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**STRUCTURAL AWARENESS IN
MEDIATED CONVERSATIONS FOR
COLLABORATIVE LEARNING
ENVIRONMENTS**

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Résumé



STRUCTURAL AWARENESS IN MEDIATED CONVERSATIONS FOR COLLABORATIVE LEARNING ENVIRONMENTS

Cette thèse prend place dans le cadre des recherches sur l'apprentissage collaboratif assisté par ordinateur et plus particulièrement les nouvelles technologies de communication pour les communautés virtuelles d'apprentissage (CVAs). Les travaux ont porté sur l'analyse des conversations d'apprentissage ayant lieu dans les CVAs et la conception de mécanismes d'assistance visant à faciliter l'émergence de ces conversations à travers des outils de type forum (OTFs). Nous avons identifié dans les OTFs plusieurs anomalies qui peuvent freiner l'apparition des conversations d'apprentissage : "incongruence interactionnelle", "incongruence de convergence", "incongruence de tour de parole" et "incongruence de perception de groupe". Afin de dépasser ces anomalies nous proposons une approche d'assistance entre pairs ("peer-to-peer") fondée sur la perception de structures ("structural awareness"). Cette approche est fondée sur la mise en évidence des propriétés structurelles des conversations afin de favoriser les interactions. Un OTF nommé MailGroup et un système d'assistance basé sur cette approche ont été conçus, développés et expérimentés. Ces expérimentations ont mis en évidence la pertinence de l'approche et permis d'identifier des pistes pour des recherches complémentaires.

Abstract



STRUCTURAL AWARENESS IN MEDIATED CONVERSATIONS FOR COLLABORATIVE LEARNING ENVIRONMENTS

This thesis takes place on the Computer Supported Collaborative Learning domain. This field is centered on the design of learning environments that makes possible the support of collaboration in a group. In this context, this study principally aimed to create new technologies of communication for Virtual learning communities (VLCs). Particularly, our research issue is to analyze learning conversations taking place in VLCs in order to provide mechanisms to support and facilitate the emergence of these interactions among the users of Forum-type tools (FTTs). We have identified in FTTs several anomalies that can discourage the emergence of learning conversations taking place in FTTs: “interactional incongruence”, “convergence incongruence”, “turn-taking incongruence” and group perception incongruence”. We try to improve the FTTs to obtain better and perfectible environments for group communications. Thus, we propose a peer-to-peer support approach that tries to overcome these incongruencies that we will call the structural awareness approach. It puts emphasis on revealing the structural properties of a group to its members in order to promote better collaborative interactions. This support has been implemented on a FTT called Mailgroup. Mailgroup has been tested twice in different contexts, obtaining initial feedback of its pertinence according to our objectives. The results indicate that the work is properly oriented, but also that it is necessary to do further research.

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Introduction



This thesis takes place on the Computer Supported Collaborative Learning domain. The field of the CSCL is centred on the design of learning environments that makes the support of collaboration in a group possible.

This domain is an active field highly involved in integrating technology in education. It combines developments in several disciplines, principally: new paradigms in education which give an active role to learners in their learning process (particularly, models of learning that are based on active participation and not on “transmission of information”), and the new technologies of information and communication (particularly, the emergence and current pervasiveness of Internet).

CSCL has transformed the e-learning notion from an individual learning perspective, to a networked e-learning¹ notion (Beaty, Hodgson et al. 2002). Therefore, network technologies and new paradigms in education have enabled web-learning communities. One particular type of online communities we are interested in are the so-called Virtual Learning Communities (VLCs). VLCs are groups of individuals geographically distributed that collaborate via information and communication technologies

(ICTs) and maintain a shared purpose for an amount of time.

VLCs are emerging virtual social systems. The development of these systems is connected closely to the Internet infrastructure and the emerging notions of lifelong learning and networked e-learning.

