *evaluation*, when some type of assessment of a representation takes place. In combination with their objects, such representations form the basic acts upon which activities are constructed, for example, solution generation, goal transformation, problem evaluation, and so on.

Collective conception. According to Visser (2002, 2003), collective conception can take two forms: a) *co-conception*, referring to the situation in which the conceivers work together on a conception project, sharing the same goal, and contributing to this goal according to their specific competences (note that this definition is very similar, if not identical, to our view of 'collaboration' described in Section 1.1); and b) *distributed*

conception, referring to situations in which the conceivers work in parallel but not jointly, meaning that each one accomplishes with one task, forming part of the common task (note that this definition is very similar to our view of 'co-operation' described in Section 1.1). In the case of co-conception, two additional tasks-activities, apart from the task conceptualization, are observed: a) actions' coordination, through which time and actions are distributed (in French, *synchronization temporo-opératoire*); and b) cognitive synchronization, which aims at establishing a context of mutual knowledge, at building a common operative system of reference (Darses et al., 2001).

4.4 DISCOURSE RELATIONS

"Why are you drinking?" Demanded the little prince.
"So that I may forget," replied the tippler.
"Forget what?" Inquired the little prince, who already felt sorry for him.
"Forget that I am ashamed," the tippler confessed, hanging his head.
"Ashamed of what?" Insisted the little prince, who wanted to help him.
"Ashamed of drinking!"

—ANTOINE DE SAINT-EXUPÉRY, *the little prince*

A classical model of discourse analysis that describes relations among segments of discourse is that of Rhetorical Structure Theory (RST). The linguistic paradigm behind RST is that of Pragmatics, as "it considers analyses of texts to crucially involve an account of the interaction between writers and readers" (Thompson & Mann, 1987; 79). The focal concept in RST is that of *relational structure*, in contrast to other types of rhetorical structures such as the "holistic" or the "syntactic" (Mann, Matthiessen, & Thompson, 1989). Such relational structure is defined on the basis of three kinds of information: a characterization of the nucleus, a characterization of the satellite, and a characterization of the rhetorical interactions between the nucleus and the satellite (Thompson & Mann, 1987).

In RST, most of the hitherto identified relations are of the type nucleus-satellite; this means that one part of the text (satellite) needs the other (nucleus) in order to be understood, whereas the contrary is not the case. This relation can also be of the reversed version (satellite-nucleus), meaning that the "dependent" part comes before the "independent". Finally, it is also possible that no-satellite or multi-nuclear relations exist.

This classification is essential for the identification of the type of a relation. In addition, other classifications and/or modifications are possible according to the use of the relations and the focus of the analysis. A well-known classification is the distinction among subject matter and presentational relations, proposed by Mann & Thompson (1988). As they state:

> Subject matter relations are those whose intended effect is that the reader recognizes the relation in question; presentational relations are those whose intended effect is to increase some inclination in the reader, such as the desire to act or the degree of positive regard for, belief in, or acceptance of the nucleus (p. 257).

Table 4 presents a relation classification on the subject matter/presentational basis.

TABLE 4. SUBJECT MATTER AND PRESENTATIONAL RELATIONS (MANN & THOMPSON, 1988)

Subject matter		Presentational
Elaboration	Otherwise	Motivation
Circumstance	Interpretation	Antithesis
Solutionhood	Evaluation	Background
Volitional cause/result	Restatement	Enablement
Non-volitional cause/result	Summary	Evidence
Purpose	Sequence	Justify
Condition	Contrast	Concession

This distinction has formed the basis of criticism against RST for Moore & Pollack (1992), who claim that "discourse elements are related *simultaneously* on multiple levels" (p. 537). The *informational* (subject matter) and *intentional* (presentational) levels are two possibilities. However, the exclusive classification of a relation to only one of these levels, as Mann & Thompson (1988) propose, is impossible because "the purpose of all discourse is, ultimately, to affect a change in the mental state of the hearer" (Moore & Pollack, 1992; p. 539). In this sense, all discourse relations are finally presentational.

On the other hand, a recent discourse relational model, with many references to RST, has been proposed by Renkema (2009). The so-called Connectivity model consists of three levels of relations, namely Conjunction, linking *form to form*, Adjunction, linking *information to information*, and Interjunction, linking *addresser to addressee*. These levels are hierarchical, in the sense that relations belonging to one type also belong to the previous type(s). As a consequence, all interjunction relations are also of the adjunction type, but the contrary is not the case. Thus, an idea of clearly separated types of relations is also present in Renkema (2009) as in Mann & Thompson (1988). However, adjunction relations do not directly correspond to the subject matter relations, neither interjunction to presentational relations.

In fact, another contribution of Connectivity model lies on the classification of relations according to their communicative function. In this sense, Connectivity model is a functional, discourse analysis model, applicable to every communicative situation, including oral discourse. The communicative function of discourse relations was also intrinsic in RST. Mann, Mathiessen, & Thompson (1989) state that "in our research in discourse analysis, we aim to contribute to an account of how language can be used to communicate, i.e. a detailed description of how it contributes to the outcomes of interaction" (p. 1). However, RST has not yet been adapted to study oral interaction, apart from some isolated, but remarkable, efforts (e.g. Taboada, 2004). It seems that such application might be more possible with the Connectivity model of discourse relations. We will briefly explain our reasons for this statement.

First of all, all discourse relations included in the Connectivity models answer the questions of an imagined (in the case of written text) or physical (in the case of oral) addressee. These questions not only define the type of relations, but also their segmentation: a new segment-relation begins at the time a new question is possible to be done. This defines some kind of functional propositional content as the nature of

discourse relations, which is very related to a communication approach. Secondly, adjunction relations are classified into three big categories (elaboration, extension, and enhancement), which also correspond to the conversational acts of "elaborate", "extend", and "enhance" (Eggins & Slade, 2004). This makes us think that even the more informational relations also have some communicative function (as Moore and Pollack had suggested). Finally, the interjunction relations are not only characterized as the more intentional ones, but they are also divided into three levels, according to their communicative function. Following Bühler's (1934/1990) tripartite "Organon" model of communication, interjunction relations are classified into: *expressing*, or symptom-based, *processing*, or symbol-based, and *impressing*, or signal-based.

Table 5 presents the adjunction and interjunction levels and types of discourse relations proposed by the Connectivity model.

TABLE 5. ADJUNCTION AND INTERJUNCTION DISCOURSE RELATIONS (RENKEMA, 2009)

Adjunction	**Interjunction**
Elaboration	*Expressing*
Quality/ quantity specification	Presentation Comment
Extension	*Processing*
Sequence Contrast Disjunction	Explanation Metatext Attribution
Enhancement	*Impressing*
Place Time Manner Causation	Attention Acceptance (Justification) Action (Motivation)

Apart from its clear communicative functionality, the Connectivity model also provides a more evident relation to the identification of arguments. Previously, few studies have been proposed regarding the connection of RST to argumentation. Azar (1999), for example, claims that five of the RST's rhetorical relations (Evidence, Justify, Motivation, Antithesis and Concession) can be characterized as *argument relations*. He defines argument relations as "the relationship that exists between two parts of a monologue, one being an argument (i.e., a supportive or a persuader), the other a conclusion (i.e., a prescribed action or an assertion)" (p. 99). He also further identifies *antithesis* and *concession* as argument relations of "the persuader type". More recent work (Green, 2010) further enlightens the connection of rhetorical relations to argumentation, by proposing RST as a tool for reconstructing enthymematic arguments.

In our point of view, discourse relations provide a useful framework for the analysis of interaction from a discursive point of view, due to the flexibility of analysis, as it is a bottom-up approach, and to the possibility of relating discourse segments at various levels, which is also a "must" for Interaction analysis. At the same time, argument identification in naturally emergent discourse is not an easy job, as most of the arguments are *enthymematic* (Walton, 1983; Hitchcock, 1985), and "jumping" from one topic to another, very common in team design as we saw in Chapter 2, also implies jumping from one argument to another, or leaving an argument incomplete and return to it later on. Thus, we believe that the identification and analysis of discourse relations can be a useful tool for both discourse analysis (e.g. Taboada & Mann, 2006) and argument analysis (e.g. Azar, 1999; Green, 2010).

In this section, some basic methodological aspects regarding two discourse relations models, RST and Connectivity model, were presented. Without pretending to do a

discourse analysis ourselves – something like that would be out of our competences – we will use some of the relations' characteristics for the analysis of team design communication, and more precisely, for the identification of the emergent arguments. These issues will be further explained in Chapter 5, where our whole methodological proposal is presented. Before that, some main ideas regarding the "father" of modern Argumentation theories, *Informal Logic*, will be presented in the following section.

4.5 INFORMAL LOGIC

"This logic doesn't really help me much in my daily life".
I said, "that's right, nor was it meant to".
They said, "so, where do we go?"
I said, "I don't know".

—RALPH JOHNSON, 2000

Informal Logic emerged as a response to the Formal Deductive Logic (FDL) in the early 70's with Kahane's famous text "Logic and Contemporary Rhetoric" (1971). In the beginning lines of this text, the main problem regarding FDL as taught in Universities is stated: "Today's students demand a marriage of theory and practice. That is why so many of them judge introductory courses on logic, fallacy, and even rhetoric not relevant to their interests" (quoted by Johnson, 2000; p. 3).

The main distinction between Informal Logic and FDL regards the arguments that are considered valid. For FDL, there is only one type of (good) argument: the one that is deductively valid, i.e. whose premises entail the conclusion. However, in Informal Logic at least three types of arguments can be valid, or, better said, sound, namely: deductive, inductive, and plausible or abductive arguments (Walton, 1989; Walton, 2011b). Table 6 presents an everyday reasoning example for each one of those, as first provided by Walton (1989, p. 14-15).

Given the fact that most of the everyday arguments belong to one of these three macro-types, and more frequently to the inductive or plausible argument type, Informal Logic seems the most appropriate paradigm at the time of identifying and evaluating them.

TABLE 6. MAIN TYPES OF VALID INFORMAL LOGIC ARGUMENTS
(IN WALTON, 1989, P. 14-15)

Deductively valid argument
Every person who does a good job should get regular pay that reflects the value of his work. Alice is a person who does a good job. Therefore, Alice should get regular pay that reflects the value of her work.
Inductively valid argument
Most people who do a good job should get regular pay that reflects the value of their work. Alice is a person who does a good job. Therefore, Alice should get regular pay that reflects the value of her work.
Plausible argument
It is widely accepted that people who do a good job should get regular pay that reflects the value of their work. Alice is a person who does a good job. Therefore, Alice should get regular pay that reflects the value of her work.

In addition to that, Govier (1987) underlines another reason for the adoption of Informal Logic perspective. In her words,

> real arguments in natural language are not amenable to fully precise treatment. They deal with topics of controversy, disputed facts, plausible hypotheses, approximately correct analogies. To evaluate them, we must sort out ambiguities, see how diverse factors fit together, weigh pros and cons, consider the credibility of those on whom we may depend for credibility and expertise (p. 5).

Thus, for Informal Logicians, a Theory of argument is subdivided into a Theory of analysis, concerning the discursive elements that become the components of the argument, and a Theory of appraisal, regarding the task of coming up with standards, criteria, and type of argument evaluation (Johnson, 2000).

Given the lack of "one and for all" univocal theory of argument, a difficulty in defining what an argument is, is more than evident in the relevant literature. Nonetheless, a place of consensus among the different scholars seems to be the distinction between

"arguments-as-products" and "arguments-as-processes" (Habermas, 1984; Johnson, 2000; Reed & Walton, 2003) based on the primary distinction proposed by O'Keefe (1977) between *type1* and *type2* arguments. Also, many authors refer to the former as arguments, and to the latter as argumentation. However put, the main idea is basically the same; that arguments can and should be defined both semantically, as propositional structures, and pragmatically, as dialogical practices. However, this distinction is not as straightforward, as structural and pragmatic elements interweave. In Freeman's (1991) words,

> Argument is the attempt to convince a skeptical but rational judge of the rightness or rational acceptability of a claim (…) Surely, not all arguments as a matter of fact originate in dialogues between a proponent and a challenger playing just the roles assigned to them in a basic dialectical situation. Many arguments may simply be conceived as monologues, as developing a series of reasons supporting some conclusions (p. 21).

As we already said, one of the major issues in the study of informal arguments is their identification and analysis. Regarding arguments as sets of propositions (Walton, 1982; Plantin, 1996), the existence and relation of at least two premises with at least one conclusion is necessary. Of the two premises, usually one has the function of supporting evidence, *datum* in Toulmin's terms (1958), and the other is a defeasible inference law between the datum and the claim-conclusion, *warrant* in Toulmin's terms. In everyday argument, it is possible that only one premise is made explicit and the other is not, what is also the case for *enthymematic arguments*, as we already explained in the previous section. It is also possible that both premises are missing or even the conclusion (Walton & Reed, 2005). In this case, a restructuration of the argument is necessary in order to decide for its soundness – the Informal logic correspondent for FDL validity. This latter is always decided upon the relevance of the premise(s), following the macro-rule expressed by Freeman (1993) as following:

> If either the truth of a premise increases the likelihood that the conclusion will be true or the falsity of the premise increases the likelihood that the conclusion is false, then the premise is relevant to the conclusion. If neither of these conditions holds, then the premise is not relevant (p. 199).

Yet, relevance is not the only criterion for deciding upon an argument's soundness. Sufficiency and acceptability are also necessary (Johnson & Blair, 1996). In fact, another "problem" in identifying and evaluating arguments has to do with their sufficiency. This problem is mostly encountered in relation to the so-called defeasible arguments, which include abductive and plausible types of inference. According to Walton, Reed, & Macagno (2008), "a defeasible argument is the one in which the conclusion can be accepted tentatively in relation to the evidence known so far in a case, but may need to be retracted as new evidence comes in" (p. 2). And they continue:

> The reason that the notion of sufficiency is up for debate is that the main types of schemes important for the study of everyday argumentation are nonmonotonic. This means that the argument fitting the scheme always needs to be seen as subject to defeat as new premises are added by new information that becomes relevant (…) In other words, such an argument is cogent only in the sense that it provides sufficient evidence to accept the conclusion at some particular point in an investigation that may later lead to the rejection of this conclusion (p. 34).

In other words, the identification of argumentation schemes, i.e. structures of inference that represent common types of arguments in everyday conversation, is an important aspect of argument analysis and evaluation, even though their appearance in dialogue may be instantaneous, in the sense that they are sufficient only at the time of their structure expression. Based on this assumption, in this dissertation we speak of argument structures in order to refer to these discourse products that fit the structure of at least one known argumentation scheme.

Last but not least, acceptability of both the premises and the conclusion is a very important aspect of argument identification and evaluation, especially in a dialogical context. We could grossly say that from an argument identification perspective, at least one of the premises or conclusions or both should be questionable, e.g. akin to be submitted to critical questioning. On the other hand, the degree to which the arguer is able to respond to the critical questions defines the degree to which her argument should be more or less accepted. In a dialogue context, each time an argument is opened to be questioned, it shifts the burden of proof to the opponent. The way critical questions are treated is decisive on whether the burden of proof "stays" with the opponent or "goes back" to the proponent. An argument is good when it is accepted as "proof-burdened". For an extensive discussion on burden of proof see Walton (1988).

However, as a dialectical analysis and evaluation of arguments' acceptability goes beyond the needs of this research, we will be limited to identifying whether an argument is "dialectically tiered" (Johnson, 2000) to at least another argument, put forward by another speaker, in order to form a (dialogical) argumentation sequence. The study of argument as a process of putting forward arguments on the same issue in order to get to a consensus regarding this issue is mainly expressed though the pragma-dialectical approach, a brief account of which is given by Houtlosser (2002):

> A pragma-dialectical analysis starts from the assumption that argumentative discourse is basically aimed at resolving a difference of opinion. The pragma-dialectical model of critical discussion, which serves as a theoretical point of departure, specifies the course of the resolution process, its stages, and the types of speech acts instrumental in the various stages. The model is a heuristic tool for the analytic reconstruction of the speech acts that are relevant to the resolution of the difference; it is also an evaluative tool for a critical assessment of the discourse. The analysis results in an analytic overview that sums up which points of view are –explicitly or implicitly– put forward, which arguments are

> advanced, what kinds of argument schemes are employed, and what the structure of the argumentation is (p. 169).

The main focus of a pragma-dialectical analysis is the critical discussion type of persuasion dialogue. During this dialogue, four stages of discussion are possible to occur (or better said should normatively occur): a) the *confrontation stage*, in which a dispute is externalized; b) the *opening stage*, in which the parties decide to conduct an argumentative discussion; c) the *argumentation stage*, i.e. the advancing of argumentation and the reaction(s) to it; and d) the *closing stage*, determining how the discussion ends. Throughout these stages, participants express their commitments through "points of view" or "standpoints", and by establishing their dialectical roles, as there should always be a *protagonist* and an *antagonist* (van Eemeren & Grootendorst, 1984).

Pragma-dialectical analysis, however useful for many contexts, appears to be insufficient, or even irrelevant, regarding our research goal and context. The reasons for that are several. First of all, we believe, together with other scholars from various fields (e.g. Canary et al., 1995, in Communication; Baker, 2003, in Computer Supported Collaborative Learning; Sampson & Clark, 2008, in Science Education) that argumentation exists also in a co-operative manner. This means that although conflicts may *prompt* argument (Trapp, 1989), they are not necessary for an argumentation dialogue to occur. As it was already implied in the Introduction, argumentation in task-oriented interactions can have other functions rather than persuasion, such as negotiation of meanings, objects, and tasks. Secondly, a dialectical analysis of argumentation offers information only regarding the dialectical level of interaction; however, as we already explained in section 4.2, interaction has at least other six levels other than the dialectical. Thirdly, we believe that a discursive approach of interaction analysis, and subsequently of argumentation analysis, can lead to a more detailed and descriptive account of how argumentation sequences actually occur. As Brashers, Adkins

& Meyers (1994) put it, group argumentation is an interactional practice "constructed and maintained in interaction, and guided perhaps by different rules and norms than those that govern the practice of ideal or rational argument" (p. 267).

In the present study, we only treat arguments-as-products, keeping in mind, though, that these arguments are dialectical manifestations of an on-going practice (Johnson, 2000). Sequences will only be defined at a dialogical level, without getting in detail into the dialectical dimension of interaction. Our focus, as we already said in Section 1.3, is on *talk-in-interaction*, thus the communicative functions of discourse have the predominant place in our analysis. Our complete methodological approach and its connections to the theoretical baselines presented in this Chapter will be presented in continuation.

5. METHOD

As it can be concluded from the previous chapters, task-oriented interaction is a "special" type of inter-personal communication, because of the double importance of both the task and the communication about the task. Comparing to other forms of group communication, e.g. family communication, interaction oriented towards complex tasks, such as problem solving, calls for an analysis approach akin to grasp both the object and content of communication, and their inter-dependence. As Nonnon (1996) puts is:

> we should thus come up with a double analysis: an analysis in terms of logical-discursive operations on the elaboration of objects of discourse, viewpoints, epistemic modalities and their transformation, and another one in terms of procedures and regulations, which get established during this work on the contents of discourse (p.85; original in French, translated by the author)

To build such a method, we use the following "lessons learnt" from theoretical approaches and empirical studies:

- Communication structures are dual structures: they are both formed by and influence on group processes.
- The nature of the task highly determines the type of interaction, but why and how specific processes arise is context-dependent.
- Institutional roles are important, but in combination to the specific interaction-related emerging behaviors of the team members.

Having these assumptions in mind, our general research questions made explicit in Chapter 3 become more specific, as following:

1. Is there a relationship between the design and the communication *process*, during eLearning team design, in terms of:
   a) pre-defined activities?
   b) the structure of the manifestation of these activities?

2. What is the *structure* of an eLearning design meeting?
   a) Are there any patterns of design and communication activities serving the same team design goal?
   b) Are these patterns case-dependent, or can we speak of some generic activities characterizing eLearning team design?
3. What type of *content* is produced?
   a) in terms of task-oriented acts and conceptual viewpoints?
   b) in terms of constraints, requirements, and proposals?
   c) in terms of design-related arguments?
4. What task-oriented *roles* do emerge?
   a) in terms of participants performing certain design acts?
   b) in terms of participants performing certain communication acts?
   c) in terms of participants performing certain argument acts?

Depending on the nature of these questions, the method applied is qualitative, and the approach followed is that of Interaction analysis, as described in Section 4.2, mixed with methodological proposals coming from the fields of Cognitive Ergonomics, Discourse Analysis, and Informal Logic. More precisely, we analyze the

verbal taking place during eLearning design meetings, trying to understand its double relation with the task of design and the task of communication.

Our methodological design is that of a *multiple case study*, following an exploratory-descriptive approach, rather than an explanatory, as it will be further explained later on this chapter. Moreover, the lack of studies in the particular context (eLearning team design) renders the formulations of hypotheses difficult, if not impossible. As an alternative, we followed two main guidelines, at the time of fine-graining the research questions previously mentioned. Firstly, the inclusion of all four main components of any observational analysis, namely (McGrath & Altermatt (2001): *what, how, who*, and *where* (in the case of interaction analysis where can also refer to the structure of it, i.e. *where in the process*). And secondly, the consideration of the main team design communication components as emerged from the literature review (Chapter 2), namely: patterns-structure, strategic content, and emerging roles.

At this point, a clarification is necessary regarding the first research question. In our research, process is treated as the manifestation of a number of pre-defined dimensions, which reflect certain theoretical constructs considered relevant for our main research goal (to inform back the design practice-practitioners). Each one of these dimensions has a pre-defined number of coding categories, on the basis of which we describe what is happening at both a design and a communication level. In order to describe either the design or the communication process, we are interested in the relation of the different manifestations of the various design or communication categories among them *in space* (meaning following one another) and in *relation to a specific goal* (in order for any task-oriented activity to be meaningful, goal is a necessary component, as we already expressed several times throughout this dissertation). Time itself in terms of meeting minutes or ID number of meeting (first, second, third. etc.) is not relevant for our research, because the observed process is not linear, giving each meeting a degree of independency, and also because of the several and different

types of issues discussed in a meeting, giving each team design episode (a term explained later on) a degree of independency.

The construction of a coding scheme to treat interaction data is an essential part of most interaction analysis studies (see Chapter 4), as it allows for taking into consideration of several dimensions for one interaction unit. This approach is very relevant when no specific research hypotheses are formulated a priori, because it allows for the emergence of various elements or events, the type of which was not pre-conceived by the analyst at the time of constructing the coding scheme. In other words, the same codified data can serve to answer different research questions, not necessarily the ones upon which the scheme was initially constructed.

Having said that, a great part of this chapter is dedicated to explain the theoretical constructs (section 5.1), coding dimensions and categories (section 5.2) used in this research. Right after, data collection and their preparation for analysis are described (section 5.3), to be followed by further explanations regarding the function(ality) of the coding process proposed (section 5.4).

5.1 THEORETICAL CONSTRUCTS

> A concept is a word that expresses an abstraction formed by generalization from particulars. A construct is a concept. It has the added meaning, however, of having been deliberately and consciously invented or adopted for a special scientific purpose.
>
> —KERLINGER, 1973

In this section, the role of theoretical constructs in this research will be shortly explained. In general, theoretical constructs are very relevant for our understanding of important phenomena (Wortman, 1994). However, their distinction from variables is not always evident. Hull (1943), for example, does not differentiate them at all. He defines the term "intervening variables" as equal to the ones of "symbolic constructs" and "hypothetical entities". On the other hand, authors such as MacCorquodale & Meehl (1948) do make the distinction between intervening variables and constructs, and they further define the notion of "hypothetical constructs". This term applies for those theoretical concepts "which do *not* meet the requirements for intervening variables in the strict sense. That is to say, these constructs involve terms which are not wholly reducible to empirical terms; they refer to processes or entities that are not directly observed" (p. 104).

In the present research, we opt for the term *theoretical constructs* instead of intervening variables, for the reason described above. On the other hand, we do not define our constructs as hypothetical, because we assume that they are constructed on the basis of the coding dimensions proposed later on. Said differently, the variables we chose to describe and analyze interaction form part of our coding scheme, and their interpretation forms the base of the theoretical constructs, most adequate to respond

to our research questions. Before we go on with describing the theoretical constructs of this research, some general considerations regarding the reliability and validity of a coding scheme will be now presented.

Generally speaking, "*reliability* is the extent to which a measurement procedure yields the same answer however and whenever it is carried out" (Kirk & Miller, 1986; p. 19). According to Krippendorff (1980), there are three types of reliability in qualitative research: a) *stability*, which can be tested by having a single coder code the same data at different times; b) *reproducibility*, which can be tested by comparing the results obtained by several coders; and c) *accuracy*, which can be tested by comparing the codings obtained by several coders to an existing standard, if such standard exists. As Carletta et al. (1997) remark, "where the standard is the coding of the scheme's 'expert' developer, the test simply shows how well the coding instructions fit the developer's intention" (p. 24). Nonetheless, in dialogue coding, this "simple" fitting between the developer's intention and other "blind" coders' interpretations is the only way of judging if a coding category "really" corresponds to what it is supposed to correspond. The most known measure of inter-rater reliability for category classifications is Cohen's Kappa (K) coefficient (Siegel & Castellan, 1988). K measures pairwise agreement among a set of coders making category judgments, correcting for chance expected agreement.

On the other hand, *validity* refers to "the extent to which it [measurement procedure] gives the correct answer" (Kirk & Miller, 1986; p. 19). In qualitative research, this is loosely interpreted as whether the measurement "truly" measures what it is supposed to measure. Regarding coding procedures, the type of validity that interests the most is the so-called *construct validity*, meaning "the quality of the relationships between an observation and the element of a model that represents such observations" (Kirk & Miller, 1986; p. 80). The issue of construct validity, and subsequently, coding validation, is quite problematic, regarding various aspects. Some of them, applicable

to small group interaction coding systems, are (Trujillo, 1986): the philosophical focus, the conceptual focus, and the operational focus.

The philosophical focus refers to the researcher's view on the theoretical and methodological status of a coding system. According to Poole & Folger (1978), three philosophical perspectives can be adopted in studying interaction: a) the *experienced perspective*, in which constructs "are concerned solely with explaining interaction in terms of categories as they are specified by the observer and the observer's theory" (p. 6). This approach is consistent to the more recent interaction analysis applications, in which the role of a coding scheme is that of interpreting rather than analyzing (Baker, 2010); b) the *experiencing perspective*, in which "theoretical terms are social constructs that are either part of a culturally shared set of meanings or established through implicit or explicit negotiations among interactants" (Poole & Folger, 1978; p. 8). This idea is more applicable regarding the nature of categories, as we will explain in Section 5.4; and c) the *experiencer perspective*, in which interaction is a product of individual interpretations of given utterances (Trujillo, 1986); this again is applied to the coding categories, rather than the theoretical constructs behind them. In the present research, the *experienced* perspective is applied in order to define theoretical constructs, whereas all three perspectives are mutually taken into consideration at the time of defining the conceptual quality of the coding categories and their units of analysis.

As far as the conceptual and ontological focus is concerned, the former refers to the conceptual quality of the definition of the categories, whereas the latter to the (multi)functionality of the coding system. But we will return to these issues later on in this chapter.

What follows in this section focuses on the theoretical constructs, which emerge, through both the literature and our dataset, as relevant to the quality of team design communication. We define six of them: *design co-construction*, *dialogicality*, *deliberativeness*, *design-related arguments*, *user experience*, and *intermediary representations*. The first three refer

to qualities, or processional aspects of interaction, whereas the latter three refer to manifestations, or interactional outputs. Both types share the following characteristic that renders them theoretical constructs in this research: they cannot be directly identified in relation to one interaction unit; their manifestation is result of the co-action of more than one actors, and even so, their ontological entity cannot be limited to any (combination of) coding category (-ies). However, their strong relation to the coding dimensions is necessary to, at least theoretically, validate their proposal.

5.1.1 DESIGN CO-CONSTRUCTION

As we already touched in Chapter 1, an interaction is constructive either when it serves a communication goal, or when it leads to the construction of a concrete (cognitive) object (Baker, 1999). With the term design construction, we mean those processes that fulfill some type of design (thinking) function, either as acts or as activities (see Section 2.4). Both acts and activities are focused on a design object, which as we already saw, can be one of the following (Newell & Simon, 1972; Darses et al., 2001): *problem, solution, goal, method, domain object, rule*, or *task*. Acts' focus is more objective, usually derived from certain linguistic forms or common sense inferences, whereas activities' focus needs a greater degree of observer inference, as it is based on several acts, not always focusing on the same object.

From a Cognitive Psychology point of view, both acts and activities are representational. Moreover, seeing design as process of (co-)construction of representations (Visser, 2006), the following types of acts and activities are possible: *generation, transformation*, and *evaluation* (see Section 4.3). It is worth noting here that the distinction between acts and activities is not made explicit in the original proposal by Visser (2006b); instead, the term "activity" is used to refer to both the individual and the team levels. However, in our adaptation of Visser's proposal, we do make the distinction between "act" level and "activity" level, the first referring to an elementary dialogue act unit (as we shall explain later on in this chapter), and the second to a set of at least two different types of acts on the same object. Acts follow one another in a continuous and dynamic way and whether they form activities or not depends either on their power to provoke some kind of *reaction* onto another speaker (in this case activities are inter-personal), either on their performer's *insistence* on going on with enrolling her representations. We use the term "insistence" to anticipate the fact that in-interaction representation construction acts, from now on "representational acts", always express some type of intention. However, such

intention can be either limited to the semantic-cognitive level, or form part of a dialogue act (addresser-addresse level).

Before going on explaining what *co-construction* is, let us first explain what *design construction* refers to in an interaction context. In other words, when can we say that design knowledge is constructed? In his article "Connectivism: a learning theory for the Digital Age", and also later on, George Siemens (2005) argues that an information becomes knowledge when it connects to other information. Expanding his definition, information is represented into knowledge elements, meaning concepts or relations (Akin, 1986), which connect to each other as part of the same cognitive object. Such connections are reflected in discourse and they are mainly expressed through *transformation acts*, meaning that the representational content of an act connects to the representational content of another act, in one of the following ways (Visser, 2006; p. 194): a) *duplicate*, that is, replicate or reformulate r_i; b) *add*, that is, introduce new information or "small alterations" into r_i; c) *detail*, that is, break up r_i into components r_{i1} to r_{in}; d) *concretize,* that is, transform r_i into r_i' which represents r_i from a more concrete perspective; e) *modify,* that is, transform r_i into another version r_i', neither detailing, nor concretizing it; f) *revolutionize*, that is, replace r_i by an alternative representation r_j , neither detailing, nor concretizing it.

Of course these acts, being situated in a collaborative design setting, do not only have a cognitive function. Communicative functions are also inherent in most cases. However, treating them only at a representation level, the main assumption we can make regarding these acts' implicit or implied (depending on whether the message or its expression comes first) communicative function is whether the representational content expressed in one speaker's act is *directly connected* to that of another's. By *directly connected,* we mean something different than simply referred to, even if this reference is oriented towards mutual understanding and acceptance (Clark & Wilkes-Gibbs, 1986). Also, it is more than what it can be generally defined as speech coherence, which, in our view, refers to internal connections at a semantic or metaphor level.

Being directly connected at a cognitive level, means that a representation is constructed upon another, previously made explicit, representation. Such "construction upon" is quite easy, yet not evident, to understand in the case of transformation acts, as we previously described. It is far less evident to decide whether a generation or evaluation act is product of co-construction.

From a socio-cognitive interaction analysis point of view, cognitions and representations emerge *through* and *from* interaction (Gilly, 1995). Based on Trognon (1991), Sorsana & Musiol (2005) claim that:

> Nowadays, two versions of the thesis that 'interaction constitutes the matrix of cognitions' can be pointed out:
> - the 'weak' version, which considers interaction as 'a medium' from which cognitions emerge. Interaction here is a catalyst or a mediator between individuals and the knowledge they have to obtain or internalize (…)
> - the 'strong' version, which assumes that the emergence of cognitions is realized within the unfolding of interaction. Here again, there are two possible ways to account for the way in which the unfolding of interaction actually works:
> - sometimes, the unfolding of interaction Is said to play its role statically: this refers to conceptions in which interaction is perceived as (a) partners' 'content of processes of thought' or (b) 'material for these processes of thought' or (c) 'models of these processes which can be internalized by individuals'
> - the other point of view consists in arguing that the unfolding of interaction plays its role dynamically, when the researcher considers that individuals who are interacting actually co-produce cognitions: each partner helps the other to 'deliver' his (her) own cognition; or they fully co-produce cognitions, so that the new cognitions become irreducible to the mere sum of individual ones (p. 170).

In our research, we treat knowledge construction in this last sense, in which cognition is either "helped" to be made explicit, or it is "co-produced". Taking for granted that all content being expressed in interaction is in one way or another elicited through the act of interacting, by design co-construction we mean only the explicit ways in

which design knowledge expressed by one person is transformed, re-used, or assessed by another person. Of course, such transformation can also take place at an individual level, within a short or –sometimes– longer sequence of acts, as part of a knowledge-oriented monologue. In this case, whereas there is design construction, we cannot speak of co-construction, according to the meaning of the term adopted in this dissertation.

To conclude, design co-construction refers to the process of transforming or evaluating the design content made explicit for the first time by another participant in the interaction. Note that co-construction and our use of the term is narrower than that of co-elaboration (Baker, 1994; Mephu-Nguifo, Baker, & Dillenbourg, 1999; Baker, 2010), which includes the communicative process going along content co-construction. Here we limit this theoretical construct at a representational level. However, there is (at least) one case in which the communicative component is "part and parcel" of the representational co-construction: the case in which a dialogue act evokes the generation of a representation in another speaker. In this case, a generation act is also possible (in addition to the transformation and evaluation acts) to be considered as a manifestation of co-construction.

But why co-construction matters for team design communication? Because it is an expression of "jointness". According to Clark (1996), a joint action is based on "the co-ordination of individual actions by two or more people. There is co-ordination of both *content*, what the participants intend to do, and *processes,* the physical and mental systems they recruit in carrying out those intentions" (p. 59). We could further say that co-construction regards jointness at the content level. It is also important to note here that jointness does not necessarily imply *sharedness*, meaning mainly the degree of conceptual convergence between communicants (Kreckel, 1981), but it is an essential component of the participants' common ground (Roschelle & Teasley, 1999), at least as it is manifested through discourse. What we mean here is that the fact, for example, that a participant re-uses (duplicates) the solution concept idea previously

manifested by another participant does not automatically imply neither that the same concept is conceived in the same way by both speakers, nor that the second conceptualizer attributes to the re-used solution concept the same (proposal) value that it was given in its initial generation. To avoid such misunderstandings, and because it exceeds our goals, in this research we are not interested in whether interaction products are more or less consensual.

5.1.2 DIALOGICALITY

In Chapter 4, we defined dialogicality as an intra-personal or inter-personal phenomenon, which describes the taking into account of "other voices" in one's own speech. Based on this definition, dialogicality can be manifested through discourse, either as a type of dialogue act, or through the enunciation of other persons or entities, different than the speaker herself. Before we continue with defining which dialogue acts are more dialogical than others, we shall first define what a dialogue act is.

The option for dialogue acts rather than speech acts – also discussed in Section 4.2 – is well justified by Bunt (2000). According to this author, there are at least four reasons in favor of an effort to define dialogue acts:

> 1. In speech act theory, a central goal of utterance interpretation is taken to be the assignment of an illocutionary force and a propositional content. But there is a considerable unclarity as to exactly which illocutionary forces should be distinguished, and why. We therefore question whether illocutionary forces are a satisfactory end point in the analysis of utterance meaning (…)
> 2. (…) We believe that communication has many 'dimensions' that a speaker can address simultaneously, and that utterances should often be considered to have several functions at the same time. We think it is therefore also more fruitful, in many cases, to consider an utterance as multifunctional rather than as (functionally) ambiguous.
> 3. (…) Pervasive phenomena in spoken dialogue, such as the use of feedback utterances (OK, Quite so, Yes, Hm, You think so?, …), hesitations, self-corrections, greetings, contact and attention signals, and apologies have not been analyzed in a speech act theoretical way to any great depth (…)
> 4. Finally, for application in the design of dialogue systems, we need a formalized theory taking into account precisely those types of communicative acts that are relevant in the situation where the system is to be used (p. 83-84).

Accepting this critique towards the adequacy of speech acts to analyze dialogues, the need to define *communicative*, and subsequently, *dialogue acts* emerges. Communicative acts take into consideration the communicative function of an utterance, in other words, "the ways in which dialogue participants use information to change the context" (Bunt, 2000; p. 89). Kreckel (1981) adds that "from a developmental perspective, functions are said to be identical with uses of language (…) The adult system seems to lose the direct function-use relationship" (p. 61). In task-oriented interaction, communication is vastly guided by the task, making its functions less ambiguous. When communicative function is added to a task-relevant semantic content, we can speak of dialogue acts (Bunt, 2000).

However, although all dialogue acts are communicative acts, not all communicative acts are also dialogue acts. Two main factors can be used to distinguish between these two, when considered separately: task-orientation and rationality. Dialogue acts always serve some other task motivating the dialogue, rather than the task of communication per se. Moreover, during a dialogue "communicative agents strive for rationality, both in their choice of communicative actions in relation to their communicative goals, and in the choice of their communicative (sub)goals depending on the goals of the underlying task" (Bunt, 1999; p. 140). These two conditions are considered to be as more generalizable regarding task-oriented interactions than other communicative behaviors such as greetings, apologies, or expressions of gratitude, which are often motivated by social, culture-binded norms and conventions.

Regarding dialogue acts, a distinction can also be made between those that directly contribute to the task, known as *task-oriented dialogue acts*, and those that are concerned with the interaction itself, also known as *dialogue control acts* (Bunt, 1999; Beun, 1999). The main functions of dialogue control acts are: turn-taking, timing, perceptual and mental contact, dialogue structuring, and the utterance formulation process. Even though these acts have been studied, together with the task-oriented dialogue acts, by

a number of scholars (e.g. Traum & Allen, 1992; Baker & Lund, 1997), we consider them irrelevant to our research goal, for the same reason described above regarding communication acts: their manifestation and replicability does not (as much) depend on the type of the task.

Various types of task-oriented dialogue acts have been hitherto proposed, and they will be exposed later on. The point that we would like to make here is that not all dialogue acts are also similarly dialogical. In other words, their inter-personal context does not necessarily imply their interactive context. For a dialogue act to be considered as 'truly' dialogical, (at least one of) the following conditions need(s) to be satisfied: a) that it responds to a previous contribution, by accepting or impeding its content, understanding, or application. This behavior most of the times takes place at an inter-personal level, but it is also possible that a person "counter-argues" to herself (Billig, 1987). Any other case of cancelling one's own content is not considered dialogical, but rather a monological attempt of self-correction (*within-agent feedback*); b) that it "carries" the voice of a relevant "Other". Relevant people in professional design are: the *stakeholders*, who in the case of an institution correspond to teams superior to the design team in the organizational hierarchy, other *institutional teams/departments* whose co-operation is necessary for the design decisions to be made, and internal (team members) or external *experts*, whose point of view is considered relevant for the specific issue. We consider acts as dialogical when these "other voices" are literally enounced in one's discourse, e.g. not only referred to, but quoting what was (imagined to be) said. The enounced content is necessary for all cases of quotation, except for when it refers to something someone of the team said before during that meeting (in these cases, just "as x said" is sufficient, as long as it is implied that everyone understands to what the speaker is referring to).

Both dialogue and dialogical acts can be further distinguished regarding their communicative "power", as it will be further explained in the 'Dialogue acts' paragraph (5.3.5). One of the types of communicative power, very relevant to team

design communication as we already saw, is what can be called as "argumentativity". This term is used here to describe the quality of some dialogue and dialogical acts to also serve an argumentation function. When such function is also combined with dialogicality, we can speak of an inter-personal argumentation structure. Given the extensively discussed relation between argumentation and collaboration, we can assume that such inter-personal structures are high-level manifestations of *jointness*, thus they are important indicators of team design collaboration. In case dialogicality is manifested though the use of an enunciative subject, such as an institutional expert or a user tester, the identification of the role and/or knowledge of such subject is important for the identification of the type of the argumentation scheme emerged (later explained in this chapter).

5.1.3 DELIBERATIVENESS

Deliberation is defined as: a) discussion of all sides of a question; b) careful consideration; c) planning something carefully and intentionally; d) a rate demonstrating an absence of haste or hurry; and e) the trait of thoughtfulness in action or decision (Wordnet, http://wordnet.princeton.edu/perl/webwn?s=word-you-want). In one mode or another, it can be said that deliberation is the principal communicative function of a meeting activity, which is "by nature" oriented towards delegation (Allwood, 2000; see also Figure 8 in Chapter 3), or, broadly said, towards decision-making. However, we should always bear in mind that decision-making is not always action-oriented, and, especially in the cases of highly complex tasks, such as design, decisions can also be knowledge-oriented.

Before defining deliberativeness, a first distinction to be made is between goal-oriented and non-goal-oriented discourse during interaction. Of course here we do not include the basic communication goal of meaning understanding and negotiation, necessary to any interaction as we already said in Chapter 1. An interaction becomes non-goal-oriented when it satisfies the criteria of a free discussion, but not those of a task-oriented dialogue. Free discussions can be deliberative in the sense of "thoughtful", but they are not taken into account in the present study if they do not contribute somehow[1] to the construction of the design object. On the other hand, it is also possible that certain types of goal-oriented interaction are not supposed to be deliberative. This is mostly the case of *action co-ordination* activities, when the object of interaction –usually task assignment or time-place decisions– does not also form an issue. Another example of non-deliberative goal-oriented interaction is that of *cognitive synchronization* activities (Darses et al., 2001; Visser, 2001), very often in team design as we saw in Chapter 2.

[1] "Somehow" here refers only to the socio-cognitive level, as it is possible that free discussions contribute to the socio-emotional level, e.g. through creating a relaxed atmosphere.

A further observation is that not all deliberative interaction guides to the taking of a decision. This statement implies two main assumptions. First of all, that deliberation is an issue-dependent activity, and as such, some task-oriented activities are more deliberative than others. Issue is a topic that becomes the object of discussion, and its treatment through discourse defines types of task-oriented activities, embedded into the macro-activity of design deliberation. Secondly, not all design-oriented activities lead to decisions, even if those are conceived in a broad sense, including both action-oriented and knowledge-oriented "make-ups of mind". Examining what type of deliberative process is also productive in the sense of a final proposal or evaluation becomes interesting if one considers the uncertainty and ambiguity of the design process (Stacey & Eckert, 2003; McDonnell, 2010).

Having said that, deliberativeness in the present study is mainly defined by distinguishing among design deliberative episodes that lead to some type of concrete action or conceptualization (action-oriented vs knowledge-oriented deliberation), and those that stay at a reflecting or free discussion level without arriving at a mind "make-up". It is worth noting here that, again, consensus is not taken into account, for the decision on deliberativeness or not. An argument from authority, for example, can mark the end of a team deliberation episode, without the approval of the rest of the team. Other guidelines regarding episode segmentation come into play that will be discussed later on (Section 5.3.3). However, what is important to state clearly here, is that in order for a piece of interaction to be considered as deliberative, thus contributing to the team's macro-goal, at least one final action or knowledge statement is necessary, by at least one person.

In the case of action-based decision making, such "final" statement is relatively easy to identify: it usually contains a "let's do" element relative to the initial issue, which can be either expressed in the form of a strategy, meaning an individual, synthetic (based on co-construction), or dialogically joint (with many people's participation) plan, regarding team's behavior. In the case of knowledge-based decision making, the

"final" statement takes the form of an intermediary representation, discussed in the following paragraph. "Final" is relative in both cases. Firstly, because it is not said that the decisions taken will also be the ones actually followed; and secondly, because participants can return to the same representations representing decisions later on in the interaction.

5.1.4 INTERMEDIARY REPRESENTATIONS

Intermediary objects (Jeantet, 1998), also known as *boundary objects* (Star, 1989) or *mediating objects* (Vinck, 1999) play a major role in design. In team design, they can refer either to physical objects, meaning tools and artifacts with a specific communicative function, or to virtual objects, meaning representations that serve as reference point for thoughts' externalization (Eckert & Boujut, 2003). The present research focuses on the second type of objects, and more precisely, on those discourse products that can be considered as relevant *intermediary representations* (Visser, 2006).

Three of the most important intermediary representations in team design are the *design constraints*, the *design requirements*, and *the design proposals*. A design constraint

> refers to some limitation on the conditions under which a system is developed, or on the requirements of the system. The design constraint could be on the systems form, fit or function or could be in the technology to be used, materials to be incorporated, time taken to develop the system, overall budget, and so on (Systems Engineering Glossary, http://www.argospress.com/Resources/systems-engineering/designconstr.htm).

Constraints are distinguished between: a) *internal and external constraints* (Savage, Miles, Moore, & Miles, 1998; Chevalier & Bonnardel, 2003), depending on whether the source of knowledge on which they are based is personal memory-expertise, or aspects linked to the problem itself (also called "problem requirements"); b) *preference and validity constraints* (Jannsen, Jègou, Nouguier, & Vilaem, 1989), depending on whether they are personally or generally important; and c*) prescribed and derived constraints* (Détienne, Martin, & Lavigne, 2005), depending on whether they are context-independent or emerging during interaction through specific viewpoints. In one way or another, design constraints form an essential part of the design problem space, as they guide solution search and selection. Moreover, in team design, they can reveal different types of expertise (Chevalier & Bonnardel, 2003), by composing different types of viewpoints on the same issue (Détienne et al., 2005).

At this point, a difference between the nature of constraints and their manifestation through discourse in team design should be made. In design thinking, constraints form part of the problem space but, at the same time, they define the design solution. As Chevalier & Bonnardel (2007) explain:

> design activities have been described as based on an iterative dialectic between problem-framing and problem-solving. To solve the problem, designers have to improve their mental representations so that they can satisfy a constraint condition, effectively transforming an ill-defined problem into a better defined one. To solve any design problem, designers have to generate and introduce new constraints that contribute to satisfy the original constraint condition (p. 2458).

In this sense, constraints and requirements are the two sides of the same coin. This is, generally, the case in which constraints and requirements are defined a priori, in the sense of *external prescribed constraints*. Nonetheless, these types of constraints are rare in eLearning design, mainly for two reasons: because stakeholders form part of the same educational institution, and because user experience, on the basis of which most constraints are produced, is not a priori defined itself; both design constraints and user experience consideration emerge as *viewpoints* during team design interaction (Détienne et al., 2005).

Another consideration, relevant to our dataset, is the differentiation between design constraints and design requirements. Although in individual design thinking, these two refer to the same entity, in team design, their distinction through discourse is possible, and sometimes necessary. As it was previously explained, constraints in eLearning design cannot be taken for granted, neither there is a list of them a priori to guide the design practice (unless past experience with the same course is used, but again, in this dissertation, we refer to design or re-design of innovative courses). Their consideration exists only at a general level before their explicitation through specific judgments regarding their nature, type, and force. Seen that way, it is an important step to make design relevant constraints explicit. A second step refers to making

explicit the requirements deriving from such constraints. As we already discussed in Chapter 2, design problems are ill-defined, in the sense that more than one solutions exist for the same problem. In team design, we should add that also design constraints are ill-defined, in the sense that different requirements can derive from the same constraint, regarding the perspective adopted at the moment of interaction. Take, for example, a usability constraint, e.g. "learners do not like reading much text on-line", based on the speaker's personal experience and/or pedagogical knowledge. A number of possible requirements, or needs for action, derive from it, such as: we need to have as less text as possible, we need to use more interactive activities, we need to have PDF as an option, etc.

A third step towards a design decision is to "translate" both the constraints and requirements made explicit into concrete design proposals. From a cognitive point of view, such proposals are not limited to a solution proposal, but to any object being presented as a catalyst for the design process. From a communication point of view, proposals can refer either at a micro or at a macro level. At a micro level, proposal corresponds to the interjunction relation-act of *presentation* in Renkema's (2009) model, in which the notion of solutionhood is relevant for its identification. At a macro level, proposal refers to a complex speech act, as defined by Walton (2006), or to the activity of proposing as defined by Aakhus (2006). We refer to the same phenomenon, as expressed in team collaborative situations, through the term of a *dialogue macro-act*: *dialogue*, because it is a rational, task-oriented communicative act; and *macro*, because other acts can be embedded on it, as we will explain later in this chapter.

Constraints, requirements, and proposals are essential components of design thinking, this is why their appearance is also frequent and relevant in design discourse. In this research, they are moreover treated as intermediary representations, emphasizing their role in shaping the final decision regarding the design artifact, i.e. the course.

5.1.5 DESIGN-RELATED ARGUMENTS

As we already said, design deliberation refers to the process of thoughtfully weighing options, before getting to a design decision. This process is strongly related to argumentation, not only because of the general relation between argumentation and deliberation (Walton, 1998), but also due to characteristics specific to the design process.

First of all, as a reasoning process, design is a form of practical reasoning, focusing on "that-which-is-not-yet" (Nelson & Stolterman, 2003), with the aim of its realization. Maximizing this process (Simon, 1969/1996) forms the base of deliberative reasoning, as it implies a selection among possible solutions, according to criteria (Walton, 1990). Secondly, the ill-structured or *wicked* nature (Rittel & Webber, 1973) of most design problems renders the design solutions highly ill-defined, meaning that there is not pre-determined way that leads to the (best) solution (Darses et al., 2001). Last but not least, design is a social process (Bucciarelli, 1988), meaning that design representations are negotiated. This aspect is very important, given that most of the complex design is nowadays done in teams.

Having said that, the emergence of arguments during design interaction is very much expected. As arguments, here, we refer to the *argument1* type (O' Keefe, 1977/1992), which by rule is "something one person makes", although there are exceptional cases in which "two or more persons had jointly made an argument1" (p. 79). In order to identify "arguments1" in oral interaction, two types of structure need to be taken into account: the arguments' *logic structure*, and the arguments' *manifested structure*.

With arguments' logic structure, we refer to the informal logic macro-criterion of cogency. Cogency includes all three criteria of relevance, sufficiency, and acceptability we mentioned in Chapter 4 (Section 4.5). It is based on formal deductive validity, but it is not directly assigned from it. This is mainly because most of the everyday arguments are plausible, meaning that the premises plausibly lead to

the conclusion. In other words, if the premises are true, it does not necessarily mean that the conclusion is also true. A well-known example is the "Tweety" case (Walton, 2011b). The premises "All birds can fly" and "Tweety is a bird" are true; however the conclusion "Tweety can fly" is not necessarily true, as for example in the case Tweety is a penguin.

The same "problem" can also be described as defeasibility of the argument structure, "meaning that even after the argument has been accepted, it might later be defeated as new evidence enters into consideration" (Walton, Reed, & Macagno, 2008; p. 7). This is very much the case for knowledge-based and practical arguments, which are the core of design reasoning (Brown & Chandrasekaran, 1986). For the description of the everyday use of these informal reasoning structures, we opt for using Walton and others' (2008) "argumentation schemes". These schemes are distinguished from other inference structures regarding their function of *shifting the burden the proof*. Said otherwise, each time an argument fitting one of the schemes is put forward, "it shifts the burden of proof to the side of the respondent in a dialogue (…) The respondent might attack the argument, by putting forward counterarguments, or may simply express doubts about the conclusion based on the evidence that he has" (Walton et al., 2008; p. 35).

Knowledge-based reasoning is "the type of reasoning built into an expert system (…) meaning that it draws its premises from a set of facts and rules (or frames) called a knowledge base" (Walton, 1989; p. 193). The main type of knowledge-based argument is the *argument from expert opinion or position to know*. This argument has the following form (Walton, et al., 2008):

> *Major Premise*: Source a is an expert/in position to know about things in a certain domain S containing proposition A.
> *Minor Premise*: a asserts that A is true (false).
> *Conclusion*: A is true/false.

In institutional, task-oriented interaction, the "expert's voice" can be either one member of the team or an external subject matter expert. Let's take the second case first, which is the less problematic. In everyday language, argument from expert opinion when referring to an external expert usually takes one of the following forms: "I *know* x because E, who is an expert, *said* so" or "E, who is an expert, says that we should do x; therefore, let's do x". The first sub-case is similar to argument from position to know, because it refers to some type of expert testimony: the person who asserts so is not an expert himself, but she has met, read, listened to, dreamt of, etc. the expert who she refers to as a source of knowledge. On the other hand, the second sub-case reflects an action-oriented argument based on expert opinion, thus it is a combination of practical and knowledge-based reasoning. Both cases, in our dataset, are identified as arguments from expertise.

However, in cross-disciplinary teams such as the eLearning design teams, expertise is very usually sought for and/or made explicit *inside* the team. This does not, of course, mean that any assertion made by the participant designers is argument from expert opinion, just because each one of the designers is an expert herself! Indeed, there are cases where expertise is made explicit in the form of arguments based on some type of experience, which renders the arguer in *a position to know*. Such experience, in the team design context, can be either domain-dependent or domain-independent. We call the argumentative inferences based on the first type of position to know "rule-based" arguments, referring to domain rules serving as support for the statement, and those based on the second type "person-based", referring to the personal experience argumentative component. Both types, can be considered as sub-types of arguments from position to know, and they are expected to be manifested in any task-oriented cross-disciplinary context, such as professional team design.

Practical reasoning can be seen "as a kind of communicative problem solving which concludes in directives for an action" (Walton, 1990; p. 13). Thus, it is the basis of joint deliberation. As far as its (informal) logic structure is concerned, it refers to the

argumentation scheme used in deliberation to solve a practical problem (Walton et al., 2008; p. 85):

> *Major premise:* A is the goal.
> *Minor premise:* B is necessary to bring about A.
> *Conclusion:* Therefore, it is required to bring about B.

Transferring this scheme to the team design context, some considerations need to be made. First of all, in a collaborative setting the goal can also sometimes be the object of deliberative practical reasoning. As we saw in Chapter 1, what distinguishes collaboration from other communication flows is the continuous re-conceptualization of both the object and the objective of interaction. In this sense, the Aristotelian assumption that "we deliberate not about ends but about means" (Walton, 1990; p. 12) does not seem to be the case. To cover every possibility, instead of "goal" we should understand "practical problem".

A second consideration has to do with the notion of "necessary condition" contained in the second premise. A broadly accepted fact in the design context is the distinction made by Herbert Simon (1969/1996) between two methods of problem solving he calls *satisficing* and *maximizing*. This statement is interpreted by Walton (1990) as following:

> What is suggested by Simon's remarks is that there are two standards of burden of proof within practical inference, depending on how ambitious the practical reasoner is: (1) looking for the best available way to carry out an objective, that is, by maximizing (comparing all the available procedures and selecting the best); (2) setting an acceptable (but less than ideal) standard in the first place, and then selecting the first, or any available procedure that meets the standard. What works to solve a problem is not always the best solution (p. 46).

In other words, the necessary-optimizing solution many times is replaced by the sufficiently satisficing alternative.

A last consideration is related to the (final) conclusion of a practical inference, which "always is a statement that the inferrer has to do something (a statement of necessity)" (Walton, 1990; p. 9). However, "the subjectivity of the practical inference affects the formulation of both premises and the conclusion" (p. 24). In team design, it is the team intention rather than the personal intention that is expressed in terms of a team goal. This assumption makes the practical inference less "psychologically" and more "epistemically" relevant, in Walton's (1990, p. 25) terms.

In sum, adapting the practical argumentation scheme to team design context, the following considerations need to be taken into account: a) the amplification of the goal premise to include any type of practical problem to be solved; b) the relation of necessity and sufficiency between the premises and the conclusion; and c) the epistemic relevance of the inference. It can be already assumed that the intermediary representations defined in the previous paragraph are main (potential) components of practical arguments. However, the exact relations between them and the distinction between arguments and non-arguments will form part of our results.

According to Walton (1990), the problem of closure for practical inference needs to be considered together with two factors: a) the question of side effects, and b) the question of alternative means. Correspondingly, two types of arguments emerge, in strong relation to the practical argument: the argument from positive/negative consequences, and the argument from alternatives.

The main form of argument from positive/negative consequences is the following (Walton, 1998; Walton et al., 2008):

> *Major premise:* If A is brought about, then, as a consequence, B will come about.
> *Minor premise:* B is a positive/negative state of affairs.
> *Conclusion:* Therefore, A should (not) be brought about.

As Walton et al. (2008) observe, "practical reasoning and argument from consequences represent two directions of the same kind of reasoning" (p. 101). We expand this observation by claiming that "practical inference is always proposing some type of action, whereas arguments from positive or negative consequences are more near to a value judgment" (Rapanta, forthcoming). In one way or another, both types of inferences are strongly design-related and their emergence in team design interaction is important to be identified.

As far as argument from alternatives is concerned, it can be considered as a "reversed" practical argument. The arguer knows the consequences of the alternative to the action she proposes, and based on them, she assumes the contrary consequences for the proposed action. Argument from alternatives is also applicable in truth-seeking argumentation, as the example taken from Aristoteles presented by Walton et al. (2008): "If the war is responsible for the present evils, one must repair them with the aid of peace". In this argument, it is well-known that "war" is the opposite of "peace", thus a property of the former is inferred to be a non-property of the latter. However, in deliberative task-oriented interaction, the above inference takes a more concrete, solution-based form:

> ***Major premise:*** **Solution a, which is proposed as alternative to solution b, has a positive/negative consequence c.**
> ***Minor premise:*** **Solution b does not have consequence c.**
> ***Conclusion:*** **Therefore, we should (not) chose solution b.**

Argument from alternatives, in the form just described above, is very related to team design. According to D'Astous et al. (2004), elaboration of alternative developments or solutions occupies the 21% of the total time spent in design review meetings.

Another form of argument very close to the design process is the argument from analogy. The general scheme proposed for this type of argument is (Walton et al., 2008):

Major premise: Generally, case C1 is similar to case C2.
Minor premise: A is true (false) in case C1.
Conclusion: A is true (false) in case C2.

A slightly different version, more applicable to objects rather than cases, is proposed by Guarini (2004):

Premise 1: a has features f1, f2,…,fn.
Premise 2: b has features f1, f2,…,fn.
Conclusion: a and b should be treated or classified in the same way with respect to f1, f2,…,fn.

This scheme's focus on features (i.e. factors, aspects, characteristics) is important for the parallelization of argument from analogy to argument from precedent, another type of case-based reasoning. According to Walton (2010), the argumentation scheme appropriate for this type of argument is the following one:

Premise 1: C1 is a previously decided case.
Premise 2: In case C1, rule R was applied and produced finding F.
Premise 3: C2 is a new case that has not yet been decided.
Premise 4: C2 is similar to C1 in relevant respects.
Conclusion: Rule R should be applied to C2 and produce finding F.

Because of its relation to creativity, which always refers to a "building-on" rather than a "from zero" creation, design process is frequently based on analogical reasoning, as an expression of case-based reasoning (Maher, 1990). In fact, the role of analogies in creative design has been extensively shown regarding the construction of new artifacts, re-constructing existing ones (e.g. Cross, 1997; Bonnardel, 1999). The cognitive mechanism behind this type of reasoning has been defined as "reuse of past design" (Détienne, 2003), and it applies to both individual and collective design situations. In this sense, argument from analogy is a very explicit case where a

designer communicates his past or relevant experience with other artifacts, which can serve as a model or example for the design-at-hand.

Of course other arguments are possible to occur in team design interaction, but we consider the above mentioned as the most related to the design thinking and process. Also, our analysis will be limited to the identification of *type1* argument structures (O'Keefe, 1977), but seen as sequences of discourse acts. This choice facilitates the process of argument identification in an extensive, everyday discussion protocol, as it allows for the following operations: a) the connection between certain types of discourse relations and argument types; b) flexibility at the time of searching for arguments as the components can be situated in various locations in the interaction; and c) the possibility to identify connections also between arguments, by applying the same rules as for one argument identification, as long as same or similar discourse relations are expressed.

However, a limitation of considering only *type1* argument structures is that other level argument relations, such as those between interaction sequences, cannot be identified. An argument situated in sequence number 4 of a deliberation episode can be dialectically "tiered" (Johnson, 2000) to an argument situated in sequence number 1. If the design issues were univocal, in the sense of one topic treated at a time with certain "pro" and "con" positions, such dialectical analysis would be possible. However, as we already implied in Chapter 1, what distinguishes team design argumentation from other contexts is that it is *object-oriented* and not issue-oriented. Thus, the cognitive and discursive dimensions can also shed some light on the identification of potential *type2* argument structures in team design.

5.1.5 USER EXPERIENCE

User experience is an amplified version of usability, which "encompasses all aspects of the end-user's interaction with the company, its services, and its products" (Nielsen Norman Group, http://www.nngroup.com/about/userexperience.html). Regarding our research, it can further be said that usability criteria make themselves explicit during interaction through the reflection on the expected user experience.

The gap between who designers and developers *imagine* their users are and who those users *really* are can be the biggest problem with product development (Kuniavsky, 2003). This problem is resolved by taking the user into account along with product development, what is also known as "user-centered design" (Garrett, 2003). Defining the elements of user-centered design depends on the specific type of design object. If an on-line course is mainly considered as part of web-site design –at least considering its "material" components– the following elements of user experience are primordial (Garrett, 2003): contents, function, structure, and visuals. Also, regarding strategy, a differentiation needs to be made between *user needs* and *site objectives* (Garrett, 2003), which are linked to institutional or business goals.

However much has been said about user experience related to the design process, it is not known how, why, and when users are taken into account during team design. One possibility is that users are considered as stakeholders, i.e. the ones who "mandate", and that their voice is being enounced in the same way as we described in paragraph 5.1.2. In eLearning design, there are two main types of users: the intermediary users, i.e. the tutors responsible to "give" the course on-line (in both our cases, tutors are different than the designers), and the final users, i.e. the students of the specific course. In some cases, a team also uses user testers before the launch of the course. What makes eLearning design special in comparison to other types of design is that users can never be considered to react "in the same way as", because learning experience always depends on the other users (eLearning nowadays is

strongly interactive) and the tutors themselves. Thus, even if the "material" components of an eLearning course are the same, user experience can never be defined a priori.

This characteristic leads designers to understand unknown users, through two main behaviors: by themselves doing what users are supposed to do as part of the course activities, and by putting themselves in the "users' shoes", through making hypotheses regarding how users would behave (Rapanta, Schadewitz, & Holden, 2010). During design meetings, we are exclusively confronted with the second case, even though designers may refer to their "do it by yourself" experiences.

Although user experience cannot be considered as a design knowledge domain for the reasons we mentioned above, it is possible that eLearning designers have developed a special type of meta-experience, meaning their own experience with user experience. In this sense, such type of "sensibility" or, even, facts-based knowledge can be considered as a separate design domain.

In sum, there are many ways that users can be taken into account during non-participatory eLearning design. The identification of these ways is necessary in order to shed light on the user experience consideration during design. Such a priori consideration can save time and money, compared to a posteriori corrections, e.g. after a user-test, or even render itself a factor of efficiency when there is no way back.

More precisely, and in relation to our dataset, we are interested in how "users´ voice" is made explicit through designers' discourse. As we already said in relation to dialogicality (paragraph 5.1.2), one way for it to be possible is through users' enunciation, either directly, by quoting a user's words, or indirectly, by imagining what she would say in a specific situation. However, other ways to make explicit one's experience on users' experience should be possible and call for investigation.

To sum up this section, six types of theoretical constructs have been defined in relation to our research context: *design co-construction*, *dialogicality*, *deliberativeness*,

intermediary representations, *design-related arguments, and user experience*. Although these constructs should be seen as conceptual representations, their manifestation in the coding process is possible and desirable. In some cases, some analysis hints were already given, in order to anticipate the relation between these constructs and the coding categories, which forms a main part of the coding scheme's functionality to be in detail discussed later on (Section 5.4).

5.2 DATA COLLECTION-PREPARATION

> The essence of a case study, the central tendency among all types of case studies, is that it tries to illuminate a decision or set of decisions.
>
> —SCHRAMM, 1971

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 2003). Moreover, case study is the preferred research strategy when "why", "what", and "how" questions are posed with explanatory, exploratory, or descriptive aims. Regarding our research questions and hypotheses, the present study is more exploratory and descriptive, rather than explanatory. However, the multiple-case design of it can allow for the inference of some causal explanations, if pattern matching among cases is successful.

One of the strongest critiques that case study research has accepted is its weak base for generalization to other settings. Multiple case-study strategy gives a response to this problem, by optimizing description and generalizability (Herriot & Firestone, 1983). The "case" refers to the unit of analysis of the study that can be the individual, the dyad, the group, the organization, but also more abstract entities, such as an event (Yin, 2003). In our study, we use this latter sense of case, by identifying them with any emerging "deliberative episode" (see paragraph 5.2.3 for segmentation). At the same time, the selection of two different organizational contexts (see paragraph 5.2.1) allows for a multiplicity at a macro level, even if it is at a limited range (just two cases).

These two choices allow for both intra-group and inter-group comparisons. Regarding the first level of analysis, context is defined by the specific design activity context, which can be defined in the same way for both institutional cases, as their focus task is of the same type (eLearning design). However, differences in the emergence and type of such sub-cases can be attributed to differences between the two groups. On the other hand, if patterns identified at the intra-group level repeat themselves at the inter-group level, such replication may imply that institutional factors are not as important or they are equalized, regarding certain phenomena.