We specifically focus our research on providing mechanisms to support Virtual Learning Communities (VLCs). In VLCs, collaborative learning activities are mainly carried out through a conversational, written, and asynchronous environment, which we call forum-type tools. Forum-type tools (FTTs) designate a mainly text-based and asynchronous, electronic conferencing system that makes use of a tree hierarchical data structure of enchainned messages called threads. These tools have opened the possibility of creating virtual learning communities in which students discuss a great variety of subjects, using a traditionally threaded conversation structure. Forum-type tools have become, along with email, the basic tools for doing collaborative learning activities. In their origin, FTTs were designed for the distribution of news, not as an environment for interactive communication (Hauben and Hauben 1997). Although research has shown an amount of difficulties associated with FTTs for its educational use (Herring 1999; Vapillon 2000; Hewitt 2001), these tools are currently widely used in this domain: they are used for communication and learning through computer conferencing pack-

¹ Networked e-learning refers to those learning situations and contexts which, through the use of ICT, allow learners to be connected with other people (i.e., learners, teachers/tutors, mentors, librarians, technical assistants) and with shared, information rich resources. Networked e-learning also views learners as contributing to the development of these learning resources and information of various kinds and types (Beaty, Hodgson et al. 2002).

ages, web-based newsgroups, and e-learning platforms.

In this context we address issues related to the structure of learning conversations taking place in VLCs. Learning conversations are the ones that “go further than just realizing information exchange; rather, they allow participants to make connections between previously unrelated ideas, or to see old ideas in a new way” (Bellamy 1997). Particularly, our research issue is to analyze learning conversations taking place in VLCs in order to provide mechanisms to support and facilitate the emergence of these interactions among the users of FTTs.

Moreover, we emphasize that this analysis is not only made with a spirit of comprehension of this phenomena, but also with the idea to study these phenomena in order to create a support mechanism that facilitates the emergence of interactions among the users of FTTs.

In order to create this support mechanism, we work with a methodology we call “technological innovation”. The tenet of this inductive methodology is that the design of new technologies deals with “revealing anomalies in practices”. An anomaly is an invisible tension that exists when users carry out a particular activity, which for phenomenological reasons people are sometimes unaware of. Our methodology consists basically in the establishment of a scientific background, which provides us certain awareness for unfolding anomalies in a specific practice. We have followed this perspective because we conjecture that: (1) this method allows us to facili-

tate revealing anomalies; (2) this inductive research is more adapted to the design and innovation of sociotechnical systems than deductive methodologies.

The establishment of the scientific background encompasses the following elements: research issue, scientific context, and theoretical considerations.

We do not consider this methodology in opposition to deductive ones, but it corresponds to a first step towards the scientific validation of proposed innovations through a deductive methodology.

We have identified in FTTs four anomalies that can discourage the emergence of learning conversations taking place in FTTs: 1) “interactional incongruence”, 2) “convergence incongruence”, 3) “turn-taking incongruence” and 4) group perception incongruence”.

The interactional incongruence is derived from the difference between the message unit that users can handle and the one they can make reference to. This incongruence causes information losses and reference confusions.

The convergence incongruence is triggered by the lack of a mechanism to manage the convergent interactions, such as consensus, connecting ideas, or synthesis.

The turn-taking incongruence is caused by the disruption between (a) the temporal and the thread order of messages, and (b) the management of parallel threads.

The group perception incongruence is caused by the lack of awareness of structural regulari-

ties of interactions' structure taking place in a group.

In this context, we try to improve the FTTs to obtain better and perfectible environments for group communications, based on the tenet that making the structures of interactions more congruent with the communication patterns that take place on these environments contributes to fostering better learning and understanding in VLCs.

Thus, we propose a peer-to-peer support approach that tries to overcome the detailed incongruencies that we will call the *structural awareness approach*. Structural awareness, therefore, deals with knowledge about structural features or activities of a group. It puts emphasis on revealing the structural properties of a group to its members in static and dynamic viewpoints in order to promote better collaborative interactions.

In particular, the structural awareness will be reified through:

1. Different strategies that aim to enable participants to perceive their interactions in a more congruent and concise way than in the actual FTT structure, allowing them to see their exchange structures in an ordered visual way, thereby overcoming the interactional, convergence, and turn-taking incongruencies. Thus, we show the group exchange structures by enabling the participants to perceive all their interactions through a graph-like visualization. Also this visualization provides particular mechanisms

for maintaining a higher coherence between these interactions and their visualization.

2. A set of indicators of a group, which allows users to get summarized information, in relation to some structural properties of a group and structural attributes of individuals that are not salient in actual VLCs. We have implemented an observation level of the communicational activity based on quantitative indicators (the group complexity and cohesion and individual status indicators). Each of these strategies has been implemented on a FTT prototype called Mailgroup, which has served us as a socio-technical test-bed for realizing real interactional experiences.