Certainly, in order for such replication to be reliable, the same data collection and analysis process has to be followed, as it will be described in this section. First, an overview of the two teams will be given (paragraph 5.2.1), together with the description of those team-based aspects that are considered relevant for any subsequent interpretation of the acquired results. Right after (paragraph 5.2.2), our data collection method is presented, together with considerations to be taken into account regarding questions of reliability. The corpus of the collected interaction data –from now on dataset– is presented in paragraph 5.2.3, together with the rules and types of segmentation, according to pre-defined levels of analysis. Finally (paragraph 5.2.4), some initial considerations regarding the construction and functionality of coding schemes in general conclude this section.

5.2.1 THE TEAMS

Two teams participated in this study, both of them belonging to well-established Distance Education institutions, also known as "open universities" (Peters, 1988/2004). The selection of the institutions has been based on criteria of quality and innovation. The first institutional case refers to one of the oldest European open universities, with a long success history, thus, experience in "openness" and implementation of innovative methods. The second one, although it has much less life than the first, has been considered since its beginning as being very much

connected with lifelong learning in a personalized and systematized way. The well-founded educational model of this young –also European– institution has also rendered it very successful in the recent years. For research ethical reasons, we will limit ourselves to these general presentations of the institutions, in order to better protect participants' privacy, and also to avoid any result of this research as being considered as part of the institutional policy.

Instead, we will give more details regarding the two specific participant teams, focusing on both their common and distinct characteristics. First of all, both teams meet at a regular base (avg. once per month) during a pre-defined period of time (keeping schedule is very important), whereas the time duration of each project varies: for the first team –from now on, Team A– the duration of the project is quite long (about one and a half year), whereas for the second team –from now on, Team B– the project is shorter (a little more than half year). Project duration can only be estimated approximately as it does not necessarily correspond to the duration between the first and the last meeting observed. The calculation of time is based on communication with the participants in both cases.

As far as the meetings observed is concerned, the duration slightly varies among the two Cases: in Team A the average is 1.8 hours, whereas the average of Team B is 1.4 hours. This difference is justified taking into consideration the number of participants per meeting. In Team A, the usual number of active participants is 6, whereas there are cases (meetings) in which up to ten people are present, of course not all of them participating at the same range. This is a usual characteristic of formal institutional meetings, in which some participants are there just because of their institutional role (e.g. secretary), and not because they actually contribute to the task. We consider that for such cases, a distinction should be made between actual "authors" –referring to the eLearning design context– and "non-authors". Moreover, the explicitation of the specific institutional role of the non-authors is also considered relevant, for the mere reason that a project manager, for example, is expected to have her say in a meeting,

whereas a secretary not as much. In Team B, an analogous distinction should be made between "academics" and "non-academics", regarding the institutional model that corresponds to this team. In terms of formality of the meeting, we consider the existence of an agenda as a relevant aspect for the meeting's organization. Team A's meetings are based on a pre-defined agenda, produced by the Course Chair and sent to the team members before the meeting, so that everyone knows what it is to be discussed. Team B's meetings are more informal, in this aspect; team members, being only three, are expected to follow very closely the process of course production, thus the existence of an agenda is not considered necessary. Also, the role of a Course Chair is not made explicit, as the two academics of the team share this responsibility.

Other characteristics regarding participants of both teams should be taken into account, regarding our research questions. Participants in both teams are very experienced in eLearning design; the average of experience in course design is 5 years for Team A, whereas in Team B the minimum of the participants' experience is 3, and the maximum 17 years. Also, cross-disciplinarity, as we defined it in Chapter 3, plays a major role in both teams. In Team A, participants share different disciplines, varying from Product Design, Industrial Design, and Interactive media, to Management and Pedagogy. In Team A, a similar situation is observed (although at a lower level, due to the lower number of participants): each member has a different background, including Communication sciences, Philology, and History. Another aspect to be mentioned here is the previous collaboration between the participants. In Team A, half of the most active participants have never collaborated with the team before, whereas in Team B, only one of the three members is a newcomer, and the coalition between the other two is very strong (also at a friendship level). An extensive knowledge regarding the socio-affective aspects of participants' relations exceeds the goals of the present dissertation.

On the other hand, the main characteristic of any task-oriented interaction, i.e. the object of interaction, is considered very relevant for our research. In fact, there are

three main object-related aspects to take into account at the time of interpreting the results. First of all, the course's subject itself is about Design in both Cases. In Team A, it refers to Design thinking in general, and in Team B, it is focused on Instructional Design. Both teams design a course about design, thus aspects of meta-design thinking are present in both processes. In other words, designers' subject matter expertise is identified with their course production skills. This characteristic is relevant to our research goals because it gives meetings a more design-based and a less managerial character: we have to do with designers who design about design. Apart from this similarity regarding the course's subject, the characteristics of the task that the two teams are assigned are quite different. Team A is asked to design "from scratch" a 60-credit bachelor course, having a duration of one year in the institution's bachelor program. This is a first-appearing, innovative course in the institution, and, as such, it has gathered a lot of expectations regarding its success and implementation. Team B's task is easier, in terms of amount of work, as their job consists in re-designing two credits of an existing 6-credit "asignatura", which is a didactic unit of a 60-credit master program. However, it can be said that their task is equally exigent, given the fact that they have to re-design a piece of a program, taking into consideration not only the didactic plan to-be-redesigned, but also the didactic plan of the whole program. Innovation is also a requisite for this case, as it forms part of an Innovation design project.

TABLE 7. A COMPARATIVE PRESENTATION OF THE PARTICIPANT TEAMS

Characteristic	**Team A**	**Team B**
Geographical context	Europe	Europe
Type of institution	Distance University	Distance University
Project duration	approx. 18 months	approx. 7 months
Participants per meeting	6-11	3
Meeting duration	avg. 1.8 hours	avg. 1.4 hours
Prescribed agenda	Yes	No

Course's subject	Design thinking	Foundations of techno-pedagogical design
Course's duration+level	One-year bachelor course (60 credits)	One-year master course (60 credits)
Type of task	Design of the whole program	Re-design of a 6-credit "*asignatura*"
Roles	1 Course Chair-Author, 4 Authors, 1 Course manager, 2 Media Project managers, 2 external collaborators, 1 secretary	2 academics (authors), 1 non-academic (support)
Level of experience	Strong	Strong
Cross-disciplinarity	Strong (Product Design, Industrial Design, Interactive media, Management, Pedagogy)	Medium (Communication sciences, Philology, History)
Previous collaboration	Medium (one author and the media project managers have never collaborated with the team before)	Strong between the two academics; the non-academic member is a newcomer in the institution

Based on Table 7, it can be said that the two participant teams can be considered as representative of eLearning design teams, because they both share characteristics that are considered relevant for high-quality eLearning design projects, such as: innovation, cross-disciplinarity, relatively long production, and working experience. However, there also some differences between the two Cases, which could not be controlled, given the empirical, in-situ character of our research.

5.2.2 DATA COLLECTION

There are many way of data collection in qualitative research. As McGrath & Altermatt (2001) summarize, the main general strategies for obtaining information about group interaction are: inferring interaction form input-output relations (without record of interaction behavior obtained), obtaining group member reports retrospectively (members rate and/or decide what went on in the groups), using online human observers (one or more observers record, code, or summarize group interaction), using mechanical or electronic recording systems (one or more cameras, tape recorders, or video cameras record group interaction for later coding).

We chose the audiovisual registration for several reasons. First of all, as we are interested in the meeting activity type as the main data source, registering the team meetings is the most complete way of having access to what actually happened during them. Secondly, the use of recording devices allows the analyst to hear and watch the tape many times, and to focus on a specific action sequence. This way, understanding of the situation is enhanced. Thirdly, this data collection method also offers significant advantages for the subsequent coding stage, compared to other methods such as the use of human observers. According to McGrath & Altermatt (2001), "it [the video registration] allows the use of much more complex coding schemes, based on much more complex distinctions among categories" (p. 530). Finally, compared to mere audio recording, audiovisual registration allows for easier and deeper interpretations of multi-modal dialogues, as gestures, especially those implying addressing, use of tools, and spatial awareness are, sometimes, only possible through the image.

On the other hand, the use of video in situated professional interaction has its own peculiarities and limitations. Mondada (2006), describing her *praxeological approach* to video practices, she makes clear that "not only the practices and methods by which video records are *produced*, but also the practices by which they are then *edited* (…) as well as the practices by which they are *viewed*" (p. 52). In other words, video is not a

mere resource, but an embedded practice itself. Subsequently, the researcher's approach of treating the data is reflected throughout the video interaction practice, from the time of collecting the data till the time of analyzing and interpreting them. In the present research, the main ethnomethodological conversational inquiry shooting techniques were respected, regarding time, participation framework and interactional space, and multimodal details (Mondada, 2006). More precisely, we were interested in capturing the whole interaction from its beginning till its (announced) end; all participants were sufficiently visible; and previewed use of space and tools allowed for capturing any movement and object manipulation related to the task.

Regarding analysis and interpretation, we are totally aware that capture of reality is not the same as reality itself. However, video offers a quite transparent account of it. Moreover, the whole logic of shooting is based on capturing moments of a social reality. This is very important to bear in mind, as in no way can it be assumed that a small part of the activity of team decision-making accounts for the whole process. Shots of life, even if they refer to institutional life, are just shots of life; representative, but not exclusive. Last but not least, a question often arises about the degree to which people are influenced by the use of the camera. However, as Jordan & Henderson (1995) claim, "experience shows that people habituate to the camera surprisingly quickly (…) Where people are intensely involved in what they are doing, the presence of the camera is likely to fade out of awareness quite rapidly" (p. 55).

A lot can be said about the camera setting and the rationale behind it. However, we will limit ourselves to a general description regarding each team setting, considering that a more detailed account is far from interest for the specific research. Regarding Team A, all the meetings were held in a room equipped with four hidden cameras, as part of the institutional setting. However, the decision to record the meeting or not was up to the team members. All team members were used to register themselves, as this formed part of their strategy in case a member was absent. After the researcher's

involvement in the project –a little bit after its beginning– most of the meetings were registered for the aims of the present research. All team members gave their consent, and they were aware of the general aims of the research.

As far as team B is concerned, an especially equipped room was not available. Thus, the recording was realized by the researcher herself. The use of one camera was considered sufficient, as both room and team size were limited. The participants' personal relation with the researcher created a relaxed atmosphere, since the beginning. On the other hand, the same reason sometimes led the participants to "speak to the camera". When this happened, the researcher maintained a neutral position and spoke back shortly and without influencing on the task flow. Moreover, as these instances were few and not directly related to the design process, they were not taken into consideration for the analysis.

As it can be implied, a main difference in the treatment of the two teams lies in the fact that in the first case the researcher was not present, whereas in the second case she was physically there in every meeting. We assume that this difference has not influenced on the participants' behavior (in the second case, it only influenced positively, as we said). As far as the researcher's understanding of the context is concerned, someone could oppose by saying that the combination of human observer with use of recording machine could be considered as "stronger" ethnographically speaking. In fact, this possible limitation was taken into consideration for the first case. The researcher may have not been present in the meetings, but she was continuously in contact with one of the members of the team. Thus, any question regarding contextual information was answered thanks to this contact. Moreover, a 3-week research visit in the department in which Team A is situated has been very enlightening regarding the researcher's understanding of organizational issues, both at an institutional and at a team level. This was also done for the second case, for which a 6-month research visit was possible (during which all the registered meetings took place).

As a conclusion, it can be said that data collection followed a more or less similar process for both teams, apart from negotiable differences. Following identically the same process for two different teams in two different institutional contexts and with varying research limitations is almost never possible. Considering that, no difference in the results obtained by the two teams can be assumed to be attributed to the data collection process.

5.2.3 THE DATASET (SEGMENTATION)

In total, 25.7 hours of interaction were registered corresponding to 15 meetings, ten of team A and five of team B. Team A' s interaction was in English, whereas team B's in Spanish. The whole meetings were transcribed by native or fluent speakers. Transcription was checked twice by the researcher, and corrections regarding contextual information were made.

A first issue to be considered regarding the dataset corpus construction is the type of transcription conventions to be used. The most used proposal is the one by Jefferson (1984). This system addresses a quite deep level of detail, considering various aspects such as the speech rhythm and tone, sound elongation, pause duration in seconds, and overlapping speech. Although such detailed conventions have served different types of conversational and discourse analysis, we consider that not all of them need to be addressed regarding our research. We agree with Edwards (2003), who claims that "the best choice of conventions in a given instance depends on the nature of the interaction, the theoretical framework, and the research question" (p. 321). Thus, a more simplified version of transcription conventions is rather applied, as the one presented on Table 8.

TABLE 8. MAIN TRANSCRIPTION CONVENTIONS USED IN THE DATASET

Symbol	Explanation
WORD	A word put in emphasis by the speaker

()	An omitted inaudible part of the speech
(word)	Transcriber's best guess regarding a part of the speech
[information]	Relevant paralinguistic information [gestures, pauses, movements]
{interpretation}	Analyst's interpretation of part of the speech when necessary for its understanding

The choice of these conventions and the omission of others are based on their meaningfulness for the utterances' segmentation and codification in the present study.

Segmentation is another issue that deserves a special attention in any dataset construction, as it influences on the whole process of analysis and interpretation. Various systems of segmentation of interaction data have been hitherto proposed, most of them considering as main unit of analysis: a) the *sentence* (Polanyi, 1988); b) the *utterance*, in the sense of turn of talk (Sacks, Schegloff, Jefferson, 1974); c) the *message*, in Bakhtin's (1986) sense of utterance, i.e. a minimal unit of communicated content. More precisely, Bakhtin (1986) defines *utterance* as following: "its beginning is preceded by the utterances of others, and its end is followed by the responsive utterances of others, although it may be silent, other's active responsive understanding (…)" (p. 71). In other words, an utterance can be composed of other utterances, in the sense of messages communicated to an active or passive addressee.

Although the message generally is the most intuitively obvious unit of analysis for communication researchers (Poole et al., 1999), it requires a high degree of observer inference, regarding the start and end of a new message. This problem could be solved with the identification of the unit act with one of the coding categories, as Bales (1950) did, but "this affects assessments of reliability of both the unitizing of interaction and its category coding" (McGrath & Altermatt, 2001; p. 533). On the

other hand, a similar solution is applied –not explicitly, though– by one of the most known RST coding manuals (Carlson & Marcu, 2001). These authors, although they consider clause as their minimal unit of analysis, a series of exceptions is proposed, all having as a common base the following assumption: a segment is defined by whether a rhetorical relation between itself and a previous one can be identified.

The problem considering the elementary unit of analysis can be summarized as such: on one side, it has to be *functional*, meaning that its relation to the coding categories needs to be clear; on the other side, it has to be *self-contained*, meaning that it cannot be defined with reference to the categories. To solve this problem, we define functionality in a double sense, so that no identification to one dimension is possible. More precisely, a new act is defined each time either a change in the propositional content is made, or a communicative intention is fulfilled. In both cases, a minimal inferred level of understanding from the other party is necessary. Simpler said, the analyst should be able to imagine that an utterance can be segmented in several sub-utterances according to whether the "right" content is communicated and/or the "intended" function is fulfilled. This duality implies two functional levels of communication: one concentrated on the design task and its representation(s), and another focused on the communication task and its fulfillment. These two levels correspond to two of our coding dimensions, namely "representational act" and "dialogue act", but they are *not defined* by them. Considering that each unit act can be either representational or dialogue or even both, the decision for each segmentation cannot be based on its pre-classification to one or both of these dimensions. Instead, once identified, it should by force be codable to at least one of these dimensions, and to exactly one of the pre-defined categories of each dimension. An exception is made for one-act-utterances that are characterized as non-codable because of their irrelevance to any of the coding dimensions. A complete list of the segmentation rules applied to the dataset can be found in Appendix 2.

A second level of segmentation refers to the sequence of acts. A sequence is a group of acts referring to the same goal. In our dataset, this goal is both communication and task-oriented, as we already said several times. However, an assumption in favor of the predominance of the task is adopted, because of its importance in guiding communication in the specific context. A task is defined by its object and the main design activity at a team level. Thus a task is changed when either its object or the main activity is changed. With object we refer to the cognitive focus of discussion at a specific moment of interaction. It is possible that a new object is introduced *during* another object's discussion, without initiating a new sequence itself. Given the fact that this can occur at any time of a sequence, the possibility to define sequences based only on the object of interaction is limited. At the same time, it is also possible that the object remains the same, but the activity around this object changes. As we said, we opt for the predominance of the design activity rather than the communication activity at the time of segmenting sequences. However, being the design activity dependent on its object, the task of deciding when one activity, e.g. a generation activity, stops and another one, e.g. transformation, initiates, becomes difficult when both activities are focused on the same object, e.g. solution.

To deal with these problems, we apply three main rules that define the succession of a sequence by another sequence in the same episode (Schegloff, 2007):

> One kind of relationship is another sequence of the same type but with reversed participatory alignment; the second kind of relationship is another sequence of the same type, with the same participatory alignment but a different item/target/topic. A third way in which a next sequence following a sequence close can be related yet separate is that it implements a next step or stage in a course of action, for which the just-closed sequence implemented a prior stage (p. 213).

Adapting these sequence relationships for segmentation purposes in our dataset, the second relationship-rule applies for the case of object change, as we previously described. However, for the cases in which the object stays the same, the other two

relationships are to be taken into consideration. The first one is very relevant to our dataset, especially to the one of Team A, because of the greater number of participants. The main reason for this relevance is that the formation of coalitions of 2-3 people is very usual in team design (e.g. Détienne & Visser, 2006; Visser, 2009) as in other cases of group communication (Mills, 1954). Thus, it is very frequent that a shift of sequence is accompanied by a shift in the consistence of coalition. Consider, for example, the case in which two participants have a discussion on an object, and then, "suddenly" the object is opened again to the rest of the team. These two instances, marked by different participatory alignments, are very possibly alleged to two different sequences. Although this relationship can serve as a potential indicator for sequence shift, it is not mandatory that this is true. The third relationship expressed by Schegloff (2007) comes in to fill this gap: in order for a new sequence to be initiated, some type of *function differentiation* is necessary. He refers to stages of action, for which the precedent is necessary to the subsequent. If a solution is generated, in one sequence, for example, it can be expected that it will be transformed or evaluated in another sequence. In this case, different functions operated on the same topic mark different sequences. However, as we already said previously, activity shift is not always easy to detect: communicative functions-activities are also necessary.

To identify and separate communicative functions at a sequence level, we are based on the notion of contribution, as defined by Clark & Brennan (1991):

> Most contributions to conversation begin with the potential contributor presenting an utterance to his or her partner (…So) contributing to conversation generally divides into two phases:
>
> Presentation phase: A presents utterance u for B to consider. He does so on the assumption that, if B gives evidence e or stronger, he can believe that she understands what he means by u.

> Acceptance phase: B accepts utterance u by giving evidence e that she believes she understands what A means by u. She does so on the assumption that, once A registers that evidence, he will also believe that she understands.
>
> It takes both phases for a contribution to be complete (p. 130).

In the above excerpt, Clark & Brennan's (1991) account of contribution, also followed in other studies (e.g. Clark & Schaefer, 1989) is presented. It is clear that for these authors the main communication goal is that of grounding, which leads to a mutual understanding between the participants. Such meaning co-ordination is the basis for any communicative interaction to occur, as we already made explicit in Section 1.3. However, in task-oriented communication, the task goal is predominant, thus co-ordination and collaboration on the task is the case in most interactions of this type. Still, the notion of contribution and its double construction of both a presentation and an acceptance phase are relevant also for task-oriented interactions. Nevertheless, some considerations need to be made.

The first has to do with the complexity of the presentation phase. A major complication is that of *embedding*. As Clark and Brennan (1991) put it, "the presentation itself can contain distinct contributions each with its own presentation and acceptance phases" (p. 130). This becomes very common in team interaction, where a contribution is very usually made by different participants. The second major consideration is related to the complexity of the acceptance phase and, more precisely, to the phenomenon of sequence "post-expansion" (Schegloff, 2007). This refers to the non-completion of a communicative sequence after the second pair part, which is also very usual in team interaction. Whether a post-expansion is limited to the acceptance phase of a contribution or it initiates a new contribution cannot be decided considering only the communicative function. Think, for example, of a case in which the assessment phase of a contribution is followed by an evaluation-oriented contribution.

To solve these two problems described above, topic consideration is necessary, not only at a sequence level, but also at an episode level, as episodes are defined as a series of sequences on the same topic (e.g. Mcdonnell, 2009). However, again, the identification of topic shift can be problematic. At an episode level, this is mainly because: a) even if there is an agenda to follow (in Team A), an agenda issue can include several topics, or, on the contrary, the topic introduced by an agenda issue is not sufficient to sustain an episode itself; b) topics refer to object components, object-related issues, or object-oriented actions, which all inter-relate to each other under the same object "umbrella"; deciding which sub-topic or related topic initiates a new episode is not always evident. This latter also applies at a sequence level.

To solve the problem of new topic identification, we are based on the concepts generated, transformed, and evaluated by the participants. In each of these acts, and their sub-acts, there are two possibilities (except for the 'generation' acts in which there is only one): either a new concept is introduced or a previously introduced concept is re-taken into consideration. Transformation and evaluation acts necessarily refer to a concept previously introduced. However, it is also possible that a new concept is generated through an act of transformation or evaluation. To decide whether a transformation or evaluation act introduces a new concept or not, we are based on characteristics of the concept, basically answering two questions: a) Is the thematic content of the act related to a concept which is further treated later on at least one more time by the same or other participant(s)? ; b) Does the act contain a concept which can be considered as highly relevant for the specific design object, either because it forms part of it (e.g. course elements, activities, characteristics, etc.), or because it influences in a way the design production/process? In both cases a new concept is introduced. How a new concept marks the initiation of a new sequence and a new episode is explained later on.

As we already said, not all interaction taking place during the meetings observed interests for our research goals: some episodes are irrelevant, or not directly

contribute to the design task. These episodes, once identified, are not taken into consideration at the time of further segmentation and analysis. Among the discarded episodes, we identified the following types: a) *free discussion* episodes, usually at the beginning and at the end of a meeting, focusing mainly on issues related to the institution and/or its members, creating (if in the beginning) or confirming (if in the end) a relaxed, common-grounding atmosphere; b) *action co-ordination* episodes, focusing on task assignment/controlling, scheduling, or process management; c) *cognitive synchronization* episodes, aiming at confirming a same level of knowledge on an issue before going on; d) *emotional synchronization* episodes, aiming at sharing emotions somehow related to the task (e.g. expressing dissatisfaction about the collaboration with another institutional team); and e) *non-design deliberative episodes*. With the latter, our discourse on the deliberativeness construct (Section 5.1.3) is applied. Non-design deliberative episodes refer to episodes of interaction in which some type of team thoughtfulness or reflection is present, but without concrete production of relevant design intermediary representations, such as constraints, requirements, and design proposals.

All design episodes of the types described above have been omitted from the dataset, as their analysis is considered irrelevant to the team design communication task. A special exception has been made for the cases of action co-ordination and cognitive synchronization, not in the form of episodes, though, but in the form of embedded sequences. Finally, only episodes identified as team design deliberative episodes have been considered as data for this research. The final dataset consists of 7625 interaction units, grouped into 436 sequences, grouped into 51 episodes for the total of 15 meetings. The vast majority of data and the different dimensions to be described call for the application of an interaction coding process, rather than other methodological tool. The next section presents some of the main general characteristics of any coding scheme.

5.2.4 THE CODING SCHEME

The main rationale behind the use of coding schemes in group interaction analysis is well explained by Poole, Keyton, & Frey (1999):

> In this procedure, trained observers identify segments of group interaction as codable units and then classify these units within the categories of a predetermined observational scheme. Such schemes provide information used to determine the interactive structure of a group, the distributional structure of interaction, and/or the sequential structure among the categorized units (p. 103).

The use of observational coding schemes as main Interaction analysis method has its share of critics, the most relevant of which is that it is somehow over-simplified (Bochner, 1978). Also, in coding systems where only one coding is true (or "more" true compared to other coding options), the question of multiple communication functions of the same message unit arises. Another issue regards the reliability of the chosen categories, as we already discussed in Section 5.1. Finally, the system's internal validity in relation to the pre-defined research questions is another issue to be resolved. Such problems can be successfully confronted if the issues of exhaustiveness, mutual exclusivity, and level of categorization are taken into consideration (Trujillo, 1986). Subsequently, we define each one of them and, additionally, we explain how exactly they are treated regarding our coding scheme.

Bales' (1950) classic IPA system is an exhaustive coding scheme, because a unit act is defined as an utterance that fits one and only one category of the system. This is feasible with *classificatory* coding schemes (Fischer, 1978), in which a communicative event is coded as an act of a certain kind or class. However, in complex coding schemes, it is very common that an act is coded to several dimensions, all contained in each act to some degree. In this case, it is also possible that an act is "non-codable" to none of the pre-defined categories (the more dimensions are used, the less categories for each dimension are expected to exist) for one or more dimensions. Also, the selection of dimensional instead of classificatory scheme implies than only

certain dimensions of a communicative phenomenon are object of observation; thus, again, it is possible that some communicative events do not give any information regarding the specific dimensions. Certainly, this has to be the exception and not the rule, as a coding scheme is supposed to cover the phenomenon it analyzes as much as possible.

Our coding system is composed of six dimensions, each one of them consisting of 3 to 18 mutually exhaustive categories. As we already implied, the possibility of non-codable acts exists, for the simple reason that there are events that do not directly interest our research questions. For example, utterances of possible signs of understanding form non-codable acts for our research, not because they are not meaningful from a communication point of view, but simply because their codification is not relevant to the theoretical constructs behind the coding dimensions. Instead, if "consensus" formed one of the constructs under analysis, the same acts could be considered as relevant, thus codable.

The second issue, mutual exclusivity, refers to the univocality of each act, meaning that assigning a single code to each act should be possible. Applying a multifunctional, dimensional scheme partly resolves this problem, as the multi-valence of an act can be treated separately, in different dimensions. However, still each dimension has various categories, which again should be mutually exclusive. This is not at all easy and coding decisions are sometimes ambiguous. This difficulty is resolved with fine-grained conceptual quality definitions, as exposed in the following section. Moreover, rules of distinction among categories, where it is considered necessary, are provided, supported with dataset based examples.

The third issue, levels of categorization, is used in this research as a reply to those critiques against coding schemes, regarding the violation of the constructive nature of communication (Hawes, 1978). Viewing communication as a dynamic process, several levels of coding are taken into consideration. In this research, the following levels of categorization are applied: an act coded in relation to a previous act, an act

coded together with a previously (in the whole interaction) made act, an act coded in relation to the whole interaction, a sequence of acts forming one coding category, and a whole episode being coded as one type or another. Moreover, two procedural levels of coding are applied: a first level, concerning coding of acts in relation to their precedent acts, sequences of acts, and episodes; and a second level, concerning the categories of design-related arguments, user experience, and intermediary representations.

The following section refers to the first level of coding, describing all the dimensions and categories that consist the coding scheme used for this research.

5.3 THE DROMEAS RUBRIC

All coding systems were at one time "new" and "customizable".

—MCGRATH & ALTERMATT, 2001

One issue always faced by researchers contemplating the observation and analysis of group interaction data is: "should I select an existing coding system, or should I design my own coding system for this study?" (McGrath & Altermatt, 2001). Here is the response these authors give:

> To the extent that you are working from a different theoretical perspective than researchers who have developed earlier coding systems, and to the extent that you are examining different questions and/or studying different operating conditions, you may be well served by developing your own coding system. Particularly to the extent that you want to apply the system to micro-level features of the interaction of certain sets of groups that you plan to study, you may need to include coding categories, unitizing rules, and recording methods that suit your unique purpose and study plans (p. 540).

Undoubtedly, the construction of a new coding scheme arises questions of validity and reliability as we already discussed. The reduction of the level of inference at the time of selecting among the pre-defined categories is considered as a main strategy to gain validity and reliability. However, the exploratory nature of the present research calls for the consideration of different dimensions and categories. We consider such complexity necessary, in order to give as concrete answers as possible regarding our research questions. Moreover, not being limited to a mere description of what is happening regarding one dimension, the constructed coding scheme searches for relations between dimensions and categories, giving an assessing power to the coding process and instrument. For this reason, we consider DROMEAS to be a "rubric",

rather than a coding scheme, to put emphasis on its dynamic and distinctive characteristics.

More precisely, the DROMEAS rubric (the name emerges from the initials of the dimensions applied) consists of six dimensions: (1) Design activity, (2) Representational act, (3) Object, (4) Meta-Epistemic reference, (5) dialogue Act, and (6) dialogue Sequence. The first three belong to the design task-process, whereas the second three to the communication task-process. Representational and dialogue acts are expressed at a unit act level; objects and meta-epistemic references are only marked when a perspective shift is made explicit through a unit act; design activities and dialogue sequences refer to a sequence of at least two acts joint together in a meaningful (representational or dialogical) way.

None of our rubric categories corresponds directly to the theoretical constructs described in Section 5.1. This is not surprising, as it is an expected inconsistency in qualitative research. As Venkatraman & Grant (1986) put it:

> In most cases, the linkage between theoretical constructs and their measures are left unspecified or else described in loose unverifiable ways. In striving for a stronger degree of correspondence between constructs and their measures, a set of criteria is needed against which these measures can be evaluated (p. 81).

Having said that, we divide the presentation of DROMEAS –meaning *runner* in Greek– in two parts: one explaining the coding categories (this section) and another explaining the functional relation of these categories with the pre-defined theoretical constructs (Section 5.4). In sum, a main contribution of the present dissertation consists in making explicit as clearly as possible the different perspectives and functionalities DROMEAS can support.

5.3.1 DESIGN ACTIVITY

As we already said in the 'Segmentation' paragraph (5.2.3), the main criterion applied for sequence segmentation in our dataset is the design activity shift. Design activity refers to the *team design goal expressed in a sequence of interaction*. As it can be expected, a collective goal is not made explicit as such, unless someone –e.g. the Course chair– states it in order to guide interaction. In most of the cases, the decision on how the design object is treated by the team –which corresponds to what we consider as a team design goal– is based on the general impression of the analyst regarding what participants actually do at a specific moment of interaction in terms of design.

Given the high level of inference regarding this dimension, the question of reliability is very important. However, two conditions are necessary in order to "correctly" infer the situated collective intention. Firstly, a very good knowledge of the context of interaction, in order for the analyst to situate herself in the team's communication flow, and thus, be able to detect any change in this flow. Secondly, given the first condition, someone could argue that the best knower of the team's goal is the team itself, thus the most adequate analyst would be a participant in the interaction. However, we consider this assumption not appropriate, for the reason that team participants are very much "inside" the interaction, and their personal involvement in the task can hinder their perception of what is happening at a team level. Therefore, we consider an external, but very much aware of the team situation, analyst as the most adequate option, even though this renders the reliability checking a more difficult task.

On the other hand, speaking of team goal at a sequence level is not the same as speaking of team goal at an episode or at a meeting level, where some "internal" institutional knowledge is maybe necessary. We consider that the definition of team design goal as interaction proceeds is possible having as a basis the inter-personal and interactional context. Inter-personal context defines any shift at a team

communication level, whereas interactional context can reveal any shift of the object of interaction and the acts performed regarding this object. Considering these two context dimensions, design activity shift identification is possible and replicable (at least at an intra-rater reliability level).

The categories describing team design activity in our dataset are few –only three– and quite different the one from the other. Adopting a Cognitive Psychology perspective of design, the following categories proposed by Visser (2006b) are used: generation, transformation, and evaluation. In the following paragraphs we present each one of them regarding team design activity at a sequence level.

Generation/Presentation (pres)**.** The goal of the team is to "make known" any relevant facts, possibilities, ideas, considerations, or plans of action regarding a specific design issue-topic, without getting into details, and without assessing their truth, feasibility, or quality.

Transformation (trans)**.** The goal of the team is to "make understand" a relevant fact, idea, or consideration regarding a specific design issue-topic, by getting into details regarding its acquaintance, adequacy, or need for taking into account, without implying, imposing or asking for any decision regarding its acceptance.

Evaluation (eval)**.** The goal of the team is to "make believe, accept, or discard" a relevant fact, idea, consideration, or plan of action, considered crucial or influencing for the design task/process. It is oriented towards decision-making, either at a conceptual or at an action level.

It is interesting to note here that the goal of each team design activity is expressed as being a communication goal (this is why we also propose to use the alternative term "presentation" instead of "generation", which is a more individual thinking concept). Three main goals are identified: make known, make understand, and make believe/accept/discard. The definition of team design activity with communication terms is necessary, because designing in team presupposes communication, in

contrast to individual design activity. In other words, what interests in team design is how the cognitive functions are communicated, and how communication influences on these cognitive functions.

On the other hand, the fact that team design activity is always situated in a communication context, renders it difficult for an outsider to identify it. For this reason, we will not provide any separate example to demonstrate coding with each one of the dimensions. Instead, we will provide a coded excerpt of the dataset after the three design-based dimensions are presented, namely design activity, design act, and design object. In this way, the relations between them at a sequence level can also be taken into consideration. Subsequently, the same coded excerpt used for the design dimensions is used in respect to the communication dimensions, namely dialogue sequence, dialogue act, and meta-epistemic reference. In this way, the mutual exhaustivity between the design and the communication process is reserved.

5.3.2 REPRESENTATIONAL ACT

As said in several ways throughout this dissertation, socio-cognitive interaction consists of a double process, the one focusing on the social task, and the other focusing on the cognitive task. Moreover, a distinction between these two modes is possible, according to the socio-cognitive interaction analysis mode. Trognon (1999), for example, makes the distinction between illocutionary and cognitive aspects of the same act. Similarly, we make the distinction between 'representational acts' and 'dialogue acts', adding the assumption that it is possible that an act is made only at the design content level, or at the dialogical interaction level.

The term 'representational act' describes the nature of any verbal act that changes somehow the semantic-cognitive content of the object under discussion. Based on Visser (2006b), we propose the following list of design representational acts: generate, specify (*concretize* in Visser's original proposal), detail, add, duplicate, modify,

revolutionize, merge (added to Visser's original proposal), and evaluate. Table 9 presents the code and definition of each one of those, as used in the specific dataset.

The calculated inter-rater reliability for this coding dimension is considered satisfying (Cohen's Kappa=0,72, Krippendorff's Alpha= 0,7428). For the inter-rater checking process, two raters were used (the author and a "blind" rater). No previous training was given to the second rater, in order to facilitate enhancement of the coding categories' definitions, on the basis of the rater's questions for clarification, comments, and externalized thoughts. As a result, a list of details concerning their further distinction emerged (Appendix 3).

TABLE 9. DROMEAS REPRESENTATIONAL ACTS

Category	***Definition***
Generate <gen>	Introduce a first-appearing main relevant element. The notion of main is defined by whether this element forms part of an intermediary representation (proposal, constraint, requirement) or it refers to a new task or object introduced.
Specify <spe>	Concretize a previously presented element, either by defining it or by making explicit (aspects of) its qualitative or quantitative nature, without expressing an evaluation towards them.
Detail <det>	Expand a concept or event by listing its component concepts and/or events, answering one or more "what else" question(s). The new information provided is usually presented in an "and", "or", "but" relation.
Add <add>	Add new information, such as time, place, means/tools, manner, or a whole idea or event to a previously stated idea or event. In the second case the new idea/event is added either because it is considered relevant or because of some type of "logical" relation, such as cause-effect, reason-result, means-purpose, condition-outcome. The goal is always to better contextualize an idea/event.

Duplicate **<dup>**	Reproduce an already generated element by shifting the focus again to it. Such reproduction can be either an exact repetition of a previously stated element e or a clear reference to it as the main focus of discussion for a second time.
Modify **<mod>**	Transform an element e into another version e', neither detailing it nor concretizing it. Such transformation can either refer to a re-contextualization of the element (e.g. when a problem becomes a solution or when a solution becomes a requirement), or to a change in its epistemic status (e.g. seen from other perspective or replaced by a slightly modified alternative). At any case a conceptual modification needs to be explicit, and not only inferred
Revolutionize **<rev>**	Replace an element e by its opposite or by a totally different alternative e' that serves the same function as e. Revolutionization can also "stop" at a level of revision or cancelling, without exactly getting to an alternative. Its goal is to doubt or negate the validity of a concept in a specific context.
Merge **<mer>**	In design made explicit visually, disjunctions and adjunctions of elements are very common and are often combined with divergent and convergent modes of reasoning. In the present research, the term "merge" is used to describe each time two (at least) concepts, previously made explicit, are put together in an effort of distinction, comparison, or jointness.
Evaluate **<ev>**	Assess an element e by attributing it a value or by expressing an attitude of towards it. Such attitude is usually related to expression of preference/non-preference, but it can also express doubt, reflection, insistence of importance, etc.

5.3.3 OBJECT

As we already implied since the beginning of this dissertation, any act or activity is object-oriented. This object refers to a cognitive entity (group of concepts expressing the same value), towards which the representation is directed (or derived from, depending on what cognitive theory perspective is applied). When made explicit in discourse, object refers to a type of generic cognitive perspective that orients discourse for a certain period of time. In interaction, this can last from one unit act to a shorter or longer sequence of acts. In task-oriented interaction, it is very rare that the same object "occupies" discussion throughout a whole episode. Rather, it is very common that continuous attention shifts at the representational level take place, making thus explicit the versatility of the design object.

Being treated as a discourse-based dimension, 'object' categories can also be accompanied by frequent discourse markers that indicate a representational shift towards a specific object category. Table 10 presents the main design object categories used in this research, adapted from Darses et al. (2001) and Newell & Simon (1972). Subsequently, Figure 14 presents a dataset excerpt coded with the three dimensions presented so far (design activity, representational act, and object). The excerpt coded and presented above is selected for being self-contained, in the sense that almost all its representational acts are related among them, and not with other acts encountered in different sequences, which is also very usual.

TABLE 10. DROMEAS DESIGN OBJECTS

Category	*Definition*
Problem <P>	Any explicit reference to a concept or state of affairs considered problematic for the design process/product
Solution <S>	An explicit idea referring either to an artifact that can potentially form part of the design object, or to a design action presented as a solution
Goal <G>	Any explicit reference either to a specific, team/course-related prescribed objective, or to a general idea of how the course should be, without getting concretized into specific solutions or strategies
Method <M>	Any explicit problem-oriented strategy. It is distinguished from solution in the sense that method is not a potential part of the design object, but rather an action that guides the problem-solving process
Domain object <O>	Any explicit use of an existing tools, artifact, or resource, as guide, model or help for the design object-at-hand. Also, any use of a disciplinary concept as intermediary representation, without "embodying" it in a concrete solution
Domain rule <R>	Any explicit reference to an existing institutional or disciplinary procedure as relevant for the design process-at-hand
Task <T>	Any explicit task co-ordination or assignment between the team members at the present meeting time. Also it is used to code any design relevant past behavior of one or more agents (not necessarily team members)

ID	Sp.	Transcription	D	R	O
1	G	Can they have an Elluminate session on their own without a tutor?	trans	spe [x]	S
2	A	Yeah that's the idea ()		**ev [x]**	
3	A	Well I wouldn't have done it ()			
4	A	I would rather give them enough information to say -			
5	G	Yeah but it's about them having the the access to that space when they need it		gen [a: access]	
6	A	Like the room the room's set up and the			
7	G	Yeah			
8	A	All that stuff			
9	G	I would actually it might you know it probably is if you've got the room open all the time		det [a]	
10	G	they probably can't go in			
11	G	() they can just go in when you don't book it ()			
12	E	I think it's difficult to have uploaded your thing and have a discussion there and then also have the group discussion at the same …	eval	gen [b: activity space]	(P)
13	E	it doesn't seem very … natural thing to do …			
14	A	Yeah			
15	E	(it would be better) WITHIN your Elluminate room		**dup [x]**	S
16	A	Yeah			
17	E	Actually I think (that is what) you said as well didn't you so that we ()			
18	A	Well that's a possibility but some people might not be happy with that or you know it's just		**rev [x]**	
19	E	Yeah but then how do they take the decision in the end?		gen [c: decision]	
20	A	Well that's the			
21	E	Question			
22	A	Yeah I mean their decision has to be made on this on this ehm		**add [d: icon]**	
23	E	Within the			
24	A	On this icon here [everyone looks at screen]			
25	E	Oh OK			
26	A	so you know the the end point should be "OK we've decided basically we've decided to work on this problem"		add [d]	
27	G	You could put as the caption there		**add [e: caption]**	
28	G	you know "if you want to you can go and do this in real time in Elluminate" or whatever		det [e]	
29	G	you could put an instruction manually where the caption is			
30	G	For the icon (to show what it) represents			
31	E	() discussion () necessary			
32	G	No no no it's important			
33	E	() just also			
34	A	Should we have a meeting the four of us next week to discuss this?		gen [f: meeting]	(T)
35	E	Yeah			

FIGURE 14. AN EXAMPLE OF CODING WITH DROMEAS DESIGN CATEGORIES

The above episode excerpt consists of two design activity sequences, namely: solution transformation (lines 1-11), and solution evaluation (lines 12-35). The problem and task generation acts that take place at lines 12 and 34 correspondingly do not mark the initiation of a new activity-sequence, as they are focused only on one unit action. Thus, the main team object for the whole excerpt has been considered to be one: solution. Beginning with the first exchange between speakers G and A in lines 1-2, the reader-analyst can immediately understand that the object treated is a solution, mainly because of the linguistic indicators "can" in line 1, and "idea" in line 2. Also, knowing the context, Elluminate session refers to one of the tools used as resources in the under-design course, which was some lines before presented as a proposal for a specific block of activities. Knowing that, and also looking at the continuation of the sequence, we can further assume that the main concept treated in the first sequence is not the element "Elluminate session", but one of its qualities. The quality specification starts in line 1 ("on their own", "without a tutor"), but neither of these elements is further treated, at least not at a representational level. The main concept, "access", is only generated in line 5 and being detailed later on in lines 9-11. Line 12 indicates a shift to "problem", marked with the words "difficult" (line 12) and "not natural" (line 13). In line 15, the "Elluminate" solution is duplicated by speaker E, and in line 18 speaker A slightly resists to it. A new element of the course activity, namely "decision", is introduced in line 19, and two functions ("icon", "caption") are added to it (lines 22, 27). Finally, a new task concept, "meeting", is introduced in line 34.

The inter-rater reliability for this dimension is considered satisfying (K= 0.72).

5.3.4 **M**ETA-**E**PISTEMIC REFERENCE

As we already said several times, the use of other voices in design is a relevant and desired process aspect. Such multi-voicedness can be expressed: a) at an *inter-personal level*, by making reference to something previously stated by another physically

present participant; b) at a *dialogical level*, by enouncing other discursive subjects, e.g. relevant persons or entities, not physically present; and c) at an *intra-personal level*, when the same participant changes her perspective, through using a different knowledge domain as her epistemic source at that moment. We consider all these three expressions of inter(intra)subjectivity of equal importance, and they are represented in our rubric in the dimension called "meta-epistemic reference".

Having said that, the "meta-epistemic reference" dimension entails three different concepts that are considered as functionally equal: the perspective, the conceptual viewpoint source, and the type of other voice. The perspective can refer either to an object-related or to a design-related cognitive orientation. Based on both the elements of the user experience (Garrett, 2003) and the ontology of design content (Gero & McNeill, 1998), the following possible perspectives are identified: content, function, structure, visuals, behavior. As far as viewpoints is concerned, these can be based on one of the following knowledge sources: Technology, Pedagogy, Management, Design, or personal experience, if no domain knowledge is used. Finally, the most relevant other voices are represented by the users, external (teams of) experts, and other physically present participants. Discourse markers help to distinguish between categories, but as they usually belong to a community's specialized *lexicon* (Clark, 1996), some context knowledge is necessary for their identification. Thus, we did not conduct any reliability test. We consider these definitions and the complete coded dataset (see Annex) sufficient for their replication. Table 11 presents all the categories of meta-epistemic reference dimension.

TABLE 11. TYPES OF META-EPISTEMIC REFERENCE

Perspective	
Content <C>	when the object is perceived as its material components, resources, or/and their relations
Content function <Cf>	when the object is perceived in relation to the technological or pedagogical function of one of its material components or resources
Function <F>	when the object is perceived as the way its elements work, as a whole, satisfying technological requirements
Structure <S>	when the object is perceived as a put-together of elements in specific positions
Visuals <V>	when the object is perceived on the basis of its graphic aspects
Behavior <B>	when the object is perceived on the grounds of actions (to be) taken by the team or other relevant others (rather than the users)
Conceptual viewpoint source	
Technology <T>	when the knowledge domain where a viewpoint is expressed is related to technological characteristics
Pedagogy <P>	when the knowledge domain where a viewpoint is expressed is related to pedagogical characteristics
Management <M>	when the knowledge domain where a viewpoint is expressed is related to management characteristics
Design <D>	when the knowledge domain where a viewpoint is expressed is related to the design field/perspective
Experience <E>	when the knowledge domain where a viewpoint is expressed is related to personal experience(s)
Other voices	
Users <U>	when users' perspective is adopted at the time of uttering a point of view or when their reaction is explicitly assumed
Expert(s)-external(s) <X>	when an expert or a team of experts is enounced as relevant to a point of view or when their action(s) is described
Other speaker <Sp>	when another present participant is quoted or explicitly addressed to in relation to an explicitly stated point of view
Rest of team <All>	when the speaker addresses the whole team asking for them to react regarding her statement

5.3.5 DIALOGUE ACT

Together with Bunt (1999), we define dialogue acts as the "functional units used by the speaker to change the context" (p. 141). These context changes can be of the following forms: linguistic, semantic, cognitive, physical, and social (Bunt, 1999). We consider that in order for a dialogue act to be defined, all its contextual factors need to be defined.

Various lists of dialogue acts have been hitherto proposed according to their communicative functions. Table 12 presents four representative proposals of dialogue acts in task-oriented contexts.

TABLE 12. FOUR PROPOSALS OF TASK-ORIENTED DIALOGUE ACTS (IN BOLD THOSE THAT APPEAR IN AT LEAST TWO PROPOSALS)

Authors	***Task-oriented dialogue acts proposed***
Traum & Hinkelman (1992)	Initiate, Continue, **Acknowledge,** Repair, Request-repair, Request-acknowledgement, Cancel, **Inform**, **Query-W, Query-YN**, **Accep**t, **Request**, Reject, Suggest, Evaluate, Request-permission, Offer, Promise, Elaborate, Summarize, **Clarify**, **Question-answer**, Convince, Find-plan
Carletta et al. (1997)	Ready, **Acknowledgement, Clarify**, **Reply-Y, Reply-N, Reply-W**, Instruct, **Explain**, Align, **Check, Query-YN, Query-W**
Bunt (1999)	**Query-YN, Query-W,** Query-ALTS, **Check**, **Answer-YN**, **Answer-W,** Confirm, Disconfirm, **Inform**, Agree, Disagree
Allwood (2000)	Statement, Specification, **Request**, **Question**, Objection/Hesitation, **Explanation**, Conclusion, **Answer**, **Acceptance**

As it can be seen on Table 12, there are substantial differences between the various proposals of dialogue acts. Considering only the few common acts, it can be said that they all perfectly apply to information-seeking dialogues, but not to more collaborative types of dialogue, such as negotiative, exploratory, and persuasive dialogues. As we already said, the macro-goal of the meetings we observed is team design deliberation. Thus, the communicative functions of the task-oriented acts performed in this context have the macro-function of thoughtful team action planning. Of course, as we said, some decisions are taken less thoughtfully than others, and also, sometimes, planning is knowledge-oriented instead of action-oriented. Nevertheless, the type of interaction we are interested in is always oriented towards knowledge-sharing, joint representation, and consensual decision-making. In such collaborative context, other communicative functions may interest the most, comparing to the ones presented on Table 12.

Thus, following the general rule that "to the extent that you are examining different questions and/or studying different operating conditions, you may be well served by developing your own coding system" (McGrath & Altermatt, 2001; p. 540), we propose our list of dialogue acts serving the specific joint deliberation context. Moreover, these acts are defined with respect to all the five contextual dimensions we mentioned above. It is their different functions regarding all of these factors that allow the exclusive classification of each unit act to only one or none of the dialogue act categories. Table 13 presents the dialogue acts we propose and their definition.

TABLE 13. PROPOSAL AND DEFINITION OF TASK-ORIENTED DIALOGUE ACTS

Propose <pro>	Present an element (concept, relation, action) as an appropriate solution at a given moment of interaction
Explain/ expose <exp>	Enhance understanding by giving new information about a statement, somebody's whole idea/saying, or a new concept/tool
Narrate <nar>	Inform others about a sequence of relevant (to the design task) past events of another person or the speaker herself (the focus always being on the events, and not on the related object, if any)
Instruct <ins>	Show how to operate an action or how a tool functions, usually accompanied by gesturing or manipulating objects
Verify <ver>	Request for a clarification about a known or unknown (introduced as new) issue
Clarify <cla>	Enhance understanding about an idea, statement, or state of affairs, either by reformulating it or by making explicit information that was previously taken for granted
Conclude <con>	Make an inference towards a statement or summarize previously stated ideas
Justify <jus>	Give support to the credibility of an opinion, either in the form of evidence, or with another opinion
Comment <com>	Express a neutral opinion related to a previous idea, without explaining/clarifying it or proposing something new
Assess negatively <neg>	Express a negative assessment related to a previously stated idea or state of affairs
Assess positively <pos>	Express a positive assessment related to a previously stated idea or state of affairs
Interpret <int>	Exteriorize understanding of another speaker's statement by reformulating it in an effort to expand it
Postpone <psp>	Cancel or delay acceptance of a proposal or plan of action
Agree <agr>	Express concordance to a previously stated opinion, by repeating its content or by expressing a simple ("good", "nice", "interesting", etc.) positive assessment or acceptance ("OK", "let's do it")
Call for attention <att>	"Alarm" the other speakers by expressing doubt about the truth of an opinion, or call into consideration non-discussed issues
Open <ope>	Introduce a new issue as object of discussion in a natural way, i.e. without calling for a special attention to it
Present alternative <alt>	Present an idea as an alternative to a previously stated one
Oppose <opp>	Express an idea as an opposite to a previously stated one

The nature of the above acts is not identical in terms of their (in)dependence in discourse. Some of them (propose, oppose, present alternative, open, call for attention, verify) are always *nucleus acts*, in the sense that they are self-contained regarding their communicative function. Some others (justify, explain, conclude, comment, assess, clarify, agree, postpone, interpret) are *satellite* acts, in the sense that they form functional units together with other acts, e.g. a proposal justification, a comment on an opened issue, or a postponement of verification. Finally, the rest of the acts (expose, instruct, narrate) are neither nucleus nor satellite, but they serve to change the discursive genre, thus the whole flow of communication, by shifting the focus either to a "physically" existing cognitive object, or a series of past or possible events, or ideas. The identification of the latter can be done linguistically-semantically, whereas for the rest the five contextual dimensions-shifts need to be described. Table 14 presents some basic linguistic-semantic indicators for the hereby-called *"genre-shifting"* acts. Table 15 presents all five contextual factors for each one of the nucleus acts. Satellite acts, given that they are the most difficult to be distinguished, will be explained in detail right after.

TABLE 14. DEFINITION OF GENRE-SHIFTING ACTS

Expose <exp>	Sequence of acts presenting a knowledge domain object (tool, artifact) or an already performed solution
Instruct <ins>	Sequence of commands, "if-steps", and deictics, used to shed more light on the performative aspects of a solution or object
Narrate <nar>	Sequence of events that have taken place in the past, but that they still influence in a way the present task

TABLE 15. DEFINITION OF NUCLEUS DIALOGUE ACTS

Open <ope>	***Ling.***	Indicators meaning “issue”, “subject”, “topic”, etc.
	Sem.	Present a new issue to be discussed
	Cogn.	Invite others to focus on a specific object, solution, or problem as the main topic of discussion
	Phys	Read agenda and/or address everyone (or at least the meeting chair), or express an intention to be heard by everyone
	Soc.	The introduced topic is followed until another one is introduced
Propose <pro>	***Ling.***	Indicators meaning “should”, “would”, “could”, …
	Sem.	Put forward an action-oriented statement
	Cogn.	Introduce a method, task, or solution
	Phys.	The tone of the voice and/or overall attitude indicating that the team should consider what is said as a proposal
	Soc.	Reaction at least by one participant other than the speaker
Present alternative <alt>	***Ling.***	Indicators meaning “whereas”, “otherwise”, “the other thing would be”, etc.
	Sem.	Present a “different than” opinion or an idea
	Cogn.	Focus on a solution conceived as alternative, or to aspects of an idea different or opposite of the one discussed
	Phys.	Address the person who had previously presented the idea towards which the alternative is proposed, point at/show objects related to the alternative solution
	Soc.	Evidence of understanding by at least one participant other than the speaker
Call for attention <att>	***Ling.***	Indicators meaning “(yes) but”, “what matters”, “anyway”, …
	Sem.	Present an opinion that is worth being considered
	Cogn.	Shift attention to problematic or unexpected aspects of the object under discussion
	Phys.	Put emphasis on the element that calls for attention
	Soc.	Reaction by the same (in a rhetorical way) or other speaker
Verify <ver>	***Ling.***	Any indicator of request or question
	Sem.	Search to clarify an ambiguous object or idea or to reduce uncertainty
	Cogn.	Ask for revealing (more) information about an object
	Phys.	Make explicit the desire to know, e.g. by addressing the supposed expert or by insisting until an answer is given by someone
	Soc.	Followed by a clarification or other response, in case of successful verification act

As far as the satellite acts is concerned, a main distinction should be first of all made: some (justify, assess, conclude) are potentially argumentative, while the rest of them (explain, comment, clarify, agree, postpone, interpret) are not. In a joint, deliberative, socio-cognitive interaction, two are the most important nucleus acts: the proposal(s), and the alternative proposal(s), where applicable. The condition that such proposals are justified, opposed to, or accepted as such is necessary for any public deliberation to take place. Of course, as we saw, other discourse genres are possible during design deliberation, either because of its strongly cognitive character, or because of it also being a natural communication (human cannot only be considered as decision-making agents). So, similarly, acts other than argumentative are possible to take place, and also to be expanded in more than one unit acts, without forming a new genre-sequence.

The notion of "macro-act" needs to be introduced here, in the sense it was first treated by Van Dijk (1977). According to this author, the same discourse function is possible to be expanded in more than one unit acts, and several micro-functions can be assigned to these secondary acts. As the focus of this research is not to analyze the totality of discourse functions encountered in the dataset, we will limit ourselves to one type of discourse, the argumentative discourse. The rest of discursive-communicative functions will be just identified, without further analyzing them. It is, for example, possible that an explanation macro-act ends up with a summary of the concepts presented. The fact that the last act embedded in an explanation macro-act is a "summary" does not meet the goals of this research. Instead, the fact that lines *x* to *y* represent an explanation is relevant.

Beginning with the non-argumentative satellite acts, a second distinction needs to be made: the exclusively *acceptance acts* and the potentially *presentation acts*. As we already saw, in Clark & Schaefer's (1989) dyadic system of communication, each verbal contribution in a dialogue consists of a presentation and an acceptance phase. Correspondingly, acts belonging to the presentation phase of a contribution can be

called "presentation acts", whereas the ones forming part of the acceptance phase will be called "acceptance acts". The latter are also known as "feedback acts" (Allwood, 1999), and according to Clark & Schaefer (1989) can also initiate a presentation phase, but of another type of contribution (let's call it a "feedback contribution"). For sake of simplicity, we stick to the primary contribution term, according to which acceptance acts do not initiate a sequence themselves. In this sense, the acts of "agree", "postpone", and "assess" can only form part of an acceptance phase, meaning that they cannot initiate a contribution –and subsequently a sequence, as we will see in the next paragraph– themselves. On the other hand, the acts of "explain", "comment", and "clarify" can also initiate a primary contribution themselves, or be central part of a presentation phase. Less frequently, they can also close a sequence, as part of an extended feedback (see paragraph 5.3.3).

A last distinction to be made, regarding the nature of satellite acts, is between the content-oriented ones and the addressee-oriented ones. The traditional distinction between semantic and pragmatic language functions has been recently put in doubt (e.g. Renkema, 2009). This doubt is also confirmed in our dataset, where most representational acts are also coded as dialogue acts, and vice versa. However, it is possible that a dialogue act only focuses on the addressee, without generating, transforming, or evaluating the design content. Acts that are possible to be encountered in this form are: verify, call for attention, agree, clarify, postpone, oppose, explain, comment, and conclude.

Having said that, the main characteristics of the satellite dialogue acts will be now given.

Comment. Express an idea or opinion about a previous statement, without evaluating it positively or negatively. It can have various functions, such as: a) assess the content of a statement; in this case it forms an *evaluative comment* and is accompanied by the "evaluate" representational act; b) add now information to a

statement's content without the intention of explaining or clarifying it; and c) express an opinion regarding the status of another speaker or her statement but without assessing or transforming its content.

Assess (positively/negatively). Make a positive or negative assessment as part of a judgment. Such judgment can be an argument from positive or negative consequences or from alternatives. Sometimes the positive/negative assessment forms a judgment itself, what is known as evaluative judgment. Linguistic markers (words, phrases) are necessary in order to decide for an assessment (see for example Goodwin & Goodwin, 1987).

Explain. It can have two main functions: a) make a whole idea more understandable, in the sense of "explain oneself"; in this case it is an addressee-oriented 'explain' act; b) add more information to a content, by extending or enhancing it; in this case it is potentially accompanied by corresponding representational acts. In all cases, 'explain' can also be expanded in more than one unit acts, giving itself the definition of a "macro-act". As we already said, 'explain' is not argumentative, however, many times it is confused, as it is usually expressed through 'because' relations. To distinguish it from a 'justify' act – defined later on –, we can bear in mind that 'explain' often answers the question "How do you know?", whereas 'justify' has a more sophisticated question: "Why do you say so?".

Conclude. The last relation/act/step of a (deductively valid) argumentative or explanatory inference. Almost always accompanied by the word "so", without necessarily implying that each time there is "so", there is also a 'conclude' act.

Clarify. Give to (better) understand a concept or idea, without adding new relevant information to it, or by slightly concretizing the information given. Such concretization can refer either to conceptual quality information that is added to the concept presented, or to "hidden" background information that the speaker is asked

to (usually with a `verify` act) or motivated alone to reveal. Usually accompanied by positive signals of comprehension or by subsequent 'verify' act(s) by the other party.

Agree. Commit to a viewpoint, by not merely accepting its truth (Allwood, et. al., 1992). This implies some action-oriented content to which agreement is expressed, such as constraints, requirements, and proposals. Positive signals of comprehension and acceptance of assessments are not marked as agreements.

Postpone. Delay action or decision, either because of external factors, such as technological problems during the meeting, or because the speaker-postponer does not feel ready, or has some good reason to postpone. It can be directed to both another speaker or the speaker herself.

Interpret. Express active understanding towards another party's statement, either by reformulating it or by adding information to it. In any case, the speaker's goal is not to further elaborate the concept of the idea contained in the statement, but to show that the communicated message has been completely understood.

Justify. Support a statement by giving evidence to it or by another statement that is considered valid and relevant in the specific context. Evidence refers to any numerical or nominal statement of facts, whose presence is considered necessary for the supported statement to be true. However, in everyday discourse the use of such evidence is quite uncommon. Instead, the use of types of reasons that are considered relevant to the specific context is more common. We have already mentioned three types of inferences strongly related to design reasoning: rule-based, user-based, and from personal opinion. These types of reasons are sufficient to support a design reasoning statement, however their necessity also has to be judged before assuming the presence of an argument. Replying the question "How do you know?" is a primary identification step. Of course, other critical questions need to be applied in order to claim about the quality of an argument, especially if it is of the type just

described, but evaluation aspects of argumentation exceed the goals of this dissertation.

Oppose. Reject or reduce the truth of other party's statement, or of oneself in case of monological argumentation, by presenting facts that render it impossible, less feasible, or less worthy of attention. It corresponds either to a counter-claim or to a counter-evidence.

As we said, some of these acts (justify, assess, conclude) are potentially argumentative, meaning that they can support a nucleus act in an "argumentative way" (we will explain how exactly in Section 5.5). It is also possible, though, that the rest of the satellite acts we just described take the place of the nucleus acts; in this way, they can also form part of an argument, if supported by one of the "purely" argumentation acts, such as 'justify' or 'conclude'. In one way or another, the search for an argument is not as evident, as it will be subsequently explained.

The inter-rater reliability for this dimension is K= 0.71 (Krippendorff's Alpha= 0.725).

5.3.6 DIALOGUE SEQUENCE

The last DROMEAS dimension refers to what we defined as Dialogue Sequence. The dialogue sequence is a communicative activity, which can be more or less dialogical, depending on the number of active participants, and the quality of their communicative acts. We preferred the term 'dialogue sequence' instead of communicative activity, bearing in mind the fact that it can also be "monolectical", meaning by means or through only one person, although the goal always being dialogical.

Returning to what se said in the previous paragraph, a new sequence can be initiated either by one of the nucleus acts (open, verify, propose, present alternative, call for attention, oppose), or by one of the following satellite acts: explain, clarify, comment,

interpret. The reason why *these* satellite acts and not the others can be considered as presentation acts is related to the acceptable (communication) distance between themselves and the nucleus they support. The acts of 'agree', 'assess', and 'postpone' are in strong relation to their nucleus, in a way that even if they are expanded, the form part of the same sequence. The case that a sequence has a genre-shifting act as a main act is also possible; in this case, we speak more of a monolectical rather than a dialogical sequence.

Having said that, we can expect 13 different types of dialogue sequences, depending on their main presentation act, and based on the assumption that a communicative contribution cannot have more than one main presentation acts. Of course, as we said, it is possible that other presentation phases are embedded in the main presentation phase, but there is always one presentation that is predominant. Moreover, not considering the genre-shifting acts, there are two main types of dialogue sequences, following the same distinction of dialogue acts: the nucleus, and the satellite sequences. The satellite sequences are necessarily initiated by a satellite dialogue act. We use the term "initiate" to stress on the primary function of a sequence's main presentation act. However, it is not said that this act is necessarily at the beginning of the sequence (see also Appendix 3). Another clarification needs to be made regarding the nucleus sequences: not all sequences having a nucleus act as a main act are also nucleus in their functionality regarding the other sequences.

In other words, dialogical sequences are also related to each other in a functional way, constructing the "glue" of task-oriented communication. Among the five nucleus acts we propose, only three, namely 'propose', 'present alternative', and 'open' are by nature nucleus, meaning that they do not need another act or sequence in order to be defined. `Verify' and 'call for attention' can be either "glued" onto a previous sequence, or initiate a new flow themselves. Even though we do not enter into detail in that part, we consider it very relevant to identify the function of each sequence and its relation, if any, to the previous ones. Such macro-discourse analysis

is necessary in a context where dynamic communication emerges as such and not previously defined dialectical games can be applied. Instead, the function of discourse can serve as the basis for an in-depth dialectical or argumentation analysis.

Before going on to further explain DROMEAS functionality, we present on Figure 15 the same excerpt coded with the design dimensions categories, this time coded with all three communication dimensions.

ID	Sp.	Transcription	ME	A	S
1	G	Can they have an Elluminate session on their own without a tutor?	Cf	**ver**	VER
2	A	Yeah that's the idea ()			
3	A	Well I wouldn't have done it ()	E	com	
4	A	I would rather give them enough information to say -			
5	G	Yeah but it's about them having the the access to that space when they need it	U	att	
6	A	Like the room the room's set up and the	**spG**	int	
7	G	Yeah			
8	A	All that stuff			
9	G	I would actually it might you know it probably is if you've got the room open all the time	F	exp	
10	G	they probably can't go in			
11	G	() they can just go in when you don't book it ()			
12	E	I think it's difficult to have uploaded your thing and have a discussion there and then also have the group discussion at the same …	F	att	ATT
13	E	it doesn't seem very … natural thing to do …	E	jus	
14	A	Yeah			
15	E	(it would be better) WITHIN your Elluminate room		pro	
16	A	Yeah			
17	E	Actually I think (that is what) you said as well didn't you so that we ()	**spA**	int	
18	A	Well that's a possibility but some people might not be happy with that or you know it's just	U	com	
19	E	Yeah but then how do they take the decision in the end?	**spA**	ver	
20	A	Well that's the			
21	E	Question			
22	A	Yeah I mean their decision has to be made on this on this ehm	S	cla	
23	E	Within the			
24	A	On this icon here [everyone looks at screen]			
25	E	Oh OK			
26	A	so you know the the end point should be "OK we've decided basically we've decided to work on this problem"	U	exp	
27	G	You could put as the caption there	V	**pro**	
28	G	you know "if you want to you can go and do this in real time in Elluminate" or whatever		exp	
29	G	you could put an instruction manually where the caption is			
30	G	For the icon (to show what it) represents			
31	E	() discussion () necessary			
32	G	No no no it's important			
33	E	() just also			
34	A	Should we have a meeting the four of us next week to discuss this?	**spE, spG**	ver	
35	E	Yeah	**spA**	agr	

FIGURE 15. AN EXAMPLE OF CODING
WITH THE DROMEAS COMMUNICATION CATEGORIES

5.4 DROMEAS' FUNCTIONALITY

Having presented all six dimensions forming part of the DROMEAS rubric, we will now present how DROMEAS is actually used in order to describe and analyze design-oriented interaction. We will do that in three parts: first, some general aspects of coding with DROMEAS will be presented; then a special focus will be given to the identification of intermediary representations, as we defined them in Section 5.1.4; and finally, a separate attention will be given to the emergence of arguments.

a. Coding with DROMEAS

Before proceeding to any coding, a first step, also discussed previously, is the segmentation of the transcribed dataset into functional communication units. A main difference between DROMEAS unit acts and other dialogue or communicative acts' lists proposed is the necessity of task-orientedness of the acts to be taken into consideration. In any task-oriented interaction, people's tasks is double: to produce meaningful for the task-at-hand contributions, and to co-ordinate such contributions in meaningful interaction. An act in order to be coded by DROMEAS needs to be either a design task contribution, or a content co-ordination joint action, or both. This double identity of DROMEAS acts, from one side, allows for greater independency regarding the units, as they cannot be pre-defined beforehand, but always on the basis of the specific interactional context. From the other side, once the analyst understands if the speaker's main intention at the time of communicating is information-oriented or addressee-oriented or both, DROMEAS guidelines of identification for each one of the corresponding acts can also serve as guidelines for the better segmentation into representational, dialogue, or double-nature acts.

A second step right after segmenting into acts is coding of the design object. This dimension's categories, apart from being relatively easy to identify, can also serve as a guide for the rest of the dimensions, as they provide us with the very basic information of "what is speaker X talking about?", always from a design point of

view. Design object is a representational category and not a topic discussion category, for the simple reason that it is individual-based and very colligated to the design representational act. This means that object shifts are possible and – it can be said – desirable, as they imply that "things are moving" from a design representational perspective. Nonetheless, although object shifts are usual, they do not take place as often during the same sequence.

In fact, a sequence is characterized by *one* main design object, with other objects possibly embedded, but not expanded to more than two representational acts; if so, they form a new sequence independently. The idea behind this main segmentation rule is that a discursive sequence represents an activity, and as such, it is object-oriented. When the object changes, the activity also changes. At the same time, being at a sequence level, a minimum exchange or micro-sequence level "deviation" from the main object is allowed and not considered as a separate activity itself. When this occurs in the middle of sequence, it is easy to recognize it and identify it as an embedded sequence. Instead, when it occurs at the end of a sequence, sometimes, as we already discussed in the 'Segmentation' paragraph (5.2.3), it is difficult to recognize if it belongs to that sequence's post-expansion, or if the new micro-sequence forms a sequence itself.

Once this problem is resolved, coding of design (representational) acts is easier. A difficulty here is related to distinguishing the main relevant concept(s) and to "follow" it during a sequence. As we saw in the presentation of Figure 14, new concepts cannot be defined on the basis of only one sequence, but rather on the basis of a whole episode. In DROMEAS, not all conceptual information is interesting; it is marked only of it is a relevant for the design course element, and/or if it is treated later on in a specific way from at least one of the participants (it can also be the initial speaker herself). These two indicators of relevance are strongly context-dependent. The first one, for example, refers to the elements-relations relevant for the specific course(s) on-line. In Case 1, some main concepts are the following: Blocks, Activities,

Tutor-marked assignments (TMA's), tutors, TLS (referring to the team responsible for media applications – the name, and all names referring to people or entities, are changed), Elluminate, Compendium (two of the tools used in the course), etc. In Case 2, correspondingly, some of the main concepts are: competences, lists of competences (referring to a priori prepared lists prepared by experts in order to guide the course's re-design), didactic plan (referring to the whole teaching program), EDT (referring to the team responsible for technological applications), tutors (in Spanish "consultores"), Wiki, Forum (two of the tools used in the course), MISA, MOT, Gibbon's layers (instructional design concepts very relevant to the contents of the course), etc. Of course, not each time one of these concepts occurs in interaction, it is also marked as relevant. The final decision for these concepts, their components, and other emerging intermediary representations is based on the interactional context at the specific moment a concept emerges.

Once the design objects and acts are identified, at an episode level, the design activity type can also be decided, on the basis of these two. Being the category with the highest level of inference, as we already mentioned, it cannot be inferred directly from the type of objects and acts. However, some general relations-rules do apply, at least in the specific dataset, such as the following: 1) the acts of 'generate', 'duplicate', and 'specify' are more related to the 'presentation' activity; the acts of 'add', 'detail', 'merge' are more related to the 'transformation' activity; the acts of 'evaluate', 'revolutionize', 'modify' are more related to the 'evaluation' activity; however, the combinations between them are more influencing than the acts themselves, for example a 'present' act together with an 'add' act is more possible to form a 'presentation', whereas an 'add' together with a 'detail' form a 'transformation'; 2) activities follow their "logical" order, namely present-transform-evaluate, but not for all design objects this order in necessary; solutions that do not appear as very innovative, in team interaction terms, can directly be transformed, without being presented first; also, problems, if they refer to problematic aspects of an already presented solution or method, can directly be transformed or evaluated; relations

between objects also play a role here, such as the strong relation between solution and method, on the basis of which an activity focusing on one can count as preparatory for an activity focusing on the other; "secondary" design objects, such as domain objects, rules, and tasks, can only be presented or transformed, if they are used as interventions regarding the main design process; 3) the intermediary representations' identification is also related to the identification of design activities, as proposals are more related to the `presentation' activity, whereas 'constraints' and 'requirements' to the 'transformation' and 'evaluation' activities; 4) in general, the more "rich" a sequence-activity is, in terms of embedded objects and emerging intermediary representations, the more possible it is for it to refer to an 'evaluation' design activity.

Dialogue acts can be coded together with the meta-epistemic reference. A first step is to identify whether the dialogue act addresses directly one, more, or all of the present participants, or whether it enounces the voice of a relevant "Other", such as an expert, an external team/collaborator, users, or even one of the team members. In these two cases, the dialogue act is also dialogical, as we already explained in paragraph 5.1.2. In the cases in which the focus of the dialogue act is not a physically or virtually present addressee, but the design object itself, the perspective from which the object is viewed through each act is marked as meta-epistemic reference. There are two main types of perspectives: the general ones, referring to a whole domain or to the speaker's overall experience, and the specific ones, referring to concrete epistemic aspects of the design object-at-hand.

Deciding which one of a sequence's dialogue acts will be considered as the main one, defining also the sequence type, follows a similar rationale as for the identification of main concepts. More precisely, as for the dialogue acts, two conditions need to apply: the importance of the act either for the design task or for the team's communication or both; the relation of the act to the rest of sequences. A problem emerges as it is possible that more than one acts fulfill these conditions, however, we should only opt

for one main act for each sequence. A strategy to do so is to consider each sequence as a self-contained goal-oriented interaction composed of three parts: the opening, the main, and the closing part. In case the main dialogue act appears in the opening part, it should maintain an important place for the rest of the sequence. If not, it is possible that it is introduced at the main part, and also "provoke" the emergence of a closing part, either as a secondary presentation or as an acceptance embedded activity, although not necessarily. In some cases, the main dialogue act of a sequence appears only at the end, having the opening and the main parts as preparatory for its emergence. In case a sequence contains more than one presentation phases, either by the same or by other participant(s), the "winning" presentation act is the one further treated in subsequent sequences.

Figure 16 shows an excerpt of the coded dataset. In bold, the representational acts considered as "joint", regarding our view of co-construction explained in Section 5.1.1. Regarding dialogue acts, we mark in bold: the act considered as main in each sequence; the addressee or enounced subject, when applicable. As far as the dialogue sequences is concerned, they take the name of the sequence's main dialogue act, and a number indicating either their order of appearance, in case they are nucleus sequences, or the number of the sequence to which they directly connect, in case they are satellite.

Line	Subj	Transcript	Des_activ	Repres_act	Obj	MetaEpi	Act	Sequence
1	C	[addresses I] you think that as well don't you?	trans			**spI**	ver	PRO2
2	I	Yeah yeah ...				**spB**	agr	
3	I	I mean students will just be questioning what the Pinboard is for		**mod [e]**	P	U	**pro**	
4	C	Yeah						
5	I	() if there are no Activities directing them to actually use it		add [g: direction]		Cf	jus	
6	A	Yeah ...yeah						
7	C	[addresses A] they've got a good point						
8	A	Yeah						
9	C	Maybe think about it a bit						
10	A	ehm						
11	A	so are you are you suggesting to to direct them to the Pinboard when they need to upload things… in the other Block Element		**spe [g]**		spI	int	
12	I	Yeah the exercises yeah						
13	A	The only trouble is that they might get they just might get lost	eval	gen [h: get lost]	(P)	U	**att**	ATT2
14	A	I mean if they are doing different different uploads at different times					exp	
15	A	you know the Pinboard's only got two slots on it						
16	I	[looks at screen] () archives		**rev [i: archive]**	S	C	pro	
17	A	They've got they've got the archive yeah				**spI**	agr	
18	I	I don't think it's a particularly complex application		**ev [i]**		Cf	com	
19	A	Do you think they could just kind of work that out on their own?		ev [i]		**spI**	ver	
20	I	Yeah () so						

FIGURE 16. AN EXCERPT OF THE CODED INTERACTION DATASET

b. Intermediary representations

Intermediary representations, referring to design proposals, requirements, and constraints, as defined in paragraph 5.1.4, are identified on the same coded excerpt, once the first coding with DROMEAS dimensions is completed. Regarding proposals, these can be related to any generated, transformed, or evaluated design object, introduced through any one of the nucleus dialogue acts. Constraints and requirements can also be introduced through one of the satellite dialogue acts. In all cases, they allege to representational acts, which are considered as highly relevant for the design product either because they form part of it, or because they lead to its

further specification. On the dataset, they are marked in different colors: green for proposals, red for constraints, and purple for requirements. Given its relevance to the eLearning design process, as we already explained in paragraph 5.1.6, we also mark those representational acts-instances that refer to the user's perspective, without being alleged to a specific intermediary representation. User's experience is marked in orange color. In the cases in which it is expressed in relation to one of the intermediary representations, it is only marked as meta-epistemic reference.

c. Argument identification

As we already commented, argument identification in DROMEAS is based on the combination of at least two dialogue acts performed on the same concept, that are related to each other in an argumentative way. Two things need to clarified here: what types of acts can together form an argument, and when we can decide that the relation between them is argumentative.

At a first place, to have an argument, we need to have at least one of the previously defined as argumentative dialogue acts. These are: 'justify', 'assess', and 'conclude'. These acts can serve as argumentative support to either a nucleus act, such as 'propose', 'oppose', 'present alternative', and 'call for attention', or to one of the other satellite acts, such as 'comment', 'agree', or 'postpone'. Sometimes it is also possible to have a design argument composed of only nucleus acts. Subsequently we describe the argumentative relations in each one of these cases.

Possibility 1: 'Justify', 'assess', 'conclude' + nucleus act. This is the most potentially valid type of argument, as the dialogue acts of 'justify', 'assess' and 'conclude' favor the existence of an argumentative relation among them. Such relation usually refers to some type of *association* (nonetheless, *dissociation* is also very usual in team design, see for example Stumpf & McDonnell, 2002), which according to Perelman & Olbrechts-Tyteca (1969) can be of three types: quasi-logical argument, argument based on the structure of reality, and arguments based on

establishing the structure of reality. The first type refers to some type of deductively valid argument, in which the conclusion seems to derive from the premises as a natural and almost undoubted consequence. This, in an ill-defined context such as design, mainly happens when the consequence is strongly alleged to a design objective, thus, the fact that it naturally derived from the premises imply that the premises are the right way to lead to the goal. For example, in practical arguments containing a conclusion, this almost always corresponds to a desired reality, which emerges as a result from the nucleus act on which it depends. A representative example of a 'propose-conclude' argument of the quasi-logical type is presented on Table 16 (all examples form part of the dataset).

TABLE 16. AN EXAMPLE OF QUASI-LOGICAL ARGUMENT

Practical quasi-logical argument	
propose	What I thought is the contribute site that I've set up is just a way of quickly getting all the stuff online
conclude	**so everyone can see it**

The second type, argument based on the structure of reality, includes association of succession and co-existence. Arguments 'from expert opinion' and some 'arguments from analogy' belong to this type. Table 17 shows one of each.

TABLE 17. EXAMPLES OF ARGUMENTS BASED ON THE STRUCTURE OF REALITY

Argument from expert opinion		***Argument from analogy***	
propose	Basically we need a Java programmer	propose	I mean the BBC has as well they have a site where the Podcast is on
justify	that is what Peter said	conclude	So we can download it from the server to iTunes

However, most arguments in design are neither quasi-logical nor based on the structure of reality, but they rather aim at *establishing* the structure of reality. Roozenburg (1993) explains the design reasoning as follows:

> A principal solution is an idealized representation (a scheme) of the structure of a system, that defines those characteristics of the system that are essential for its functioning (…) The act of conceptualizing the artifact is the determining of the variables, such that the conclusion *becomes* true. In other words, the designer has to conceive of the form and actuation of the artifact and, at the same time, to 'construct' a true conditional that connects this form and actuation to its purpose (p. 12-14)

Having this double reasoning task of both constructing the reality and its conditionals, the designer mainly has two roots to choose from: either go for a routine design, meaning an already tried root, so that the level of inference is reduced; or go for an innovative design, in which the purpose is defined by its conditionals. A mode of reasoning very connected to the association towards establishing the structure of reality is *abduction*. In design, two main types of abductive reasoning are possible to be encountered: explanatory abduction and innovative abduction. "In explanatory abduction, it is assumed that the rule (of the syllogism) is given as a premise; innovative abduction aims at finding new rules" (Roozenburg, 1993; 17). Table 18 shows, again, one example of each.

TABLE 18. TWO EXAMPLES OF DESIGN ABDUCTIVE RESONING

Explanatory abduction		***Innovative abduction***	
Requirement	The other thing that needs to have some thinking about is how to upload	Constraint	you know students can just go in there and do stuff
"Constraint"	because I do get concerned about the fact that they can just like throw everything out at the kitchen sink, at their Compendium map locally on their machine	Requirement	then that somehow is going to need somebody to have an overview

Regarding DROMEAS functionality, the first case is not coded as an argument, whereas the second case it is. Moreover, the constraint in the first case is not a real constraint, but the speaker's worry about a possible users' behavior. For this reason, it is not marked in red, but in orange, to indicate users' perspective. On the other hand, the second case it is based on a constraint presented as real, more precisely a usability constraint, which generated a requirement in a practical inference mode.

Possibility 2: Nucleus act + nucleus act. A special case of the design abductive reasoning mentioned above is when a requirement is followed by a proposal. What makes this case of reasoning special are mainly two things: first, it cannot be identified as a quasi-logical argument, as it is very similar but different than the constraint-proposal mode; and second, one has to be careful at the time of deciding whether the "derived" proposal is a sufficient or a necessary outcome (Walton, 2007) of the requirement, as it is expressed.

This type of argument is very common in design. Indeed, it has been identified as a pattern of design reasoning, namely "reasoning from purpose to form and actuation", having the following form (Roozenburg, 1993):

Premise: q

Conclusion: p→q

Conclusion: p

Translating this scheme into the design language, it takes the following main form:

Premise: A is a requirement

Conclusion: If action B is taken, A will be satisfied

Conclusion: Thus, action B should be taken

Table 19 shows two examples of this type of reasoning.

TABLE 19. EXAMPLES OF REASONING FROM PURPOSE TO FORM AND ACTUATION

	Explanatory abduction	***Innovative abduction***
Requirement	if you haven't actually specified that you wanted	they may want to link to resources they found
Constraint	that's why I think you've got the marking guide	and so the idea is that they kind of do a kind of a visual representation of the problem

Again, the explanatory abduction case is not considered as an argument, even though it combines a requirement with a constraint, whereas the innovative abduction represents an argument, and more precisely a practical inference.

Possibility 3: Non-argumentative satellite act + argumentative act. Finally, a last possibility of dialogue acts combination refers to the cases in which no nucleus act is present in the inference, and more precisely when an argumentative act supports another satellite act. In our dataset, this is very common when users-based or rule-based comments are justified; thus they form an argument, but not a very strong one, considering that such arguments usually do not involve any constraints, requirements, or proposals. In these cases, the presence of 'justify' act, rather than other argumentative act, serves as indicator. Table 20 shows two examples of rule-based arguments following this form.

TABLE 2O. TWO EXAMPLES OF COMMENT-JUSTIFY ARGUMENTS

comment	Yeah yeah (if we) want to change some of the text then they can't say no	That's a big problem
justify	We are the customer	About 80% of our work is done on Macs

In all cases discussed above, a common possibility is that the satellite argumentative act anticipates the main act. In these cases, arguments are marked in pink, to indicate that the first act appearing in the argument refers to a subsequent, and not to an antecedent act, as in all other cases.

Figure 17 shows a completely coded excerpt from the dataset, with all colors corresponding to different intermediary representations (red for constraints, green for requirements, green for proposals, and orange for users' perspective/experience) and with the emerged arguments identified in the dialogue sequence column; also marked in pink, in case they are "reversed".

1	A	What I thought is the contribute site that I've set up is just a way of quickly getting all the stuff online	eval	spe [a]	M	B	**pro**	PRO2	
2	A	so everyone can see it		add [a]		U	con	practi	
3	A	roughly in the form that students are kind of going to go through it					cla		
4	A	and then you, you as TLS or someone else, would transfer it from the contribute site to the structured content		**add [b]**		X	pro		
5	B	That's what I sort of envisioned				**spA**	agr		
6	B	But in my view the problem is that if you are talking about a lot of, if you're talking about big documents, it might make the process a bit tricky		**gen [h: big documents]**	(P)	F	neg		alt_neg
7	B	So that's why I would like to have a browse through		mod [i: browse through]		B	alt		

FIGURE 17. A COMPLETE EXCERPT OF THE CODED INTERACTION DATASET

6. RESULTS

What might at first look like a simple device in fact turns out to be a complex of mediations –that is of coordination between structures.

—D' ANDRADE, 1984

The results coming out from the analysis of the coded dataset can be classified into two big categories: the *exploratory* ones, that could potentially lead to the construction of conceptual framework working hypotheses, and the *descriptive* ones, that probably apply only to the specific cases studied, but are considered relevant to the research questions. In the following paragraphs the most salient observations hitherto acquired, regarding both aspects of our research – i.e. exploratory and descriptive – will be presented.

A) EXPLORATORY RESULTS

a. Relation between design and communication processes

One of our main research questions regards how and whether the design and communication process enrolled throughout team design interaction relate one to another. Before getting into detail in this relation, let us first look at the nature of each process separately. On the basis of DROMEAS dimensions, the design process is characterized by three main entities, namely: design activity, design act, and design object. Figure 18 shows the frequencies of each one of those for the whole dataset (all frequencies tables of both cases are presented in detail in Appendix 4).

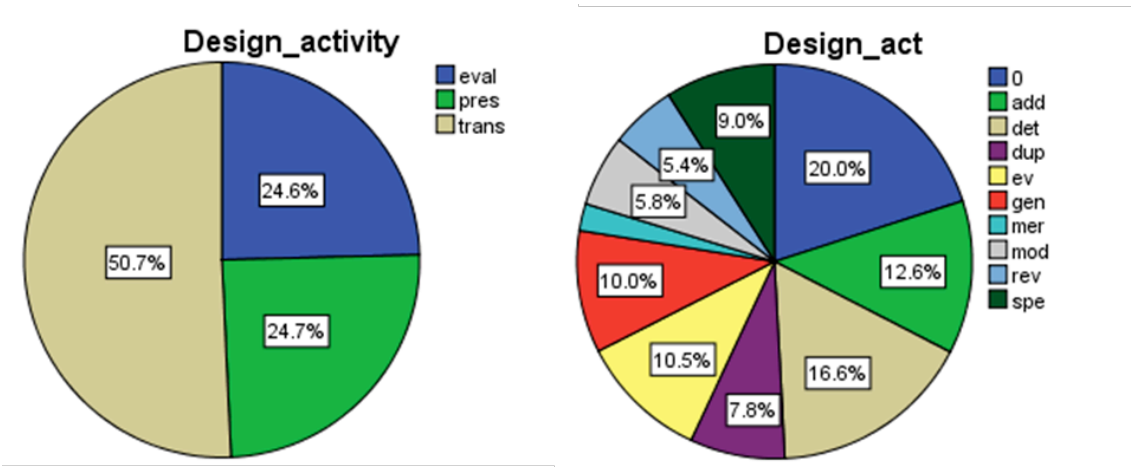

FIGURE 18. OVERALL FREQUENCIES OF DESIGN ACTIVITIES AND ACTS

As it can be seen in Figure 18, the frequency of 'evaluation' and 'presentation' design activities is almost the same (24.6 and 24.7% correspondingly) considering the whole dataset, whereas the activity of 'transformation' occupies the half (50.7 %) of the total team design activity. Considering the design (representational) act categories, and leaving out the unit acts not related to any representational act, a predominance of 'detail' and 'add' acts can be identified (16.6 and 12.6% correspondingly), followed by 'evaluate' and 'generate' acts (10.5 and 10% correspondingly), followed by 'specify' and 'duplicate' acts (9 and 7.8%). The frequency of 'modify', 'revolutionize', and 'merge' acts is considered low (5.8, 5.4, and 2.2%).

In concordance with the design process, the communication process is composed of communication activities (dialogue sequences in DROMEAS), communication acts[2] (dialogue acts in DROMEAS), and communicative perspective (meta-epistemic

[2] We use the term 'communication act' for the sake of simplicity and coherence with the design categories. The difference between 'communicative acts' and 'dialogue acts' explained in Chapter 5 is still valid.

reference in DROMEAS). The frequencies of each type of those for the whole dataset are represented in Figure 19.

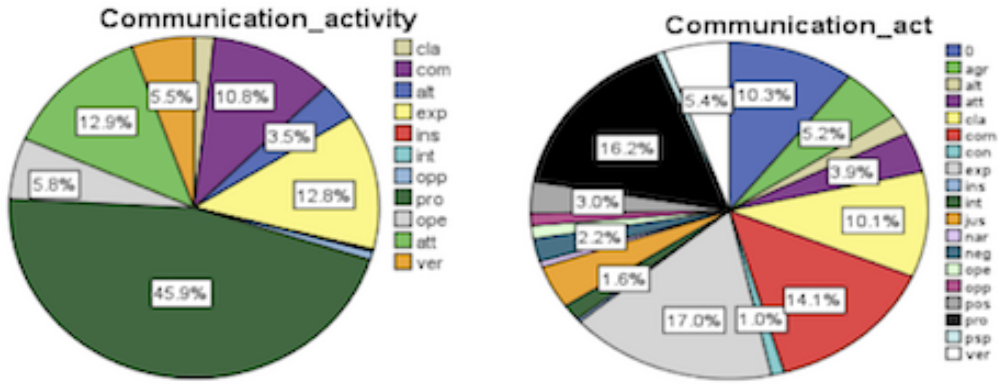

FIGURE 19. OVERALL FREQUENCIES OF COMMUNICATION ACTIVITIES AND ACTS

Regarding communication activities, the predominance of 'propose' is evident, occupying almost half of the total team activity (45.9%). The activities of 'call for attention', 'explain', and 'comment' follow, with a frequency of 12.9, 12.8, and 10.8% correspondingly. The rest of activities are much less frequent, except for 'open', 'verify', and 'present alternative' whose frequency is also low, but at least considerable (5.8, 5.5. and 3.5% correspondingly). As far as communication acts are concerned, a similar distinction between high, medium, and low frequency acts is observed, giving a predominance to the acts of 'explain', 'propose', 'comment', and 'clarify' (17, 16.2, 14.1, and 10.1%), followed by 'verify', 'agree', 'justify', and 'call for attention' (5.4, 5.2, 4.1, and 3.9%). The rest of the acts appear even less frequently.

Regarding the relation between design and communication process, a strong dependency (Cramer's V= 0.362) between the design and communication activity is found. The precise relations between the different types of activities are presented on Table 21 (in grey the ones considered as more relevant).

TABLE 21. RELATIONS BETWEEN DESIGN ACTIVTY AND COMMUNICATION ACTIVITY TYPE

D1_activity_ * C1_activity_ Crosstabulation													
D1_activity		C1_activity											Total
		alt	att	cla	com	exp	ins	int	ope	opp	pro	ver	
eval	Count	82	164	30	289	36	0	4	11	17	341	59	1033
	%	.55	.30	.41	.64	.07	.00	1.00	.05	.52	.18	.26	.25
pres	Count	41	125	0	9	49	0	0	116	16	673	7	1036
	%	.28	.23	.00	.02	.09	.00	.00	.48	.48	.35	.03	.25
trans	Count	25	254	43	157	454	6	0	116	0	912	164	2131
	%	.17	.47	.59	.35	.84	1.00	.00	.48	.00	.47	.71	.51
Total	Count	148	543	73	455	539	6	4	243	33	1926	230	4200
	%	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Starting from the less strong relations, the one between 'open' and 'evaluation' appears to be quite weak. Instead, 'evaluation' has strong relation with the activities of 'present alternative' and 'comment', and somehow strong with 'oppose', which is also related to 'presentation' activity. Moreover, 'presentation' is strongly related to the 'propose' activity, whereas it has no relation with 'clarify', 'comment', and 'verify'. Regarding the latter, its strong relation to 'transformation' also appears to be salient. However, the strongest connected communication activity to the one of transformation is 'explain'. It is also interesting that the activities of 'oppose' and 'present alternative' have no or weak relation to 'transformation'.

Regarding the relation between design and communication acts, again, there is a strong dependency (Cramer's V= 0.437). Table 22 shows the exact relations between design and communication acts (only the acts for which some interesting relations – in grey –, emerge appear on the Table; Total refers to the total of acts, including also the ones missing from the Table). All complete crosstabulation tables appear on Appendix 4.

TABLE 22. RELATIONS BETWEEN DESIGN AND COMMUNICATION ACTS

D2_act* C2_act_ Crosstabulation														
D2_act		agr	cla	com	con	exp	jus	neg	ope	opp	pos	pro	ver	Total
0	Count	170	227	68	6	103	39	1	3	12	7	7	108	842
	%	.78	.53	.11	.14	.14	.23	.01	.06	.24	.06	.01	.48	.20
add	Count	2	15	138	19	46	73	20	0	0	7	132	10	528
	%	.01	.04	.23	.43	.06	.42	.22	.00	.00	.06	.19	.04	.13
det	Count	0	7	7	4	444	15	1	0	0	1	12	2	696
	%	.00	.02	.01	.09	.62	.09	.01	.00	.00	.01	.02	.01	.17
ev	Count	16	1	211	4	2	13	48	0	2	105	4	6	443
	%	.07	.00	.36	.09	.00	.08	.52	.00	.04	.83	.01	.03	.11
gen	Count	0	1	0	2	4	12	8	47	2	0	259	14	421
	%	.00	.00	.00	.05	.01	.07	.09	.90	.04	.00	.38	.06	.10
rev	Count	2	1	91	1	2	6	9	0	33	2	13	0	228
	%	.01	.00	.15	.02	.00	.03	.10	.00	.66	.02	.02	.00	.05
Total	Count	219	425	594	44	712	173	93	52	50	126	681	225	4200
	%	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Beginning with the quite frequent case (842 out of 4200 acts) in which no act takes place at a representational level, it can be easily observed that this happens mainly when communication acts of 'clarify', 'agree', and 'verify' occur. Other relations appear, such as: 'generate-open', 'evaluate-assess positively', and 'revolutionize-oppose'. Regarding the relation between the 'evaluate' representational act and the 'assess' communication act, a clarification needs to be made: the first one refers to a specific concept expressed in a previous unit, whereas the latter is not necessarily alleged to the semantic content of a statement, but to the idea expressed through it. Having said that, it is interesting to note that whereas the 'assess positively' act is almost exclusively related to the 'evaluate' design act, the same cannot be said for the 'assess negatively' act, which is also related to the 'add' act. Conclusions and justifications also have a strong relation to the 'add' act. Finally, other relevant relations are: 'explain-detail', 'propose-generate', and 'comment-evaluate'. Most of these relations explained in this paragraph do not only serve as indicators of the inter-dependency between the design and communication process, but also, and mainly, may serve for the construction of a theoretical model of task-oriented communication, as it will be further supported in the next chapter.

A last relation we checked considering the dependency between design and communication processes regards the dimensions of co-construction and dialogicality. As we already explained in Chapter 5, co-construction in our dataset is expressed through those representational acts that refer or reply to the content of some other participant's acts; whereas dialogicality refers to whether a communicative act focuses on the addressee or the enounced subject more than on the content carried in the act. Our question regarding these two constructs is the following: Are episodes with high or low co-construction also marked by high or low dialogicality, correspondingly? In other words, are these two constructs mutually dependent at an episode's level? The answer is positive only for 11 out of 52 episodes; 8 of these 11 episodes also appear to be highly argumentative (for the complete results see Appendix 4).

b. Structure of team design deliberative episodes

Regarding their overall structure and goal, the following macro-types of team design deliberative episodes emerge: 1) problem framing, 2) solution finding, 3) solution assessment, 4) method finding, and 5) method assessment. Figure 20 shows the frequencies of these 5 episode types in the whole dataset. As it can be easily observed, 'method finding' is the most predominant type or expressed goal at a team level.

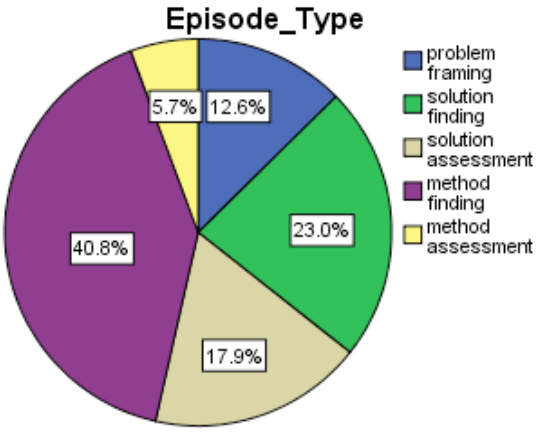

FIGURE 20. DISTRIBUTION OF EPISODES ACCORDING TO THEIR TYPE

Considering the whole dataset, the following structures of design objects emerge at an episode level (with the help of and Object-Oriented pattern recognition software): 'solution-problem-solution' (32 occurrences), 'method-problem-method' (29), 'method-rule-method' (28), 'solution-rule-solution' (22), 'problem-solution-method' (20), 'solution-task-solution' (17), 'solution-object-solution' (17), 'solution-method-solution' (14), 'rule-method-rule' (14), and 'method-solution-method' (14).

A second level of patterns emerged is that of design and communicative activities. Regarding design activities, the following patterns are the most frequent in the whole dataset: 'transform-present-transform' (33), 'present-transform-transform' (30), 'transform-evaluate-transform' (24), 'transform-transform-transform' (22), 'present-transform-present' (20), 'transform-transform-evaluate' (19), and 'evaluate-transform-evaluate' (19). On the other hand, regarding communication activities, the following appear as more frequent: 'propose-propose-propose' (20), 'propose-comment-propose' (18), 'propose-call for attention-propose' (17), 'propose-propose-comment' (13), and 'propose-explain-propose' (12).

Regarding the structures composed of at least two design or communicative activities focusing on a specific object, the following patterns appear as more frequent: 'transform method-transform rule' (24), 'transform problem-transform solution' (22), 'transform rule-transform method' (21), 'transform method-transform problem' (20), 'transform object-transform solution' (19), 'transform solution-transform method' (19); 'propose problem-propose solution' (30), 'propose solution-propose problem' (23), 'propose solution-propose method' (22), 'propose method-propose problem' (22), 'propose problem-propose method' (20), 'propose method-propose solution' (20), 'propose method-propose rule' (20).

Finally, we were interested in the patterns of acts and objects inside an activity. Regarding communication acts patterns, the following appear as more frequent: 'propose-explain-propose' (38), 'explain-propose-explain' (37), 'propose-explain-comment' (36), 'explain-comment-comment' (29), 'verify-clarify-explain' (27).

Regarding design acts patterns, we have: 'detail-detail-detail' (39), 'generate-specify-detail' (25), 'specify-detail-add' (23), 'detail-add-detail' (22), 'generate-detail-add' (21), 'detail-specify-detail' (20).

To summarize, we have patterns of objects per episode; patterns of activities per episode; patterns of activities per episode together with their objects; and patterns of acts per activity. Regarding the first type of patterns, what interests most is the sequence of emerging objects, and not as much their number (as no comparison between design and communication categories applies). Table 23 shows the passages from one object to another in each one of the most frequent patterns. Regarding activities and acts, the summary of the patterns emerged is presented on Table 24, together with their frequency.

TABLE 23. THE PASSAGE FROM OBJECT TO OBJECT IN THE MOST FREQUENT OBJECT PATTERNS

DESIGN OBJECT PATTERNS						DESIGN OBJECT PATTERNS					
P	S	M	T	R	O	P	S	M	T	R	O
2	1, 3						1, 3		2		
2		1, 3					1, 3				2
		1, 3		2			1, 3	2			
	1, 3			2				2		1, 3	
1	2	3					2	1, 3			

TABLE 24. THE MOST FREQUENT EMERGED PATTERNS

DES. ACTIVITY PATTERNS	N	COM. ACTIVITY PATTERNS	N
transform-present-transform	33	propose-propose-propose	20
present-transform-transform	30	propose-comment-propose	18
transform-evaluate-transform	24	propose-call for attention-propose	17
transform-transform-transform	22	propose-propose-comment	13
present-transform-present	20	propose-explain-propose	12
transform-transform-evaluate	19		
evaluate-transform-evaluate	19		
Total	**167**	**Total**	**80**
DES. ACTIVITY + OBJECT	**N**	**COM. ACTIVITY + OBJECT**	**N**
trans. method-trans. rule	24	propose problem-propose solution	30
trans. problem-trans. solution	22	propose solution-propose problem	23
trans. rule-trans. method	21	propose solution-propose method	22
trans. method-trans. problem	20	propose method-propose problem	22
trans. object-trans. solution	19	propose problem-propose method	20
trans. solution-trans. method	19	propose method-propose solution	20
		propose method-propose rule	20
Total	**125**	**Total**	**157**
DES. ACT PATTERNS	**N**	**COM. ACT PATTERNS**	**N**
detail-detail-detail	39	propose-explain-propose	38
generate-specify-detail	25	explain-propose-explain	37
specify-detail-add	23	propose-explain-comment	36
detail-add-detail	22	explain-comment-comment	29
generate-detail-add	21	verify-clarify-explain	27
detail-specify-detail	20		
Total	**150**	**Total**	**167**

c. Relation between design and communication structures

One of our first emerging questions was if the design episode type, as it was defined regarding the specific dataset, influences on the emergence of the design object structures discussed above. In fact, some interesting relations regarding type of object pattern and type of episode emerge, as it can be observed on Table 25.

TABLE 25. RELATIONS BETWEEN DESIGN OBJECT PATTERNS AND EPISODE TYPE

D3_Obj_Patterns*Epis_type_Crosstabulation							
Des_Object_Patterns		**Epis_Type**					Total
		1	2	3	4	5	
S-P-S	Count	21	154	55	134	35	399
	%	.04	.16	.07	.08	.15	.10
M-P-M	Count	20	39	18	180	8	265
	%	.04	.04	.02	.11	.03	.06
S-R-S	Count	30	65	73	47	7	222
	%	.06	.07	.10	.03	.03	.05
M-R-M	Count	4	37	30	181	39	291
	%	.01	.04	.04	.11	.16	.07
P-S-M	Count	40	38	31	89	33	231
	%	.08	.04	.04	.05	.14	.06
S-T-S	Count	14	54	43	63	24	198
	%	.03	.06	.06	.04	.10	.05
S-O-S	Count	37	86	29	14	17	183
	%	.07	.09	.04	.01	.07	.04
S-M-S	Count	15	21	82	59	10	187
	%	.03	.02	.11	.03	.04	.04
R-M-R	Count	0	27	7	44	23	101
	%	.00	.03	.01	.03	.10	.02
M-S-M	Count	3	22	30	133	9	197
	%	.01	.02	.04	.08	.04	.05
Total	Count	530	967	752	1713	238	4200
	%	1.0	1.0	1.0	1.0	1.0	1.0

More precisely, the episode type 1, 'problem framing' is more related to the 'problem-solution-method' pattern. Episode type 2, 'solution finding', is more related to 'solution-problem-solution', 'solution-object-solution', and 'solution-task-solution'. Episode type 3, 'solution assessment', is relatively more related to 'solution-method-solution' and 'solution-rule-solution'. Episode type 4, 'method finding', is relatively more related to 'method-problem-method' and 'method-solution-method'. Finally, episode type 5, 'method assessment' has a relatively stronger relation to 'method-rule-method' and 'rule-method-rule´.

Regarding the relation between patterns, a dependency between design and communication patterns at an episode level has been found for all most frequent patterns. More precisely, some design and communication patterns appear to be relatively more related than others, such as 'present-transform-transform' with 'propose-explain-propose', and 'transform-evaluate-transform' with 'propose-propose-propose' (see Appendix 4 for complete dependency measures). However, such relation does not always make itself evident. In fact, there are team design episodes that favor the emergence of one type of patterns more than another. Moreover, this seems to be more frequent with the communication patterns rather than with the design patterns. In fact, a greater dependency between team design episode and communication patterns has been found. Table 26 shows the distribution of the most frequent design and communication activity patterns per episode and the degree of dependency (Cramer's V) of each type with the team design episode ID. The Table shows only the episodes for which some interesting observation can be made. For the complete list of episodes see Appendix 4.

TABLE 26. RELATIONS BETWEEN THE MOST FREQUENT ACTIVITY PATTERNS AND EPISODE ID

Episode ID	pro-com-pro	pro-pro-pro	pro_att_pro	pro-pro-com	pro-exp-pro	trans-pres-trans	pres-trans-trans	trans-trans-trans	trans-eval-trans	pres-trans-pres	Total
3	0	21	24	0	23	59	19	23	19	23	149
5	0	0	0	0	0	21	39	13	35	0	104
8	0	0	19	0	0	34	18	0	0	28	142
10	0	43	0	0	0	24	22	21	51	0	134
11	0	80	0	0	0	0	0	0	0	27	153
16	0	0	0	16	37	0	0	0	0	0	50
23	0	31	26	0	0	55	26	0	47	45	115
25	0	0	51	0	0	0	0	0	0	0	51
30	0	0	0	0	0	27	29	80	0	24	144
33	0	0	0	0	0	0	34	66	0	0	90
35	0	0	0	0	0	27	43	26	0	0	69
36	67	26	71	36	0	85	67	80	0	26	152
39	29	0	0	0	0	0	0	0	0	0	29
40	56	74	0	0	73	82	66	50	56	0	144
46	69	46	0	52	38	25	38	60	39	45	152
Total	617	517	469	375	352	855	865	675	632	431	4200
Cramer's V	0.68	0.602	0.718	0.602	0.689	0.540	0.550	0.669	0.588	0.586	

B) DESCRIPTIVE RESULTS

a. Content type produced

In accordance to our third research question, we are interested in three types of design content produced by the participants during interaction: task-oriented acts, conceptual viewpoints, and intermediary representations (arguments are treated separately in the next paragraph).

With task-oriented acts, we mean both the representational and communicative acts that are clearly oriented towards one of the pre-defined design cognitive objects, namely: problem, solution, goal, method, domain object, domain rule, and task. Regarding their frequency in the whole dataset, solution (34.3%) and method (26.4%) are more frequent than the rest, which follow in this order: object (10.2%), task (9.4%), problem (9.2%), domain rule (9.2%), and goal (1.3%). Each design object is expressed through one of the 13 possible communication perspectives (including all types of DROMEAS meta-epistemic reference categories). That of 'content' is relatively higher (37.8%) regarding the rest, of which 'behavior' and 'users' perspectives stand out (11.9 and 10.1% correspondingly). The other perspectives appear even less frequently, with a salience observed regarding 'content function', 'function', and 'experts' (7.6, 7.4, and 6% correspondingly).

The frequencies of both design object and communication perspective are shown on Figure 21.

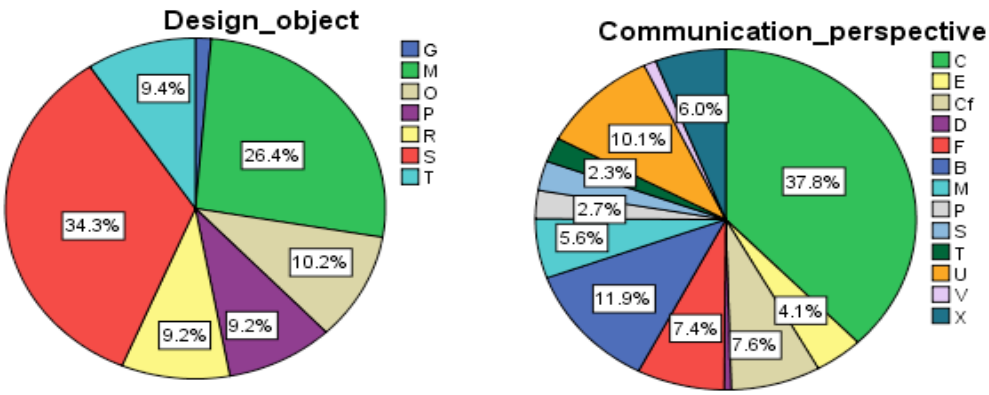

FIGURE 21. OVERALL FREQUENCIES OF DESIGN OBJECTS AND COMMUNICATION PERSPECTIVES

The relations between expressed object and perspective (Cramer's V= 0.254) are presented on Table 27.

TABLE 27. RELATIONS BETWEEN DESIGN OBJECT AND COMMUNICATION PERSPECTIVE

D3_object*C3_perspective_Crosstabulation												
D3_obj		C3_persp										Total
		B	F	S	C	Cf	V	X	M	P	T	
G	Count	6	0	0	13	3	4	0	1	11	0	56
	%	.01	.0	.0	.01	.0	.09	.0	.0	.10	.0	.0
M	Count	252	44	21	383	64	3	54	57	54	21	1108
	%	.51	.14	.18	.24	.20	.07	.21	.24	.48	.21	.26
O	Count	13	28	13	267	25	3	15	3	1	18	429
	%	.0	.09	.11	.17	.08	.07	.06	.0	.0	.18	.10
P	Count	36	65	1	95	24	7	21	33	9	8	385
	%	.07	.21	.0	.06	.08	.16	.08	.14	.08	.08	.09
R	Count	21	45	5	91	20	4	24	91	12	15	387
	%	.0	.14	.0	.06	.06	.09	.10	.38	.11	.15	.09
S	Count	72	126	76	639	178	22	32	26	25	36	1442
	%	.14	.40	.64	.40	.56	.50	.13	.11	.22	.37	.34
T	Count	98	4	2	100	6	1	106	26	0	0	393
	%	.20	.0	.0	.06	.0	.0	.42	.11	.0	.0	.09
Total	Count	498	312	118	1588	320	44	252	237	112	98	4200
	%	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

As it can be easily seen above, the most evident relation between object and perspective is the 'solution-content' relation. This means that most of the solutions discussed by the teams are related to types of materials and/or resources to be used in the course. Regarding the other object-related perspectives, 'behavior' is more related to management issues, whereas 'structure', 'content function', and 'visuals', all seem to be strongly related to solutions. An interesting exception is 'function', which is also very related to design problems. As far as the other voices are concerned, the only relevant emerging relation is the one between 'expert opinion' and 'task'. Focusing on the relation between knowledge domain and design object, 'management', 'pedagogy', and 'technology' appear to have some clear relation with 'domain rules', 'methods', and 'solutions' correspondingly.

Regarding the intermediary representations, i.e. proposals, requirements, and constraints, their frequency in the whole dataset has as following: proposals occupy a 55.35%, whereas requirements arrive at a 29%, and constraints correspond to only a 15.35%. The exact frequencies of the perspective type in each one of the intermediary representations type is shown on Table 28.

Some interesting observations regarding the relation between perspective and type of intermediary representation (in grey on the Table above) are the following: almost half of the total 'proposals' (49.3%) are based on 'content', which is also the most frequent perspective regarding 'requirements' (33.7%); 'behavior' occupies the second position in 'requirements' (21.2%) and the third in 'proposals' (9.7%), confirming some type of consistency between these two types of representations; however, the image changes regarding 'constraints', for which 'users' is the most predominant perspective (27.9%), followed by 'management' (17%). 'Users' also occupies the third position in 'requirements' (10.2%).

TABLE 28. FREQUENCIES OF PERSPECTIVES IN PROPOSALS, REQUIREMENTS, AND CONSTRAINTS

	proposals		requirements		constraints	
perspectiv	Frequency	Valid Percent	Frequency	Valid Percent	Frequency	Valid Percent
B	49	9.7	56	21.2	10	6.1
C	249	49.3	89	33.7	23	13.9
Cf	56	11.1	9	3.4	10	6.1
D	2	.4	3	1.1	1	.6
E	10	2.0	1	.4	1	.6
F	33	6.5	12	4.5	19	11.5
M	19	3.8	26	9.8	28	17.0
P	18	3.6	14	5.3	8	4.8
S	18	3.6	8	3.0	2	1.2
T	10	2.0	8	3.0	5	3.0
U	16	3.2	27	10.2	46	27.9
V	5	1.0	5	1.9	3	1.8
X	20	4.0	6	2.3	9	5.5
Total	505	100.0	264	100.0	165	100.0

b. Arguments' type produced

The total number of arguments produced regarding the whole dataset is 256. Exactly half of them are classified as "main" design arguments, because they correspond to one of the argumentation schemes described in Section 5.1.5. Among them, 'practical arguments' (32 occurrences) and 'arguments from alternatives negative' (31) are the most predominant, followed by 'arguments from negative consequences' (22). Among the arguments classified as 'others', the three types of inferences already described in Section 5.1.5 appear in a great frequency, with 'users-based arguments' occupying the 20.7% of the total number of arguments. Also, four "new" types of arguments emerge, coded as 'practical from task assignment' (practi_task), 'practical from alternative' (practi_alt), 'practical based on expert' (practi_exper), and 'expert-

based analogy' (exper_anal). All of them will be explained and discussed in the next chapter. Frequencies of argument types appear on Table 29.

TABLE 29. ARGUMENT TYPES FREQUENCIES

Main	Frequency	Percent	Others	Frequency	Percent
practi	32	12.5	rule_based	40	15.6
neg_cons	22	8.6	person_based	21	8.2
pos_cons	9	3.5	users_based	53	20.7
alt_neg	31	12.1	practi_task	8	3.1
alt_pos	11	4.3	practi_alt	4	1.6
analog	13	5.1	practi_exper	1	.4
expert	10	3.9	exper_anal	1	.4
Total	128	50.0	Total	128	50.0
			Total_arguments		256

Regarding the relation between arguments and conceptual viewpoints, some interesting results emerge. First of all, we were interested in identifying the relation between communication perspective and arguments, as it can be seen on Table 30.

TABLE 30. RELATIONS BETWEEN ARGUMENT AND PERSPECTIVE

argument*perspective_Crosstabulation																
argument		perspective														Total
		B	C	Cf	D	E	F	M	P	S	T	U	V	X	0	
	Count	22	40	13	1	2	15	26	9	3	6	28	4	9	78	256
	% within argument	.09	.16	.05	.00	.01	.06	.10	.04	.01	.02	.11	.02	.04	.30	1.00
	% within perspective	.19	.11	.16	.17	.17	.23	.36	.23	.11	.26	.32	.31	.26	.43	.23
Total	Count	115	354	79	6	12	64	73	40	27	23	87	13	35	183	1111
	%	.10	.32	.07	.01	.01	.06	.07	.04	.02	.02	.08	.01	.03	.16	1.0

Two interesting relations emerge (marked in grey). The first one regards the 'management' perspective. Although it occupies only the 7% of the total conceptual viewpoints, 10% of it is combined with arguments. A similar relation regards 'users'

perspective. Although it occupies just the 8% of the total conceptual viewpoints, 11% of it is used to form some type of argument. It is also interesting that in total the two teams had 1111 viewpoints' instances (lines), but only 362 of them contained some type of argument.

Secondly, regarding the relation between arguments and intermediary representations, the only significant positive correlation is that between constraints and arguments, as it can be seen on Table 31.

TABLE 31. CORRELATIONS BETWEEN TYPE OF INTERMEDIARY REPRESENTATIONS AND ARGUMENTS

Correlations			
	proposals	constraints	requirements
argument _Y/N	-.228	.174	-.115
Pearson correlation, significant at the 0.01 level (1-tailed)			

Finally, the combination of more than one intermediary representations in the same argument, where applicable, was investigated. We consider this characteristic as an additional indicator of design-relatedness, and thus, of argument relevance. In fact, 81 out of 256 of the identified arguments are composed of at least two clearly defined conceptual viewpoints, referring either to an intermediary representation or to users' perspective. Moreover, in 11 of them there is the participation of two speakers instead of one. The complete "argument map" composed of speaker, dialogue act, type of conceptual viewpoint, and type of argument is presented in Appendix 5.

c. Emerging task-oriented roles

Different types of participants' roles can emerge from the combination of specific DROMEAS categories with the 'speaker' category. However, we will only present the relations between speaker and the emergent 'products' of interaction, meaning arguments, perspective, and viewpoints. Such selection is due to two main reasons: first, because it guaranteed some degree of efficiency of the emerging role, and second, because of the relation of each one of these interaction outcomes with two main person-based task-oriented institutional interaction characteristics, namely *power* and *expertise*.

Beginning with arguments, the following relations emerge as presented on Table 32.

TABLE 32. RELATIONS BETWEEN SPEAKER AND ARGUMENT TYPE IN THE TWO CASES

Team 1	**speaker**											**Team 2**	**speaker**		
Argu_type	A	B	C	D	E	F	G	I	J	M	Total	A	B	C	Total
practi	2	5	1	1	4	6	6	1	4	0	30	7	18	2	27
neg_cons	4	9	2	0	1	1	5	0	2	2	26	3	1	2	6
pos_cons	1	0	0	1	1	2	3	0	1	0	9	0	1	0	1
alt_neg	12	11	1	0	0	2	4	0	7	1	38	10	5	1	16
alt_pos	6	4	1	0	1	1	1	0	0	0	14	3	1	0	4
analog	3	1	1	0	6	2	0	0	1	0	14	3	3	0	6
expert	3	0	1	0	0	0	0	0	3	0	7	0	3	1	4
rule_b	7	9	6	0	0	3	2	0	0	0	27	5	13	2	20
person_b	5	1	1	1	2	0	6	1	0	0	17	3	4	0	7
users_b	15	8	1	2	1	9	12	0	1	0	49	14	8	0	22
practi_tas	0	4	2	0	0	0	1	0	0	0	7	0	0	0	0
practi_alt	0	0	0	0	0	0	3	0	1	0	4	1	1	0	2
practi_exp	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
expert_an	1	0	0	0	0	0	0	0	0	0	0	1	2	0	3
Total	58	52	17	5	16	26	43	2	20	3	242	50	62	8	120

Some clear argument-based roles emerge inside both teams, as it can be seen on Table 32. First of all, regarding Team A, it is possible to identify a main arguer for at least half of the argument types emerged. For 'arguments from negative

consequences' the main producer is 'B', for 'arguments from analogy' it is 'E', for 'rule-based arguments' it is again 'B', for 'person-based arguments' it is G, and for 'users-based arguments' it is 'A', who is also the main producer of 'arguments from alternatives-negative', in which speakers 'B' and 'J' are also active. The mostly distributed type of argument is the practical inference. Some clear roles emerge for Team B, in which both speakers 'A' and 'B' have a relatively high predominance for two different types of arguments, 'arguments from alternatives-negative' and 'users-based arguments' for 'A', whereas 'practical inference' and 'rule-based' for speaker 'B'.

Regarding the perspective through which the conceptual viewpoints are expressed, some interesting observations emerge according to Table 33.

TABLE 33. RELATIONS BETWEEN SPEAKER AND CONCEPTUAL VIEWPOINT PERSPECTIVE

Team 1	speaker												Team 2	Speaker		
Perspective	A	B	C	D	E	F	G	H	I	J	M	Total	A	B	C	Total
B	12	11	4	2	3	12	11	0	0	2	0	57	15	39	3	57
C	30	4	1	3	13	17	18	0	3	8	1	98	119	135	5	259
Cf	17	7	0	0	3	2	12	0	3	8	1	53	10	8	1	19
D	0	0	0	0	0	0	1	0	0	1	1	3	2	1	0	3
E	0	0	0	0	2	0	3	0	0	0	0	5	4	2	1	7
F	19	16	0	3	8	4	6	0	0	5	0	61	0	0	1	1
M	8	19	8	1	0	1	10	1	0	1	2	51	12	11	0	23
P	6	2	0	2	2	6	3	0	0	1	0	22	4	13	0	17
S	7	3	1	0	1	2	0	0	1	1	0	16	11	1	0	12
T	3	6	0	0	0	2	1	0	0	0	1	13	2	3	4	9
U	18	8	2	2	1	6	15	0	1	15	1	69	12	8	0	20
V	5	1	0	1	1	1	3	0	0	0	0	12	1	0	0	1
X	5	10	3	0	1	2	1	0	0	0	0	22	5	8	0	13
Total	130	87	19	14	35	55	84	1	8	42	7	482	197	229	15	441

As we can see above, Team A has a quite different image than Team B, mostly regarding the fact of 'perspective accumulation' in one person, 'A', who also corresponds to the Course Team Chair. Interestingly, though, the leader's 'multiperspectivism' allows for the emergence of various perspectives also in other

participants: it can be easily observed that perspective distribution is high also for speakers 'F', 'G', and somehow for 'E'. Moreover, speaker 'F' shares the predominance of 'Pedagogy' perspective with speaker 'A', and speakers 'G' and 'J' are also relatively high regarding 'users' perspective. Finally, two saliences characterize speaker 'B' of Team A, regarding 'management' perspective and 'expert's voice'. It should be noted here that speaker B participates in the meetings as representative of another institutional team. Regarding Team B, speaker 'B' stands out for the 'content', 'behavior', and 'pedagogy' perspectives, whereas speaker 'A' predominates regarding 'structure', shares the 'content' perspective viewpoints with speaker 'B', and shows somehow greater 'multiperspectivism', even though he participates with less viewpoints. Finally, speaker 'C' is the most active participant regarding 'task' perspective.

Last but not least, the relations between speaker and viewpoint type were investigated. A type of 'responsibility sharing' between two participants appears as relevant in both teams. In Team A, it regards the division of 'constraints' and 'requirements' among speakers 'A' and 'B', and in Team B, it refers to the division of 'proposals' and 'constraints' again between speakers 'A' and 'B'. However, a main difference is noted regarding the most remarkable salience of the relation speaker-viewpoint, as it can be seen on Table 34: in Team A, such salience regards 'proposals' and speaker 'A', whereas in Team B, it regards 'requirements' and speaker 'B'. Another interesting observation emerges from Team A, and more precisely, the very active participation in the production of proposals of two other speakers, rather than 'A' and 'B', namely 'G' and 'F'. The same is not observed for Team B, in which proposals' expression is shared between speakers 'A' and 'B'.

TABLE 34. RELATIONS BETWEEN SPEAKER AND VIEWPOINT TYPE

Team 1	speaker												Team 2	speaker		
Viewpoints	A	B	C	D	E	F	G	H	I	J	M	Total	A	B	C	Total
proposals	82	30	7	3	20	33	53	0	3	20	2	253	119	122	8	249
constraints	21	24	5	4	6	5	9	1	2	7	1	85	26	28	3	57
requirements	33	25	4	3	8	16	18	0	1	15	2	125	59	76	3	138
Total	136	79	16	10	34	54	80	1	6	42	5	463	204	226	14	444

C) SUMMARY OF RESULTS

a. Relation between design and communication processes

There is a strong relation between the design and the communication process at both a macro and micro level. Table 35 shows the summary of the most interesting relation (always in relation to the others).

TABLE 35. SUMMARY OF RELATIONS BETWEEN DESIGN AND COMMUNICATION ACTS AND ACTIVITIES

Design activity	Communication activity	
	Strong (+)	Weak (-)
evaluation	present alternative, comment, oppose	open
presentation	propose, oppose	clarify, comment, verify
transformation	explain, verify	oppose, present alternative
Design act	**Communication act (+)**	
no act	clarify, agree, verify	
generate	open	
evaluate	assess positively, comment	
add	assess negatively, conclude, justify	
revolutionize	oppose	
detail	explain	
generate	propose	

Finally, regarding the design construct of 'co-construction' and the communication construct of 'dialogicality' no strong relation has been found, implying that more co-constructive episodes are not always the most dialogical ones. However, in the episodes where some dependency is identified, the number of arguments is also increased.

b. Structure of team design deliberative episodes

First of all regarding the structure of the whole dataset, the following types of episodes are identified, in order of frequency: method finding, solution finding, solution assessment, problem framing, and method assessment. Regarding the structure of episodes, independently of their type, interesting patterns emerged regarding objects, activities, and acts.

Nine of the ten of the emerged types of design object patterns are circular, meaning that their first and last object is the same. This mostly happens with solutions and methods, meaning that most of the patterns are either solution- or method-based. The in-between object varies. The only linear pattern is the 'problem-solution-method' pattern.

Circularity is also the main characteristic regarding design and communication activity patterns, as 74.9% (corresponding to 185 out of 247 occurrences) of the total patterns are of this type. Moreover, in all of the activity patterns one of the components is repeated at least twice. This repetition becomes the rule without exception when, together with the activity, we also take into consideration the object. The two most predominant activities, the 'transformation' design activity and the 'propose' communication activity, systematically follow one another at an episode level. It is interesting to observe, though, that however similar they are in their repetition, the same does not apply for their accompanying object. The only similarities for the 'transform' and 'propose' patterns regard the following sequences

of objects: 'problem-solution', 'solution-method', 'method-problem', and 'method-rule'.

Finally, regarding patterns of acts inside an activity, all phenomena of circularity, repetition, and linearity are possible, as it is summarized on Table 36.

TABLE 36. QUALITIES OF DESIGN AND COMMUNICATION ACT PATTERNS

Qualities	Design patterns	Communication patterns
Circularity	detail-add-detail, detail-specify-detail	propose-explain-propose, explain-propose-explain
Repetition	detail-detail-detail	explain-comment-comment
Linearity	generate-specify-detail, specify-detail-add, generate-detail-add	propose-explain-comment, verify-clarify-explain

c. Relation between design and communication structures

Regarding the relation between design and communication structures, the following can be said: a) the team design goal type favors the emergence of certain design object patterns than others, b) interdependency between design and communication patterns exists, but c) design patterns are more equally distributed throughout the episodes, whereas the manifestation of certain communication patterns more than others depends on the episode.

d. Content type produced

Regarding the type of task-oriented acts, as they were expressed in the dataset, solution- and method-oriented acts occupy more than the half of the total number, whereas 'problem' is not so often (only 9.2%) and 'goal' is hardly made explicit

(1.3%). To speak of 'conceptual viewpoints' in our dataset, the manifestation of a task-oriented act is not sufficient; some type of intermediary representation or argument expressed together with a communication perspective is necessary. Table 37 shows a summary of the most interesting (in comparison to the rest) relations between type of communication perspective and type of content (letters in the vertical column correspond to the design objects' codes, whereas letters in the horizontal line refer to perspective codes). The last four lines are also types of conceptual viewpoints.

TABLE 37. TYPES OF CONCEPTUAL VIEWPOINTS PRODUCED

Content	Communication perspective										
Type	B	C	F	Cf	S	V	U	X	M	T	P
M	✓										✓
P			✓								
R									✓		
S		✓		✓	✓	✓				✓	
T								✓			
Propos.	✓	✓		✓							
Require.	✓	✓					✓				
Constr.		✓					✓		✓		
Argum.							✓		✓		

e. Arguments' type produced

Arguments are studied in depth separately due to their relevance to team design communication as we already saw in the theoretical part. Two findings are considered of interest regarding our research questions: a) the type of emerged argument structures, and b) their relation to conceptual viewpoints. Regarding their type, the most frequent arguments are: 'users-based', 'rule-based',

‘practical’, ‘from alternatives-negative’, and ‘from negative consequences’. Also, distinguishing between “authentic” arguments –the ones for which some pre-defined form exists– and “emerging” arguments, we observe that they are equally distributed. Finally, regarding their proportion in the dataset, they are few compared to the total number of unit acts (4.8%), but sufficiently evident regarding the total number of conceptual viewpoints (32.6%). More precisely, the 31.6% of the emerged arguments are composed of at least two conceptual viewpoints, including intermediary representations and users’ perspective. Among the first, constraints appear to have the strongest relation to arguments’ manifestation.

f. Emerging task-oriented roles

Clear roles emerged regarding types of arguments, conceptual viewpoints, and intermediary representations for both teams (less obviously for Team B due to the small number of participants). A common pattern regarding both teams is the accumulative production of intermediary representations by co-alitions of 2 to 3 (in Team A) participants. However, the equality or not of their distribution differs between the teams and the type of representation.

7. DISCUSSION

In this chapter, we will discuss the dissertation's main results presented previously, through a double perspective, according to our research goals. First, regarding the eLearning design context and the support of professional teams involved in it; and second, from a point of view of task-oriented interaction analysis methodological contribution.

A) eLEARNING DESIGN IN TEAMS

In general, eLearning design in teams shares many characteristics with team design in other professional fields. As we saw in Chapter 2, team design is a non-linear process, that can rather be described in terms of activities than pre-defined stages, and in which patterns of communication emerge. In fact, our observations of the two eLearning design teams confirm all of these characteristics. As far as non-linearity is concerned, most of the observed patterns are circular. Linearity is only observed at some micro-level patterns, regarding acts inside activities. In general, circularity is the rule in patterns of design objects, and of both design and communication activities. Object and activity are the main components of any task-oriented system, as we argued in Chapter 1. Our results provide strong evidence that team design systems tend to re-produce the same objects and activities in order to refine or reach their goals. This has already been conceptualized partly through the notions of "co-evolution" (Dorst & Cross, 2001) or "cycles of activity" (Cross, 2001) in the Design Research field, and also through the

findings about problem-solution cycles (Poole, 1983b) and decision recycles (Poole & Roth, 1989) in the Small Group Communication field. Our research provides evidence of this phenomenon also at a more fine-grained level of analysis.

Another aspect of team design activity already discussed in the theoretical part is that it is not exclusively based on problem solving. This was confirmed in our research through the predominance of 'solutions' and 'methods' among the possible design objects. These are not only the most frequent cognitive orientations, but also are the protagonists in most of the patterns emerged. However, an interesting result regarding 'problems' also emerged. Although their distribution in the dataset is low in comparison to the other objects, they form part of the most frequent design object patterns, and of most of the object-oriented activity patterns. In addition, the only linear object pattern emerged is the 'problem-solution-method' pattern. All these results considered together lead to one observation: problem solving is one of the most important reasoning patterns in eLearning design teams. In fact, all five episode types emerged (i.e. problem framing, solution finding, solution assessment, method finding, and method assessment) relate in one way or another to problem solving.

In addition to these re-confirmed observations, this study makes another contribution as result of the method of analysis used. As we already discussed in Chapter 5, one of the major issues that Interaction analysis has touched is the independent coding of the cognitive and the social dimensions (Trognon, 1999). Applying this method to our dataset, we were not only able to describe in depth both processes, but also to identify the relation between them. In fact, a strong interdependency between the design and communication processes at many levels (acts, activities, patterns) has been found. In addition, regarding the nature of these processes, it seems that the design structures depend on the design goal, but the same cannot be said for the communication structures. The latter appear to be more "serendipitous" in terms of their context of

manifestation. In fact, some of them appear to be concentrated in certain episodes and totally absent in others. The same does not happen with the design patterns, which are more distributed throughout the dataset. This result may guide us to assume that most relations observed between design and communication structures at an episode level, depend on the type of the latter and not on the former. In other words, some communication goals favor the emergence of certain design structures more than others. At the same time, the fact that most design structures are strongly related to more than one communication structures regarding acts and activities may guide us to the assumption that design goals favor certain communication strategies to emerge at a meso or micro level. To be more precise:

- when the team goal is: a) to set the problem frames, the linear pattern 'problem-solution-method' is generally followed; b) to find solutions, the circular pattern 'solution-problem-solution' is followed; c) to assess solutions, the circular pattern 'solution-method/rule-solution' is followed; d) to find methods, the circular pattern 'method-problem/solution-method' is found; e) to assess methods, either the one or the other of the circular patterns 'method-rule-method' and 'rule-method-rule' is followed

- when the team goal is to make proposals, the design activity of 'transformation' is the most common, in one of the following pattern forms: 'present-transform-transform' or 'transform-evaluate-transform'

- when the team goal is to evaluate, the strategies of 'present alternative', 'comment' and 'oppose' are used, whereas in order to transform design content, the strategies of 'explain' and 'verify' are used

- when an individual wants to revolutionize, the strategy of 'oppose' is used, whereas in order to evaluate, the strategies of 'assess positively' and 'comment' are used; negative assessments are usually followed by adding some information

The above observations imply a precedence of the communication goal in some cases and a precedence of the design goal in some others. However, this assumption cannot be fully certified, as we refer to co-emerging processes. As we said in Chapter 1, what is the context and what the contextualized is difficult to distinguish.

Regarding the strategic content produced, two types of observations can be made: the ones regarding the team design field in general, and the ones that apply only for the eLearning design field. Regarding the first, the important role of constraints (Martin, Détienne, & Lavigne, 2002; Détienne, Martin, & Lavigne, 2005) and arguments (Stumpfl & McDonnell, 2002; Baker et al., 2009) has been confirmed. First of all, a strong relation between them has been found, meaning that most of the arguments expressed in team design are constraints-based. It is also interesting to note that the same communication perspectives are interestingly related to both of them, namely 'users' and 'management' perspective. Considering them separately, it can also be observed the abundance of requirements regarding the number of constraints expressed. Something similar has not been hitherto observed in the relevant literature. A reason for that may be our conceptualization of 'requirement' as different than that of 'constraint'. This distinction is considered necessary in the field of eLearning, where both concepts are emerging and not defined a priori. In other fields-contexts where requirements are given, specification may be only manifested in the form of constraints. In our dataset, requirements are not only made explicit, but they appear twice as the constraints. If, to this observation, we add the strong relation between arguments and constraints, it can further be assumed that it is not the quantity of constraints but their role in design communication that matters the most. On the other hand, if they really favor arguments

to emerge, the combination of each explicit requirement or proposal with a possible constraint could favor team design argumentation, and subsequently, communication.

As far as the quantity and type of arguments is concerned, we can claim that the total number of arguments (256 corresponding to 362 lines) is relatively small regarding the total size of the dataset (7625 interaction units), but not so small considering the total number of conceptual viewpoints (1111). However, it is true that in an ill-defined context such as design, it is expected that designers justify their viewpoints, forming some type of argument. This does not appear to be the case. Moreover, only half of these arguments are "authentic" in the sense that some pre-defined argumentation scheme can be identified. The rest consists of plausible, mainly inductive inferences, which relate in a way to the design decisions. In fact, the most frequent argument is one of these inferences, named "users-based", because it refers to users or users' perspective as a main argumentative component. Among the rest, an interesting observation regards the predominance of 'arguments from negative consequences' and 'arguments from alternatives-negative', in relation to their positive versions. This result is coherent to the studies of small group communication high-lightening the prevalence of negative evaluations (e.g. Hirokawa, 1988), as we already saw in Chapter 4.

Related to the eLearning design field, an interesting observation can be made regarding the tripartite nature of eLearning, composed of technological, pedagogical, and organizational aspects (Jochems, van Merrienboer, & Koper, 2004; Seufert & Euler, 2004; Sangrà, Vlachopoulos, Cabrera, in press). Our results confirm this assumption adding that the pedagogical perspective is relatively more related to design methods, the managerial perspective, that includes institutional procedures, is more related to domain rules, and the technological perspective to design solutions. This last can be explained taking into consideration that 'problems' are relatively more related to 'function'. If this is true, then also the opposite, that most solutions would be technological rather than

pedagogical or managerial, is justified. Moreover, regarding 'Management' perspective, its relation to constraints, as we already commented, is also of interest, as it is confirmed by a number of theoretical studies focusing, among other things, on how Institution conditions the design and development process in eLearning (e.g. Kessels, 1999; Bates, 2000; Rothwell & Kazanas, 2008).

Last but not least, some clear participants' roles emerged regarding the production of some argument types more than others, the adoption of one type of perspective more than others, and the expression of some type of conceptual viewpoint more than others. Some salient similarities between the emergence of concrete types of roles in both teams regard the following categories: 'arguments from alternatives-negative', 'rule-based' and 'users-based', for the types of arguments; 'pedagogy' and 'structure', for the perspectives; no clear salience is observed for the conceptual viewpoint adoption, as the two teams appear to behave quite differently in this respect. These results can be interpreted as following: clear task-oriented roles emerge where some type of expertise or 'big image' vision is necessary, whereas the production of design-relevant representations depends more on team organization aspects. Power mechanisms are very strong candidates, given the fact that Team A is characterized by clear institutional roles, whereas this is not the case for Team B.

B) TASK-ORIENTED INTERACTION METHODOLOGY

The results described in this section are those that, in our point of view, could be considered as contributions in the construction of a theoretical framework regarding task-oriented interaction in general.

First of all, given the (justified) lack of univocality regarding how to analyze task-oriented communication, any methodological contribution regarding this aspect is a potential contribution to what can be generally defined as 'team communication'. As we synthesized in Chapter 4, there is a vast number of theories, studies, and models regarding small group communication in general, and no one method exists to do Interaction analysis in particular. Thus, the construction of new coding interaction schemes is both a need and a potential contribution.

We consider that DROMEAS has both some positive and negative characteristics, when being considered as a tool to analyze task-oriented interaction, and more precisely, team design interaction. Starting with the positive, the following aspects may be considered as 'strong points', regarding the field-related emergent research needs: a) It is multi-dimensional. Team interaction nowadays can be very complex, as different expertises, demands, and considerations come into play. The more we consider them, the more possible it is to "grasp" the real meaning of interaction; b) it is relatively easy to combine the coding dimensions with pre-defined theoretical constructs; and c) it allows for different types of analysis, not only the ones it was conceived for. Regarding its negative aspects, some main issues can be raised, such as: a) its use by a non-expert; some of the categories may result difficult for a non-specialized researcher to deal with in the expected way. Although inter-coder reliability was relatively high for all the categories checked, it should be mentioned that all raters were expert either in Design or in Communication; b) its complexity regarding the results. Combination between the various dimensions can give many different directions for investigation. An ability to select between those dimensions and those types of analysis adequate to answer the research questions is necessary; and c) the difficulty of communicating these results to the participant designers. Of course, adopting a totally different perspective to see design than the people who actually do it does not facilitate its direct communication to the

participants. Some kind of "translation" is necessary, for example using the "design patterns" language, as proposed by Alexander, Ishikawa, & Silverstein (1977), transformed into "workplace patterns", in the sense proposed by Martin, Rodden, Rouncefield, Sommerville, & Viller (2001). Our first attempt in this direction is described in Rapanta et al. (2010).

However, the analysis of the dataset using DROMEAS has offered a number of concretizations regarding the categories used to analyze communication. First of all, the inter-rater reliability is satisfying (avg. K= 0.72) for all the three categories for which it was checked, namely: 'design object', 'representational act', and 'dialogue act'. More precisely, we will focus on the 'dialogue acts' proposal, given the small number of studies in this direction. Our main contributions regarding this aspect are: a) the selection of acts that are meaningful from a task-oriented point of view. A main difference between communicative acts and dialogue acts is that the first can also be 'task-free', meaning that their emergence in interaction can also depend on other factors, rather than the task itself. Focusing only on the 'dialogue acts', a greater replicability of such acts in similar task settings is favored; b) the adequacy of these acts for the context of interaction, in the sense that they always take the addressee into consideration. In comparison to the speech acts, which were proposed to analyze language, dialogue acts are more adequate when the goal is to analyze interaction; and c) the definition of (some of) these acts on various dimensions, such as linguistic, semantic, cognitive, physical, and social, following the line of Bunt (1999).

More precisely, regarding the semantic-cognitive dimension of the dialogue acts proposed, some interesting relations emerge between those and what we defined as 'representational' acts. Considering that most of the dialogue acts are also accompanied by a representational act, and also that there are some strong relations between some categories of one type and another, the assumption that the representational acts can be

considered as part of the semantic-cognitive function of the dialogue acts is highly reasonable, at least in some cases. This is also in concordance with the interaction analysis approach, according to which at least seven dimensions come into play in a dialogue (Baker, 1999, 2003), with a strong interdependency between the social and the cognitive macro-dimensions (Trognon, 1999). Making explicit how such relation is manifested at a dialogue act level could be considered as a theoretical contribution regarding this aspect.

More precisely, the most interesting relations between dialogue and representational acts are summarized in Table 38. Only the most frequent representational correspondents have been marked for each dialogue act.

TABLE 38. RELATIONS BETWEEN THE SOCIAL AND THE COGNITIVE DIMENSION AT AN ACTS LEVEL

Repres	Dialogue acts																	
	agr	alt	att	cla	com	con	exp	ins	int	jus	nar	neg	ope	opp	pos	pro	psp	ver
0																		
add																		
det																		
dup																		
ev																		
gen																		
mer																		
mod																		
rev																		
spe																		

Interpreting the Table above, the following semantic-cognitive functions of the dialogue acts proposed, emerge:

- The acts of 'postpone', 'narrate', and 'instruct' most of the times do not change the representational flow of the interaction, at least not verbally (regarding 'instruct', for example, it is many times accompanied by a non-verbal representational function, such as the use of a tool).

- The non-representational function is also usual for the acts of 'agree', 'clarify', and 'verify'; the two latter also often have a specification function regarding contents.

- Regarding the very much discussed, in the field of Informal Logic, relation between explanation and justification, a clear distinction emerges regarding their cognitive function: the one of 'explain' is mainly to 'detail' a concept, event, or idea; whereas that of 'justify' is more related to 'add' new information.

- Regarding the function of 'generate' concepts, this does not only belong to the 'propose' and 'open' acts, as one would expect, but also to the 'call for attention' act. Distinguishing between the cases could also be interesting from a dialectical point of view, as introducing a concept by calling for attention to is very related to the rhetorical functions of discourse.

- 'Present alternatives' can either have a 'modify' or a 'revolutionize' function. Again, this can be interesting from a dialectical point of view, as 'revolutionize' is also performed by 'call for attention' and 'oppose' acts. Identifying in which cases an idea is slightly modified or replaced by an alternative, in a way that the selection of the second renders impossible or more difficult the execution of the first, is crucial in multiple choice decision-making. Even more, when various

sources of alternatives' production (e.g. the team's participants) exist at the same time, and 'following' a decision is not always easy.

- 'Comment' can either have an adding information or an evaluative function. In the latter case, we refer to what is also known as 'evaluative comments'.

- 'Conclude', 'interpret', and 'justify' also have an 'add' function. This is explained considering the numerous function the act of 'add' has (see also Appendix 2). Further distinguishing between them at the time of coding could be enlightening also regarding the distinction between the three dialogue acts, when it is necessary.

- Finally, an interesting observation regards the two types of 'assess' act, i.e. the positive and the negative form. Although the 'assess positively' is mainly related to the evaluative function, the 'assess negatively' sometimes is connected to the 'add' function. This may imply that people feel the need to add some information together with their negative assessments, maybe for making them less 'heavy' from a socio-relational point of view. In this aspect, it would also be interesting to investigate the relation between 'assess' and 'justify' acts to further check for any differences between the positive and negative version. However, this would exceed the goals of our research.

Last but not least, a special interest has been given to the identification of some of the Walton and others' (2008) argumentation schemes in our extended (7625 lines) dataset. Doing that, 14 arguments emerged that neither applied to any of the schemes, nor could they be classified as other design relevant quasi-logical inferences. More precisely, these argument modes are: 'practical argument from task

assignment'[3], 'practical from alternative', 'practical based on expert' and 'expert-based analogy'. Table 39 shows representative examples from the dataset for each type.

TABLE 39. THE 'NEW' EMERGING ARGUMENT MODES

Practical from task assignment	Practical from alternative	Practical based on expert	Expert-based analogy
I think as you go along, () got an excellent CTA, Ann Jones. So if we do it… you know as we go along and she can do this transferring thing hopefully. She's worked in a lot of () courses, she knows about you know (trans. lines 166-170)	yeah, it's simpler to do that, cause in order to write that Introduction, we are going to have a complete overview of the whole thing anyway (trans. lines 3158-3160)	How the editing process has gone along after that, I really don't know. We should ask it to Merce and Juan (trans. lines 5388-5389, original in Spanish)	As I told you, the tutor said to me that the module was very infantile and de-phased to him (…) I think that this gives us reasons for us to also have the same perception (trans. lines 6241-6251, original in Spanish)

Considering their frequency (8, 4, 1, and 1 times correspondingly) the first could be considered as a strong candidate for a new argumentation scheme (Doug Walton, personal communication, Windsor, 17/05/2011), and possibly also the second. The third and fourth seem to be as variations of 'argument from expert opinion' and also maybe cultural ones, as they only appear in the Spanish dataset. A further investigation of these schemes and also their completion with critical questions, as in Walton et al. (2008) would be necessary before going on to any assumptions.

[3] I owe this argument name proposal to Doug Walton (personal communication, Windsor, 17/05/2011).

8. CONCLUSION

Team design is a complex socio-cognitive process. Such complexity becomes greater when different disciplines, perspectives, and "unknown" users are involved, as in the case of eLearning design and development. Communication plays a major role in this process, as it forms the basis of *sharedness* and *jointness* of the intermediary representations "put on the table", in other words, it forms the basis of collaborative design.

In the present dissertation we answered questions regarding the three main components of the co-design process in the eLearning field, which are: people, methods/strategies, and contents. More precisely, our descriptive results concern the design and communication process structure, the task-oriented roles adopted by the participants, and the identification of conceptual viewpoints and arguments emerging during eLearning project meetings in two different teams.

Our main observations can be summarized in the following statements:

- The design and communication processes are highly interdependent.
- Solutions and methods are "re-visited" in a systematic way, with the intermediation of problems, domain rules, objects, and tasks. Goals are hardly made explicit.
- Decisions are taken in a circular rather than a linear mode.
- Pedagogy, technology, and management are all present in the discussion of contents, with the pedagogical perspective being more related to design methods,

the managerial perspective more related to domain rules, and the technological perspective to design solutions.

- Requirements are made explicit more than constraints, but the latter are strongly related to the emergence of arguments.
- Management and usability, when discussed, are often related to some type of argument.
- Discussion about users emerges very often, and in the following forms: users perspective, usability constraint, or users-based argument.
- Arguments emerge not as much as expected and half of them do not correspond to sound argumentation schemes, as proposed in the field of Informal Logic.
- The negative aspects of design solutions are more argued rather than the positive.
- Similar roles emerging for both teams concern some types of arguments (arguments from alternatives-negative, rule-based, and users-based), and some types of perspectives (pedagogy, and structure). Design-relevant intermediary representations (proposals, constraints, and requirements) are produced quite differently regarding the two teams' participants, implying the intermediation of power mechanisms in the task-oriented interaction.

Based on these observations, and on the discussion presented in the previous Chapter, the following guidelines can be extracted regarding team design practice in the field of eLearning:

- Recycling methods and solutions is productive as long as it serves a concrete design goal. If this is partly or completely served, a communication goal must

intervene for the design activity to change. Communication, although it appears opportunistic, serves to guide the design thinking.

- Design is a continuous and dynamic transformation of proposals. During this process, constraints and arguments play a major role. Making explicit one of them also has positive influence on the other. Institutional rules and users' perspective seem to be the content most related to their emergence.

- Certain task-relevant roles are related to the clear pre-existence of institutional or organizational roles. Apart from multi-perspectivism, which is a characteristic of any creative democratic team, specific proposals, constraints, and requirements need to be taken into consideration for a design decision to be taken in the "best" way possible. On the other hand, as Technology, Pedagogy, and Management intervene as possibilities, expertise in one field or another is a relevant criterion for the adoption of such roles. The co-existence of organizational roles, such as 'agenda-keeper' or 'time-keeper', with expertise-based roles, such as 'technological constraints expert', appears as a possible solution.

To give more precision to the general guidelines presented above, further work is necessary. These are some possible directions:

- Regarding the role of communication in "guiding" design thinking, the analysis of *dialogue shifts* (as already proposed by Walton & Krabbe, 1995) in relation to the content discussed is a possible line of investigation. In this way, it can be proven that designers do not just "jump" from one topic to another, but topics refer to implicit or explicit communication goals. Deciding between strategic and opportunistic dialogue shifts can also add more information to each participant's *dialectical profile* (Baker et al., 2009).

- Regarding the emergence of institutional constraints and users' perspective in designers' discourse, more analysis focused on this aspect is necessary. Such micro-analysis can shed more light in the connection between certain decision typologies with certain types of institution and users' manifestations, such as telling personal stories, or putting oneself in the 'users' shoes'.

- Finally, regarding roles, more research is necessary regarding how expertise is made explicit through discourse. Given the fact that knowledge management in teams, and even more, in cross-disciplinary teams, is a requisite, analyzing conceptual viewpoints as expert language manifestations is a valuable source at the time of analyzing workplace activity.

Apart from these main observations regarding eLearning design in teams, some insights are provided regarding task-oriented interaction analysis methodology, as discussed in Chapter 7. The coding scheme we propose, DROMEAS, appears to be a functional tool at the time of analyzing team design interaction in several meaningful dimensions. More precisely, we coded a 15 meetings' interaction dataset (see Annex) into six relevant dimensions: design activity, representational act, object, meta-epistemic reference, dialogue act, and dialogue sequence. Our main contribution regarding the proposal of these dimensions is the list and definition of 18 dialogue acts, to describe participants' task-oriented communication moves.

As far as the dialogue sequences are concerned, a contribution consists in their segmentation, mainly following Schegloff (2007), but also in the search for functional relations among them. This means that the way we coded the sequences – putting the name but also a number indicating to which previous sequence It refers – can be helpful at the time of performing a dialectical analysis, in which a whole sequence serves as a 'macro-argument' to a previous one. Such an analysis, based on discourse relations,

could be very useful in the field of collaborative problem solving, in general, as 'co-construction' rather than 'confrontation' is the general team dialectical goal.

Finally, we are aware that our methodological proposal has not touched all aspects possible in this complex research situation. However, DROMEAS categories can be applicable to other analytical perspectives, such as social network analysis, tools-based multimodal communication analysis, affective regulation identification, and so on.

Some indications for future research regarding the methodological aspects discussed are the following:

- The further investigation, analysis and application of the proposed dialogue acts in other task-oriented contexts, not necessarily related to the eLearning design field.

- The identification of argumentation sequences. This can also be done with the help of a top-down model, as the ones proposed to analyze joint deliberation in the field of Artificial Intelligence (see, for example, McBurney et al., 2007; Walton, 2011). We acknowledge that such application may have not been possible from the beginning, given the nature of real-time, emerging communication in a creative context. However, having identified bottom-up structures, such as the goal-oriented sequences and the argumentation schemes, the identification of pre-defined phases *a posteriori* is possible, as we already showed in our recent work (Rapanta, forthcoming). We consider that the confrontation of top-down with bottom-up approaches is necessary, if we want to get into a deeper evaluation of team communication and argumentation.

- The combination of DROMEAS with other methods of analysis. Social network analysis, for example, can be very enlightening at the moment of comparing pre-defined, institutional roles, with emerging, task-defined ones.

In general, in this dissertation we treated team design communication mainly as a deliberative type of dialogue, limiting our analysis only to the episodes in which some type of decision making was evident. However, we acknowledge that how decisions are finally taken in an eLearning team depends on a number of factors, which could not all be treated in the margins of one research. The triangulation of the transcripts' coding with other data sources, such as interviews or field notes, can shed more light on other aspects of communication, not necessarily related to the socio-cognitive dimension of interaction, which is the focus of the present research. We believe that a multi-faceted empirical approach is the most adequate way to enhance our understanding of this new, still ill-defined research field, called *eLearning design in teams*.

APPENDIX 1. TEAM DESIGN REVIEW RESULTS

Reading key for summary table

Domain: the specific field of application; *eng* for engineering design (comprising industrial, mechanical, and electrical design), *SW* for software design, *arch* for architectural design, *oth* for other

Participants: the identity of the study participants; *stud* for students and *prof* for professionals

Situation: the specific encounter type in which team design takes place; *mee* for co-located meetings, *sess* for experimental sessions, *dist* for in situ meetings with long hearing and/or visual distances

Method: referring to the main data analysis method; *quali* for open qualitative methods, *cod* for any protocol coding method using pre-defined categories or interaction analysis coding, *surv* for survey techniques, *smet* for sociometric analysis techniques and *other*

Study ID	Domain				Participants		Situation			Method				
	Eng	SW	Arch	Oth	Stud	Prof	mee	sess	dist	quali	cod	surv	smet	othe
1. Bucciarelli (1984, 1988)	√					√			√	√				
2. Walz, Elam, Krasner & Curtis (1987), Walz (1988)		√				√			√	√				
3. Curtis, Krasner & Iscoe (1988)		√				√			√			√		
4. Tang & Leifer (1988)		√			√	√		√		√	√			
5. Minneman (1991)	√					√		√	√	√				
6. Medland (1992)	√					√			√	√				
7. Olson, et al. (1992)		√				√	√				√			
8. Sonnenwald (1995, 1996)			√			√	√			√			√	
9. Peng, C. (1994)			√			√	√			√				
10. Scaife, Curtis & Hill (1994)		√				√	√			√				
11. Herbsleb, Klein, Olson et al. (1995)		√				√	√				√			
12. Kraut & Streeter (1995)		√				√			√			√		

Study ID	Domain				Participants		Situation			Method				
	Eng	SW	Arch	Oth	Stud	Prof	mee	sess	dist	quali	cod	surv	smet	othe
13. Brereton, Cannon, Mabogunje & Leifer (1996)	√					√		√			√			
14. Cross & Cross (1995)	√					√		√		√				
15. Dwarakanath & Blessing (1996)	√					√		√			√			
16. Goldschmidt (1996), Goldschmidt & Weil (1998)	√					√		√			√			√
17. Radcliffe (1996)	√					√		√			√			
18. Trousse & Christiaans (1996)	√					√		√			√			√
19. Perry & Sanderson (1998)	√					√		√		√				
20. Smith & Tjandra (1998)	√				√			√		√				
21. Smith & Leong (1998)	√				√	√		√			√			
22. Valkenburg & Dorst (1998)	√				√			√			√			
23. Busseri & Palmer (2000)				√		√		√				√		√
24. Austin & Steele (2001)				√		√		√				√		
25. Martin, Detienne & Lavigne (2002); Détienne, Martin & Lavigne (2005)				√		√	√				√			
26. Darses, Détienne, Falzon & Visser (2001)		√				√	√	√			√			
27. Eckert (2001)				√		√			√	√				
28. Badke-Schaub & Frankenberger (2002)	√					√			√	√				√
29. Boujut & Laureillard (2002)	√					√	√		√	√				
30. Stempfle & Badke-Shaub (2002)	√				√			√			√			

Study ID	Domain				Participants		Situation			Method				
	Eng	SW	Arch	Oth	Stud	Prof	mee	sess	dist	quali	cod	surv	smet	othe
31. D'Astous, Détienne, Visser & Robillard (2004)		√				√	√				√			
32. Détienne & Visser (2006), Visser (2009)			√			√	√				√			
33. Kratzer, Leenders & van Engelen (2008)	√					√			√			√		
34. Adams, Mann, Jordan & Daly (2009)	√					√	√			√				
35. Badke-Schaub, Lauche, Neumann & Ahmed (2009)	√					√	√				√			
36. Baker, Détienne, Lund & Séjourné (2009)			√			√	√				√			√
37. Botturi & del Percio (2009)				√		√	√						√	
38. Goldshmidt & Eshel (2009)			√			√	√				√			
39. Mabogunje, Eris, Sonalkar, Jung & Leifer (2009)	√					√	√			√				
40. McDonnell (2009)			√			√	√				√			

APPENDIX 2: SEGMENTATION "RULES"

A) Segmentation of acts

a. Linguistic forms of saying exactly the same thing in other words, or slightly reformulating it but without changing somehow the message or its communication are not considered as separate acts.

b. Incomplete sentences or clauses that they do not communicate a message by themselves are considered as a separate act when they are the only elements of an utterance. In any contrary case they are not separated from the precedent or subsequent act to which they are more related.

c. Regarding all acts, a general segmentation rule is that they form separate acts each time a physical or imaginary addressee is considered able to understand the message contained in them, taking into account the context of interaction. In this sense, they are always "self-contained".

d. Duplications and immediate concept clarifications inside the same utterance are not considered as separate acts.

B) Segmentation of sequences

a. Each sequence has ONE principal contribution act that can mainly be one of the following: open, verify, propose, present alternative, call for attention, oppose, explain, clarify, comment, interpret.

b. In many cases, this corresponds to the initiating act of the sequence. However, it is also possible that the principal act is manifested a little bit later in the sequence and, sometimes, just before the end of the sequence.

c. In order to distinguish between the post-expansion feedback of a sequence and a new sequence,

- if the feedback acts focus on the same object as the sequence's main presentation, a new sequence is introduced in two cases: first, when a new communicative function is initiated; and second, when a new relevant aspect is presented, and it is treated in at least two representational acts

- if the feedback acts introduce focus on a different object, only the second case mentioned above applies.

C) Segmentation of episodes

a. Episodes are segmented by topic. In the cases in which this is devised in sub-topics, the criterion of segmentation is the making of a decision on one topic before passing on to another. In other words, if the sub-topic is introduced in order to facilitate decision-making on the main topic, and after it is discussed, the focus returns on the initial topic, the episode is not segmented. However, when some kind of decision, in the form of an intermediary representation, is reached regarding a topic, and subsequently a second, "independent" decision is taken regarding a sub-topic, extended in at least two sequences, the sub-topic decision is treated as a separate episode.

b. However, it is also possible that a decision appears as "final" at one moment of interaction, but the team returns to it after one or more episodes. In these cases, we consider the second episode as a second, independent team decision-making episode, and not as a continuation of the previously taken decision. Design is a dynamic socio-cognitive process in which objects, contents, and roles change continuously, even after some degree of specification is achieved. In this sense, "returning" to the same decision actually is not possible, as none decision remains the same during and after its specification. In any case, it is worth mentioning that our goal is not to identify how exact decisions regarding the design object were taken, but how the object is constructed through these decisions.

c. Only episodes that can be somehow considered as "efficient" regarding the team deliberation process are included in the analysis. Such efficiency in our dataset is manifested through the emergence or confirmation of a relevant intermediary representation, that can be either the specification of a constraint or a requirement, or a final, in the sense of not put under further discussion, proposal.

APPENDIX 3: GUIDELINES FOR DESIGN ACTS' IDENTIFICATION

a. Specify (spe)

- as concept definition: *this is your blog now is it? (…) <u>these are all the pages that I'm proposing that we put the work onto</u>* (trans. lines 103-105)
- as object quality definition: *<u>So this is not Mac friendly?</u> No* (trans. lines 117-118)
- as object quantity definition: *O sea estamos hablando de unas ochenta páginas (trad.: so, we are speaking of about eighty pages)* (trans. lines: 7115-7116)
- as metaphor: *you know it's kind of like ...it's the stickerbook thing isn't it* (trans. line 3373)

b. Detail (det)

- as list of concepts: *We've got the, I mean the storyboard at the end, storyboarding, 3D modeling (…), PostIt notes* (trans. lines 4376-4381)
- as sequence of (past) events: *and we're kind () we can maybe schedule the different types of media that we're thinking of using, and how we kind of manage those, and what kind of people are going to be helping us* (trans. lines 9-11)
- as a "mix" of concepts-events sequence: *because for me, only having, all I have to guide myself is existing work, which is like written blogs, and (they don't have anything) to do with what was done before* (trans. lines 281-183)
- as adding of only one piece of information, which is, however, akin to form part of a sequence: *I think where we will have most influence is in the sort of studio environment too, <u>where we could sort of get the individual pages customizable</u>* (trans. lines 325-326)
- as hypothetical inference: *where you basically you can talk into a, into your computer, while you navigate around your Compendium map, and explain what you've tried to do* (trans. lines 660-662)

c. Add

- as result/consequence: *so I was thinking that the next step would be to try and get some writing to go along with it, so they can actually paraphrase for you straight from the horses mouth* (trans. lines 13-14)

- as causal inference: *I mean you can't expect these people to come and sit for three hours at a time in course team meetings, because they are working on other courses* (trans. lines 36-38)

- as enhancing a concept or an idea: *so the advice is to keep it short and pithier, and you know, if you can, bullet stuff* (trans. lines 253-254)

- as adding a "concept-event" relation: *because because that's going to change anyway, when the visuals (get) put in* (trans. lines 1112-1113)

d. Generate (gen)

- as a new topic introduction: *Have you, have you, sorry… have you looked at the thing that A's cut up that these guys are going to be writing?* (trans. line 66)

- as a new proposal: *whereas it would be nice if you kind of put a bookmark somewhere here* (trans. line 239)

- as a new constraint: *would you prefer it if we were writing into this? (…) Ideally but you're Mac based and stuff like that* (trans. lines 111-113)

- as a new requirement: *I think we would welcome some guidance though* (trans. line 222)

e. Duplicate (dup)

- as an exact repetition of another speaker's expressed content: *and I'm thinking, ok, is the style going to be less chatty (…) It is quite chatty, yeah* (trans. lines 284-290)

- as a re-use of an idea, even though it is not exactly reproduced: *because I think what would be nice to almost, you have free handover, you know you have a*

development freeze in this (…) You know, you've got this developing, it's open to everybody (trans. lines 195-203)

- as returning to an already expressed idea, by the same or another speaker: *But also at other times you might see that and you think "I want to look back at that video that I watched last week with that person talking" (…) But then there's kind of these multimedia element that people might want to review* (trans. lines 2063-2111)

f. Modify (mod)

- as an expression of a different perception: *It's a difficult one choosing music (…) I do like a bit of music* (trans. lines 1967-1971)

- as an expression of a different conception: *But in my view the problem is that if you are talking about a lot of, if you're talking about big documents, it might make the process a bit tricky; so that's why I would like to have a browse through* (trans. lines 138-139)

- as an expression of a different conceptualization: *I mean you can't expect these people to come and sit for three hours at a time in course team meetings (…)I think what you're asking for is better upfront help* (trans. lines 36-40)

- as an expression of a different contextualization: *Do people from the TLS have a Java programmer? it would need to be seen if they're available* (trans. lines 744-750)

g. Revolutionize (rev)

- as an expression of doubt towards a concept: *Now it's a shame and sounds line a duplication of work (…) well, I don't know, I don't know if it's duplicated* (trans. lines 151-156)

- as a substitution of a concept idea by another: *So when they've got time they can just go in and () (check this) and give advice early on rather than this kind of frustrating* (…) (trans. lines 205-208)

- as cancelling the truth of a statement: *What we (need to do) would be to look at the model of another course (…)I think these days we don't have those course particularly in existence* (trans. lines 230-234)

- as a total replacement of a statement by a confronting alternative: *every block looked very similar (…)The alternative way is we start off by saying "ok, here's the course team", well we introduce the course team different people, different personalities* (trans. lines 386-394)

h. Merge (mer)

- put together two previously mentioned concepts: *these are the cards which …haven't got any of the text that I had generated at all [laughs] on them (…) I mean the IMAGES are nice (…) but I just my idea my thought about it was that we had kind of had an image on one side and that that kind of a small amount of text* (trans. lines 1733-1739)

- synthesize in a solution: *one of my anxieties is how we get from this to …to show to TLS (…)I think as you go along, () got an excellent CTA (…) she can do this transferring thing hopefully* (trans. lines 166-168)

- compare or disjunct two concepts: *If they did a video, how can they have that on compendium?* (trans. line 4411)

i. Evaluate (ev)

- express some estimation regarding a state of affairs: so I was thinking that the next step would be to try and get some writing to go along with it (…)*This is again based on their availability* (trans. lines 13-17)

- attribute a positive or negative value to a state of affairs: *so at least when you're writing it, you've almost got a templated briefing for me to write a brief or in your mind, I mean I find that a lot easier way to work* (trans. lines 59-60)

- attribute a positive or negative value to a concept: *Yeah that's the thing with structured content, it's more fiddly* (trans. lines 117-118)

APPENDIX 4: STATISTICS TABLES

A. Frequencies of design categories

	Overall		Team 1		Team 2	
D1_activity	Frequency	Percent	Frequency	Percent	Frequency	Percent
eval	1033	24.6	715	29.1	318	18.2
pres	1036	24.7	719	29.3	317	18.2
trans	2131	50.7	1021	41.6	1110	63.6
Total	4200	100.0	2455	100.0	1745	100.0

	Overall		Team 1		Team 2	
D2_act	Frequency	Percent	Frequency	Percent	Frequency	Percent
0	842	20.0	576	23.5	265	15.2
add	528	12.6	307	12.5	221	12.7
det	696	16.6	321	13.1	375	21.5
dup	327	7.8	183	7.5	144	8.3
ev	443	10.5	290	11.8	153	8.8
gen	421	10.0	251	10.2	170	9.7
mer	93	2.2	44	1.8	49	2.8
mod	245	5.8	121	4.9	124	7.1
rev	228	5.4	118	4.8	110	6.3
spe	377	9.0	244	9.9	134	7.7
Total	4200	100.0	2455	100.0	1745	100.0

	Overall		Team 1		Team 2	
D3_object	Frequency	Percent	Frequency	Percent	Frequency	Percent
G	56	1.3	42	1.7	14	.8
M	1108	26.4	604	24.6	504	28.9
O	429	10.2	114	4.6	315	18.1
P	385	9.2	235	9.6	150	8.6
R	387	9.2	205	8.4	182	10.4
S	1442	34.3	1027	41.8	415	23.8
T	393	9.4	228	9.3	165	9.5
Total	4200	100.0	2455	100.0	1745	100.0

B. Frequencies of communication categories

	Overall		Team 1		Team 2	
C1_activity	Frequency	Percent	Frequency	Percent	Frequency	Percent
alt	148	3.5	135	5.5	13	.7
att	543	12.9	362	14.7	181	10.4
cla	73	1.7	56	2.3	17	1.0
com	455	10.8	180	7.3	275	15.8
exp	539	12.8	307	12.5	232	13.3
ins	6	.1	6	.2	.0	.0
int	4	.1	4	.2	.0	.0
ope	243	5.8	125	5.1	118	6.8
opp	33	.8	33	1.3	.0	.0
pro	1926	45.9	1041	42.4	885	50.7
ver	230	5.5	206	8.4	24	1.4
Total	4200	100.0	2455	100.0	1745	100.0

	Overall		Team 1		Team 2	
C2_act	Frequency	Percent	Frequency	Percent	Frequency	Percent
0	433	10.3	139	5.7	294	16.8
agr	219	5.2	158	6.4	61	3.5
alt	80	1.9	62	2.5	18	1.0
att	162	3.9	121	4.9	41	2.3
cla	425	10.1	295	12.0	130	7.4
com	594	14.1	308	12.5	286	16.4
con	44	1.0	39	1.6	5	.3
exp	712	17.0	405	16.5	307	17.6
ins	13	.3	10	.4	3	.2
int	66	1.6	51	2.1	15	.9
jus	173	4.1	133	5.4	40	2.3
nar	24	.6	11	.4	13	.7
neg	93	2.2	65	2.6	28	1.6
ope	52	1.2	38	1.5	14	.8
opp	50	1.2	34	1.4	16	.9
pos	126	3.0	70	2.9	56	3.2
pro	681	16.2	345	14.1	336	19.3
psp	28	.7	22	.9	6	.3
ver	225	5.4	149	6.1	76	4.4
Total	4200	100.0	2455	100.0	1745	100.0

	Overall		Team 1		Team 2	
C3_persp	Frequency	Percent	Frequency	Percent	Frequency	Percent
B	498	11.9	332	13.5	166	9.5
C	1588	37.8	539	22.0	1049	60.1
Cf	320	7.6	231	9.4	89	5.1
D	25	.6	11	.4	14	.8
E	173	4.1	102	4.2	71	4.1
F	312	7.4	295	12.0	17	1.0
M	237	5.6	160	6.5	77	4.4
P	112	2.7	59	2.4	53	3.0
S	118	2.8	73	3.0	45	2.6
T	98	2.3	51	2.1	47	2.7
U	423	10.1	365	14.9	58	3.3
V	44	1.0	44	1.8	59	3.4
X	252	6.0	193	7.9	0	.0
Total	4200	100.0	2455	100.0	1745	100.0

C. Complete crosstabulation between design and communication acts

D2_act* C2_act_ Crosstabulation

D2_act		C2_act																			Total
		0	agr	alt	att	cla	com	con	exp	ins	int	jus	nar	neg	ope	opp	pos	pro	psp	ver	
0	Count	13	170	2	10	227	68	6	103	8	18	39	14	1	3	12	7	7	26	108	842
	%	.03	.78	.03	.06	.53	.11	.14	.14	.62	.27	.23	.58	.01	.06	.24	.06	.01	.93	.48	.20
add	Count	32	2	3	9	15	138	19	46	1	20	73	1	20	0	0	7	132	0	10	528
	%	.07	.01	.04	.06	.04	.23	.43	.06	.08	.30	.42	.04	.22	.00	.00	.06	.19	.00	.04	.13
det	Count	188	0	1	1	7	7	4	444	2	3	15	8	1	0	0	1	12	0	2	696
	%	.43	.00	.01	.01	.02	.01	.09	.62	.15	.05	.09	.33	.01	.00	.00	.01	.02	.00	.01	.17
dup	Count	80	27	10	18	22	16	2	38	1	2	5	0	3	2	0	1	77	1	22	327
	%	.18	.12	.13	.11	.05	.03	.05	.05	.08	.03	.03	.00	.03	.04	.00	.01	.11	.04	.10	.08
ev	Count	12	16	4	13	1	211	4	2	0	2	13	0	48	0	2	105	4	0	6	443
	%	.03	.07	.05	.08	.00	.36	.09	.00	.00	.03	.08	.00	.52	.00	.04	.83	.01	.00	.03	.11
gen	Count	8	0	12	49	1	0	2	4	1	1	12	0	8	47	2	0	259	1	14	421
	%	.02	.00	.15	.30	.00	.00	.05	.01	.08	.02	.07	.00	.09	.90	.04	.00	.38	.04	.06	.10
mer	Count	12	1	1	4	6	15	1	13	0	2	2	0	0	0	0	1	25	0	10	93
	%	.03	.00	.01	.02	.01	.03	.02	.02	.00	.03	.01	.00	.00	.00	.00	.01	.04	.00	.04	.02
mod	Count	6	1	23	20	3	40	2	12	0	9	8	1	1	0	1	1	112	0	5	245
	%	.01	.00	.29	.12	.01	.07	.05	.02	.00	.14	.05	.04	.01	.00	.02	.01	.16	.00	.02	.06
rev	Count	6	2	23	38	1	91	1	2	0	1	6	0	9	0	33	2	13	0	0	228
	%	.01	.01	.29	.23	.00	.15	.02	.00	.00	.02	.03	.00	.10	.00	.66	.02	.02	.00	.00	.05
spe	Count	76	0	1	0	142	8	3	48	0	8	0	0	2	0	0	1	40	0	48	377
	%	.18	.00	.01	.00	.33	.01	.07	.07	.00	.12	.00	.00	.02	.00	.00	.01	.06	.00	.21	.09
Total	Count	433	219	80	162	425	594	44	712	13	66	173	24	93	52	50	126	681	28	225	4200
	%	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

D. Distribution of design and communication patterns in each episode

Episode ID	pro-com-pro	pro-pro-pro	pro_att_pro	pro-pro-com	pro-exp-pro	trans-pres-trans	pres-trans-trans	trans-trans-trans	trans-eval-trans	pres-trans-pres	Total
1	0	0	0	0	10	27	0	0	0	10	41
	.00	.00	.00	.00	.03	.03	.00	.00	.00	.02	.01
2	0	0	0	0	0	0	0	0	18	27	59
	.00	.00	.00	.00	.00	.00	.00	.00	.03	.06	.01
3	0	21	24	0	23	59	19	23	19	23	149
	.00	.04	.05	.00	.07	.07	.02	.03	.03	.05	.04
4	0	0	13	0	0	25	0	0	24	0	138
	.00	.00	.03	.00	.00	.03	.00	.00	.04	.00	.03
5	0	0	0	0	0	21	39	13	35	0	104
	.00	.00	.00	.00	.00	.02	.05	.02	.06	.00	.02
6	0	16	12	18	0	14	28	19	16	0	56
	.00	.03	.03	.05	.00	.02	.03	.03	.03	.00	.01
7	0	0	0	0	0	16	0	0	0	24	24
	.00	.00	.00	.00	.00	.02	.00	.00	.00	.06	.01
8	0	0	19	0	0	34	18	0	0	28	142
	.00	.00	.04	.00	.00	.04	.02	.00	.00	.06	.03
9	0	0	0	0	0	0	0	0	0	0	30
	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
10	0	43	0	0	0	24	22	21	51	0	134
	.00	.08	.00	.00	.00	.03	.03	.03	.08	.00	.03
11	0	80	0	0	0	0	0	0	0	27	153
	.00	.15	.00	.00	.00	.00	.00	.00	.00	.06	.04
12	24	0	0	0	0	0	0	0	0	0	48
	.04	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
13	0	0	0	0	0	0	16	35	0	0	118
	.00	.00	.00	.00	.00	.00	.02	.05	.00	.00	.03
14	0	30	0	0	0	0	33	0	0	0	70
	.00	.06	.00	.00	.00	.00	.04	.00	.00	.00	.02
15	0	0	0	22	0	27	0	0	39	0	57
	.00	.00	.00	.06	.00	.03	.00	.00	.06	.00	.01
16	0	0	0	16	37	0	0	0	0	0	50
	.00	.00	.00	.04	.11	.00	.00	.00	.00	.00	.01
17	0	0	39	0	0	18	13	0	0	0	104
	.00	.00	.08	.00	.00	.02	.02	.00	.00	.00	.02
18	0	0	42	0	0	35	0	0	0	42	51
	.00	.00	.09	.00	.00	.04	.00	.00	.00	.10	.01
19	17	0	0	0	0	0	22	0	0	14	44
	.03	.00	.00	.00	.00	.00	.03	.00	.00	.03	.01
20	0	30	0	32	22	0	0	0	0	22	57
	.00	.06	.00	.09	.06	.00	.00	.00	.00	.05	.01
21	0	0	0	0	0	25	0	0	0	26	46
	.00	.00	.00	.00	.00	.03	.00	.00	.00	.06	.01
22	0	0	0	0	0	0	0	0	0	0	44
	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
23	0	31	26	0	0	55	26	0	47	45	115
	.00	.06	.06	.00	.00	.06	.03	.00	.07	.10	.03
24	19	18	44	0	16	0	31	0	0	0	79
	.03	.03	.09	.00	.05	.00	.04	.00	.00	.00	.02
25	0	0	51	0	0	0	0	0	0	0	51
	.00	.00	.11	.00	.00	.00	.00	.00	.00	.00	.01
26	0	0	0	0	39	0	39	0	0	0	39
	.00	.00	.00	.00	.11	.00	.05	.00	.00	.00	.01
27	0	0	0	0	0	0	0	0	0	0	41
	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01

Episode ID	pro-com-pro	pro-pro-pro	pro_att_pro	pro-pro-com	pro-exp-pro	trans-pres-trans	pres-trans-trans	trans-trans-trans	trans-eval-trans	pres-trans-pres	Total
28	0	0	0	0	0	0	19	51	0	0	96
	.00	.00	.00	.00	.00	.00	.02	.08	.00	.00	.02
29	0	23	0	0	0	0	0	0	0	23	51
	.00	.04	.00	.00	.00	.00	.00	.00	.00	.05	.01
30	0	0	0	0	0	27	29	80	0	24	144
	.00	.00	.00	.00	.00	.03	.03	.12	.00	.06	.03
31	0	50	0	0	0	30	0	0	0	25	50
	.00	.10	.00	.00	.00	.04	.00	.00	.00	.06	.01
32	37	0	0	0	29	0	29	0	0	0	70
	.06	.00	.00	.00	.08	.00	.03	.00	.00	.00	.02
33	0	0	0	0	0	0	34	66	0	0	90
	.00	.00	.00	.00	.00	.00	.04	.10	.00	.00	.02
34	0	0	74	0	0	0	32	0	0	0	83
	.00	.00	.16	.00	.00	.00	.04	.00	.00	.00	.02
35	0	0	0	0	0	27	43	26	0	0	69
	.00	.00	.00	.00	.00	.03	.05	.04	.00	.00	.02
36	67	26	71	36	0	85	67	80	0	26	152
	.11	.05	.15	.10	.00	.10	.08	.12	.00	.06	.04
37	0	0	15	0	0	15	17	27	32	0	80
	.00	.00	.03	.00	.00	.02	.02	.04	.05	.00	.02
38	0	0	39	0	0	0	0	0	44	0	63
	.00	.00	.08	.00	.00	.00	.00	.00	.07	.00	.02
39	29	0	0	0	0	0	0	0	0	0	29
	.05	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
40	56	74	0	0	73	82	66	50	56	0	144
	.09	.14	.00	.00	.21	.10	.08	.07	.09	.00	.03
41	37	29	0	0	0	0	0	0	74	0	109
	.06	.06	.00	.00	.00	.00	.00	.00	.12	.00	.03
42	0	0	0	0	42	0	35	42	0	0	50
	.00	.00	.00	.00	.12	.00	.04	.06	.00	.00	.01
43	93	0	0	65	0	52	0	0	34	0	114
	.15	.00	.00	.17	.00	.06	.00	.00	.05	.00	.03
44	33	0	0	32	0	0	0	0	33	0	64
	.05	.00	.00	.09	.00	.00	.00	.00	.05	.00	.02
45	0	0	0	0	0	0	0	0	34	0	69
	.00	.00	.00	.00	.00	.00	.00	.00	.05	.00	.02
46	69	46	0	52	38	25	38	60	39	45	152
	.11	.09	.00	.14	.11	.03	.04	.09	.06	.10	.04
47	0	0	0	0	23	40	0	0	0	0	117
	.00	.00	.00	.00	.07	.05	.00	.00	.00	.00	.03
48	59	0	0	25	0	0	25	82	0	0	85
	.10	.00	.00	.07	.00	.00	.03	.12	.00	.00	.02
49	38	0	0	37	0	0	0	0	37	0	77
	.06	.00	.00	.10	.00	.00	.00	.00	.06	.00	.02
50	0	0	0	0	0	52	46	0	0	0	95
	.00	.00	.00	.00	.00	.06	.05	.00	.00	.00	.02
51	39	0	0	40	0	40	79	0	0	0	103
	.06	.00	.00	.11	.00	.05	.09	.00	.00	.00	.02
Total	617	517	469	375	352	855	865	675	632	431	4200
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Cramer's V	0.68	0.602	0.718	0.602	0.689	0.540	0.550	0.669	0.588	0.586	

E. Complete crosstabulation between design object and communication perspective

D3_obj		C3_persp													Total
		B	C	Cf	D	E	F	M	P	S	T	U	V	X	
G	Count	6	13	3	0	0	0	1	11	0	0	18	4	0	56
	%	.01	.01	.0	.0	.0	.0	.0	.10	.0	.0	.0	.09	.0	.0
M	Count	252	383	64	8	36	44	57	54	21	21	111	3	54	1108
	%	.51	.24	.20	.32	.21	.14	.24	.48	.18	.21	.26	.07	.21	.26
O	Count	13	267	25	5	28	28	3	1	13	18	10	3	15	429
	%	.0	.17	.08	.20	.16	.09	.0	.0	.11	.18	.0	.07	.06	.10
P	Count	36	95	24	2	19	65	33	9	1	8	65	7	21	385
	%	.07	.06	.08	.08	.11	.21	.14	.08	.0	.08	.15	.16	.08	.09
R	Count	21	91	20	6	12	45	91	12	5	15	41	4	24	387
	%	.0	.06	.06	.24	.07	.14	.38	.11	.0	.15	.10	.09	.10	.09
S	Count	72	639	178	4	32	126	26	25	76	36	174	22	32	1442
	%	.14	.40	.56	.16	.18	.40	.11	.22	.64	.37	.41	.50	.13	.34
T	Count	98	100	6	0	46	4	26	0	2	0	4	1	106	393
	%	.20	.06	.0	.0	.27	.0	.11	.0	.0	.0	.0	.0	.42	.09
Total	Count	498	1588	320	25	173	312	237	112	118	98	423	44	252	4200
	%	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

F. Symmetric measures (Cramer's V) between the most frequent design and communication activity patterns

	trans-pres-trans	pres-trans-trans	trans-eval-trans	trans-trans-trans	pres-trans-pres
pro-pro-pro	0.10	0.08	0.175	0.089	0.072
pro-com-pro	0.18	0.73	0.151	0.124	0.100
pro-att-pro	0.122	0.046	0.003	0.052	0.084
pro-pro-com	0.084	0.022	0.151	0.048	0.010
pro-exp-pro	0.031	0.252	0.108	0.155	0.053

G. Crosstabulation between jointness and dialogicality per episode ID

Joint * Dialogicality * Epis_ID Crosstabulation

Epis_ID	Jointness	Dialogical	Total	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Epis_ID	Jointness	Dialogical	Total	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Epis_ID	Jointness	Dialogical	Total	Exact Sig. (2-sided)	Exact Sig. (1-sided)
1	Count	1	5			18	Count	2	16			35	Count	4	16		
	%	.07	.12	.645	.436		%	.15	.31	.185	.136		%	.31	.23	.481	.349
Total	Count	14	41			Total	Count	13	51			Total	Count	13	69		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
2	Count	1	10			19	Count	1	8			36	Count	2	32		
	%	.05	.17	.145	.096		%	.08	.18	.402	.237		%	.07	.21	.069	.033
Total	Count	19	59			Total	Count	13	44			Total	Count	28	152		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
3	Count	8	21			20	Count	0	15			37	Count	3	19		
	%	.18	.14	.445	.271		%	.00	.26	.049	.034		%	.13	.24	.245	.126
Total	Count	45	149			Total	Count	10	57			Total	Count	23	80		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
4	Count	1	13			21	Count	6	18			38	Count	0	7		
	%	.02	.09	.015	.009		%	.46	.39	.738	.387		%	.00	.11	.182	.133
Total	Count	56	138			Total	Count	13	46			Total	Count	15	63		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
5	Count	2	20			22	Count	4	13			39	Count	0	2		
	%	.06	.19	.030	.015		%	.44	.30	.414	.241		%	.00	.07	1.000	.569
Total	Count	33	104			Total	Count	9	44			Total	Count	7	29		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
6	Count	4	7			23	Count	3	34			40	Count	5	38		
	%	.17	.13	.447	.338		%	.11	.30	.016	.008		%	.16	.26	.171	.087
Total	Count	24	56			Total	Count	28	115			Total	Count	32	144		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
7	Count	0	2			24	Count	2	18			41	Count	1	7		
	%	.00	.08	.493	.330		%	.11	.23	.219	.153		%	.04	.06	1.000	.543
Total	Count	10	24			Total	Count	18	79			Total	Count	23	109		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
8	Count	0	13			25	Count	5	14			42	Count	1	5		
	%	.00	.09	.004	.003		%	.33	.27	.732	.389		%	.09	.10	1.000	.699
Total	Count	50	142			Total	Count	15	51			Total	Count	11	50		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
9	Count	1	7			26	Count	4	17			43	Count	1	14		
	%	.08	.23	.104	.089		%	.33	.44	.494	.307		%	.05	.12	.459	.277
Total	Count	13	30			Total	Count	12	39			Total	Count	19	114		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
10	Count	7	25			27	Count	0	4			44	Count	1	11		
	%	.16	.19	.641	.342		%	.00	.10	.569	.404		%	.07	.17	.434	.205
Total	Count	45	134			Total	Count	8	41			Total	Count	15	64		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
11	Count	10	36			28	Count	2	23			45	Count	1	9		
	%	.23	.24	1.000	.531		%	.09	.24	.055	.040		%	.10	.13	1.000	.613
Total	Count	44	153			Total	Count	23	96			Total	Count	10	69		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
12	Count	7	22			29	Count	2	10			46	Count	1	17		
	%	.41	.46	.765	.431		%	.22	.20	1.000	.571		%	.04	.11	.201	.136
Total	Count	17	48			Total	Count	9	51			Total	Count	28	152		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
13	Count	4	26			30	Count	1	27			47	Count	0	17		
	%	.11	.22	.090	.045		%	.04	.19	.028	.017		%	.00	.15	.041	.032
Total	Count	36	118			Total	Count	27	144			Total	Count	20	117		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
14	Count	3	20			31	Count	1	13			48	Count	2	16		
	%	.23	.29	.744	.455		%	.13	.26	.662	.321		%	.10	.19	.338	.208
Total	Count	13	70			Total	Count	8	50			Total	Count	20	85		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
15	Count	2	15			32	Count	1	11			49	Count	0	17		
	%	.09	.26	.015	.012		%	.08	.16	.676	.345		%	.00	.22	.031	.021
Total	Count	23	57			Total	Count	13	70			Total	Count	14	77		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
16	Count	1	6			33	Count	0	14			50	Count	1	23		
	%	.08	.12	1.000	.503		%	.00	.16	.351	.167		%	.06	.24	.063	.032
Total	Count	13	50			Total	Count	10	90			Total	Count	18	95		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		
17	Count	1	26			34	Count	0	9			51	Count	0	20		
	%	.03	.25	.001	.000		%	.00	.11	.342	.198		%	.00	.19	.003	.001
Total	Count	30	104			Total	Count	13	83			Total	Count	26	103		
	%	1.0	1.0				%	1.0	1.0				%	1.0	1.0		

H. Episodes ordered by episode ID (in grey the episodes with significant relation between jointness and dialogicality)

Case_ID	Epis_ID	Means	N argum	St.Deviat.	% of total
1	11	.58	33	.502	7%
1	3	.58	31	.502	7%
1	4	.61	23	.499	5%
1	30	.24	51	.428	5%
1	23	.24	41	.435	4%
1	8	.39	23	.499	4%
1	20	.38	24	.495	4%
2	37	.30	27	.465	3%
2	35	.33	24	.482	3%
1	5	.54	13	.519	3%
1	14	.41	17	.507	3%
2	38	.39	18	.502	3%
1	22	.41	17	.507	3%
1	17	.18	34	.387	2%
1	2	.75	8	.463	2%
1	6	.43	14	.514	2%
1	18	.30	20	.470	2%
1	1	.67	9	.500	2%
2	49	.23	26	.430	2%
1	28	.14	36	.351	2%
2	33	.25	20	.444	2%
2	48	.13	38	.343	2%
1	13	.19	26	.402	2%
2	43	.14	35	.355	2%
1	24	.15	34	.359	2%
1	9	.67	6	.516	2%
2	39	.29	14	.469	2%
2	42	.31	13	.480	2%
1	19	.25	16	.447	2%
2	41	.13	32	.336	2%
1	10	.19	21	.402	2%
2	46	.10	41	.300	2%
1	32	.13	24	.338	1%
2	40	.11	28	.315	1%
2	44	.19	16	.403	1%
2	36	.08	39	.270	1%
1	25	.10	21	.301	1%
1	21	.15	13	.376	1%
1	27	.18	11	.405	1%
1	31	.13	16	.342	1%
2	45	.13	16	.342	1%
2	47	.08	24	.282	1%
1	26	.10	10	.316	0%
1	12	.13	8	.354	0%
2	50	.04	24	.204	0%
1	7	.00	2	.000	0%
1	15	.00	5	.000	0%
1	16	.00	4	.000	0%
1	29	.00	12	.000	0%
2	34	.00	25	.000	0%
2	51	.00	28	.000	0%
	Total	.23	1111	.421	100%

APPENDIX 5: ARGUMENT MAP

Arguments made by one speaker: Arguments made by at least two speakers:

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
pro	B			M		1													
pro	B	B				1													
jus	B		M										2						
pro	B	M											2						
alt	A	M											3						
att	C		B										4						
att	A		M										5						
pro	B	T												6					
pro	C		M			**7**													
opp	B		F										8						
neg	B		F						9										
alt	B	B							9										
neg	B								10										
jus	A													11					
pro	C	X														12			
exp	B	F																	
pro	B	X														13			
neg	B		M				14												
pos	B									15									
pro	F			B									16						

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
pro	F			B							17								
alt	A	F							18										
jus	B		U			19													
neg	D		V											20					
jus	A										21								
pro	B	S				22													
neg	B								23										
att	B		U		1										24				
jus	F		P												24				
	F				1										24				
jus	B				1										25				
con	B										26								
neg	F		V				27												
alt	F	P						28											
jus	B				1										29				
att	B			V												30			
pro	B	X														30			
pro	A	C				31													
con	F	B				32													
pro	B			M			33												
neg	B		M				33												
alt	B	M								34									
pos	B			M						34									
att	A		F												35				
com	C										36								

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
exp	C				1										37				
att	B		F				38												
pro	B			F									39						
jus	B				1										40				
alt	F	C								41									
att	D		U		1										42				
pro	B		F				43												
alt	B			B						44									
att	A			F			45												
neg	A		P				45												
pro	D	B				46													
alt	D	C													47				
exp	F		F												48				
pro	A			M								49							
pro	D	M						50											
jus	E				1										51				
att	B			F	1										52				
jus	A				1										53				
pro	B	C							54										
pro	A	C													55				
pro	B																56		
psp	A		U												57				
pro	A			M			58												
jus	B												59						
con	A													60					

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
att	B			T									61						
cla	B			F									61						
neg	B		X				62												
neg	B		X				62												
jus	A				1										63				
com	B		B										64						
att	G		F										65						
pro	G	V					66												
neg	B		F				66												
	A												67						
pro	G	Cf													68				
	C			M								69							
jus	C			M												70			
pro	A	S										71							
jus	A				1										72				
pro	E	C				73													
jus	E		P			73													
att	E		F											74					
pro	G	E												75					
jus	G				1										76				
jus	G		U												77				
alt	E	P					78												
neg	A			S			79												
alt	A									80									
pro	C			B									81						

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
jus	C		M										81						
jus	A														82				
jus	C		M										83						
alt	G									84									
pos	G													85					
alt	G								86										
pro	A			M								87							
com	C													88					
alt	C									89									
exp	A													90					
pos	A							91											
jus	A				1										92				
com	C												93						
neg	J				1		94												
neg	J		U				95												
exp	A													96					
agr	J											97							
att	B			U			98												
alt	B	C													99				
com	A				1				100										
pro	B			M									101						
att	J				1							102							
jus	J				1							103							
pro	J		U			104													
con	J	M				104													

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
pro	J	F									105								
att	A				1						105								
pro	A			U	1										106				
pro	C			B			107												
neg	C		M				107												
att	J		U			108													
com	J					108													
com	F				1	108													
pro	A	U			1										109				
neg	J		U						110										
alt	J			Cf					110										
pos	A												111						
opp	M			M			112												
neg	M		U				112												
pro	E	E									113								
neg	E		F								113								
jus	G		U		1										114				
int	A												115						
pro	G													116					
jus	G													116					
pro	E	Cf									117								
con	E	F									117								
pro	A	B												118					
com	F												119						
att	F		F										120						

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
att	E	B				121													
jus	E		F			121													
com	E													122					
pro	F	C													123				
jus	F				1										124				
pro	A					125													
jus	A				1										126				
pos	A												127						
pos	A										128								
pro	F	C									129								
pro	G			M									130						
pos	G				1			131											
pro	G	B															132		
att	G			B													133		
pro	G													134					
jus	G				1									135					
pro	C			M									136						
alt	C	M							137										
alt	G	M															138		
att	G		U			139													
pro	G			P		139													
pro	G	M														140			
alt	B	Cf							141										
neg	B		Cf						141										
con	A				U								142						

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
pro	B		U			143													
jus	I			Cf		144													
pro	B	Cf							145										
alt	B	Cf							145										
neg	B		U						145										
opp	G	Cf				146													
jus	G		Cf			146													
neg	A		U						147										
jus	G				1										148				
att	B		U												149				
jus	B				1										149				
opp	I													150					
pro	A	X													151				
jus	A		U												152				
pro	G							153											
jus	G	B			1										154				
exp	G				1										154				
pro	B	M							155										
pro	E	F								156									
att	A		S							156									
pro	F			B											157				
jus	F				1										157				
pro	J			U													158		
pro	F	U			1										159				
con	F		U			160													

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
pro	F	P				160													
pro	F	C				161													
jus	F			U		161													
pos	F				1			162											
pro	J	Cf													163				
jus	G				1										163				
alt	J	Cf							164										
alt	J	Cf							164										
neg	J		Cf						164										
pro	J			B					164										
pro	F			B											165				
pro	A	Cf							166										
neg	A		Cf						166										
pro	A			F						167									
com	A				1					167									
pos	A				1					167									
neg	M		T						168										
att	G			U	1										169				
pro	G	Cf													169				
neg	G		U		1				170										
alt	G	C							170										
con	G				1				170										
com	E							171											
neg	A		Cf						172										
con	A			V					172										

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
pro	G	C													173				
jus	G				1										173				
pro	J	C						174											
pro	G			P			175												
alt	F	C							176										
com	F				1				176										
pro	A	U							177										
alt	A	C							177										
pro	A	C													178				
jus	A				1										178				
pro	G	C				179													
jus	G			P		179													
pro	A		U						180										
pro	G	C					181												
alt	G	F					181												
neg	G		U				181												
Team 2																			
pro	A	U							182										
neg	A		U						182										
pro	B	B				183													
neg	B		C			183													
jus	A			U											184				
opp	B												185						
neg	A		Cf				186												
jus	B			P		187													

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
pro	B	T				187													
pro	A		C				188												
neg	A		U				188												
att	A		C												189				
exp	B		M												190				
jus	B				1										190				
jus	B												191						
att	B		B			192													
pro	C	B				192													
att	B			B									193						
jus	B				1										194				
exp	B				1										194				
att	A		C											195					
jus	A	E												195					
pro	A	U			1										196				
exp	A				1								197						
jus	A			M									197						
neg	B		C						198										
att	C		T			199													
opp	C											200							
pro	B		T				201												
opp	A												202						
pro	B			B							203								
com	B		M															204	
pro	B	X																204	

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
pro	C	T					205												
neg	C		T				205												
att	A		M			206													
pro	A			V		206													
pro	B	X														207			
pro	A	X														208			
psp	B												209						
att	B		X			210													
pro	B	B				210													
com	B		X			211													
pro	B	C				211													
att	B			C		211													
pro	B	C				212													
exp	B	C				212													
pro	B			C		212													
pro	B	C									213								
pro	B			C							213								
pro	A		U								214								
con	A	C									214								
pro	A			P					215										
alt	A				1				215										
jus	B			C									216						
pro	A			C											217				
exp	A				1										217				
jus	A		U												217				

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
opp	C												218						
pro	C	C											219						
com	B												219						
jus	B			P									219						
pro	B	P													220				
jus	B			C											220				
pro	A	Cf									221								
jus	A				1										222				
neg	A		C						223										
pro	A	C							223										
com	B		P											224					
pro	B			E										224					
pro	A	C													225				
pro	A	C													225				
jus	A				1										225				
neg	A		U						226										
pro	A	C											227						
agr	B												227						
pos	B													228					
pro	B		U			229													
pro	B	C				229													
pro	B			B											230				
jus	B				1										230				
pro	B			C								231							
att	B			P									232						

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
com	B																		233
exp	B																		233
pro	B	C												234					
neg	A													235					
alt	C	C							236										
pro	A	C							236										
att	B		C			237													
pro	B	C				237													
pro	B			C									238						
jus	A				1										239				
pro	B			C									240						
alt	B			C					241										
neg	B			C					241										
com	A		D							242									
alt	A	Cf								242									
pro	A	C								242									
att	B		C			243													
pro	A	C				243													
jus	B		X									244							
pro	B	C										244							
com	B	mC											245						
jus	B		C										246						
com	A		C			247													
pro	A	C				247													
pro	A		M			248													

act	speaker	prop	constr	requir	user_exp	practi	neg_cons	pos_cons	alt_neg	alt_pos	analog	expert	rule_b	person_b	users_b	practi_ta	practi_alt	practi_expert	exper_an
pro	A	C				248													
neg	B		P						249										
alt	A	C							250										
att	A		M						250										
neg	A		M						250										
jus	A				1										251				
att	B									252									
pro	B								253										
com	B	Cf						254											
pro	A	C													255				
jus	A				1										255				
jus	A												256						

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LINKS (IN ORDER OF APPEARANCE)

Wordnet (definition of 'deliberation'):

http://wordnet.princeton.edu/perl/webwn?s=word-you-want

Systems Engineering Glossary (definition of 'design constraint'):

http://www.argospress.com/Resources/systems-engineering/designconstr.htm

Nielsen Norman Group (definition of 'user experience'):

http://www.nngroup.com/about/userexperience.html

ANNEX: CODED DATASET

The coded dataset concerns 7625 interaction units coded with DROMEAS categories for two different teams working on different projects during a (sufficiently) long period of time. In this Annex all coded data are provided, in order to make clearer the analysis described throughout the dissertation.

Apart from DROMEAS categories, put in the same order as presented in this dissertation, the following reading keys are also necessary: a) each green line separates an episode from its next one; in this line several information are given, such as the case identification (T1, T2), the number of meeting according to its order of appearance in the dataset (e.g. M5 corresponds to the fifth video-registered and analyzed meeting forming part of the dataset); and, finally, the episode type number, according to our classification; b) colored blocks (green, red, purple) correspond to intermediary representations (proposals, constraints, and requirements correspondingly), and user experience indicators are marked in orange; c) connecting lines appearing in-between 'dialogue acts' and 'dialogue sequence' represent argumentative connections, and they are named after one of the pre-defined and emergent argument types.

In general, all names are changed to preserve participants' anonymity, and as regards themselves, they are coded as 'A', 'B', etc. Given the large size of the dataset, it is presented in a CD-ROM, instead of a printed form.