Therefore, Mailgroup allows participants to be aware of (a) the ongoing evolution of their threaded conversations, through a visualization that better shows the timely linear debate growth, and (b) the regularities of structure of interactions taking place in a group through the structural indicators.

Tests were done in order to collect: feedback of the current characteristics of our prototype from the user's perspective, and some preliminary results were obtained concerning the use of this tool.

This thesis is divided into four parts. The first part contains the "Research background". In this part we can find the methodology approach taken in this thesis and the different elements that compose the scientific background (research issue, scientific context, and theoretical

considerations). Our actual organization of the research background implied the division of this part in chapters with visibly different sizes. The second part, “Research findings and development”, details the anomalies found and the pro-

posed strategies in order to overcome them. The third part, “implementation and tests” deals with more practical issues such as the implementation of the proposed tool and the tests done with it. The last part involves the conclusions chapter.

I

RESEARCH BACKGROUND

1 Methodological approach



Abstract: In this chapter we detail the methodological approach this research is based on. The methodological approach involves a system of principles of organizing and structuring theoretical and practical aspects of scientific work. This refers to an actual structure for research in order to address a defined set of questions.

In particular, we adopt an inductive or exploratory methodology based on the concept of “technological innovation” and a particular vision about the creation of computer-based frameworks. This vision frames the proposed research design which tries to facilitate, organize, and formalize our research as a process of exploration through the scientific background statement involved in this thesis.

1.1 Introduction

The system formed by persons communicating through computers, which is a system we call computer-based socio-technical systems, creates a new context for social interactions. The rich complexity of this new context makes that it remain as poorly understood. Indeed, the classical two-step paradigm of (1) defining hypotheses, and (2) testing them through experimentation, seems inappropriate for grasping this context.

It is our opinion that the study of socio-technical systems through scientific experimentations allows for only a partial comprehension of inherent practices that take place in these systems. Here we propose, instead, a methodology centered on study through practice, which could be outlined by the three-step methodology of “technological innovation”: *designing*, *implementing*, and *testing* new frameworks. Through this methodology we have been able to gather the experience and data that has enabled us to progress in the conceptualization of the domain of computer-based socio-technical interactions, particularly Forum Type Tools (FTTs) in VLCs, and their intrinsic phenomena. More precisely our aim is to contribute to: (a) a better understanding of interactions that take place in VLCs, and (b) create new computer-based so-

cio-technical systems that manage these interactions.

In spite of some interpretations that can be deduced from the title of this chapter, we do not present here a methodology of our scientific research, as can be thought in a traditional way: That is to say, the construction of general rules for the purpose of carrying out research which can be applied to a variety of domains. In what follows, we intend to show formally how our research was carried out, focusing not only on the findings from our investigation, but also on how this investigation has been organized in practice. In this study, the methodological focus has as its main role to provide decision making and orientation tools for the purpose of developing our investigation.

First, we will detail the background on which our methodology of technological innovation is based. Here, the concept of “anomaly”, an invisible tension or uneasiness underlying a practice, plays a central role. After providing a working definition of the concept of anomaly, we will outline the problem of revealing anomalies in socio-technical systems. Based on these elements we will describe the research design of this thesis.

1.2 Methodological considerations

We refer to our methodology as “technological innovation”. This methodology originated from an understanding of research as an exploration and aims at revealing and overcoming anomalies in socio-technical systems. The conceptualization and understanding of anomalies is in turn enriched by the development of new technologies. This more phenomenological and enactive vision of methodology (phenomenological given we focus on a phenomenon; enactive given the strongly interwoven interaction between the conceptualization and creation of technological artifacts) orients us to make technological innovations that act in a specific community.

Technological innovation for us does not mean just building new artifacts, but corresponds to a transformation of a human practice in a certain context. This vision is strongly inspired by the notion of “ontologically oriented design” proposed by Winograd and Flores (1986): “[...] Ontologically oriented design is therefore necessarily both reflective and political, looking backwards to the tradition that has formed us but also forwards to as-yet-uncreated transformations of our lives together. Through the emergence of new tools, we come to a changing awareness of human nature and human action, which in turn leads to a new technologi-

cal development. The designing process is part of this ‘dance’ in which our structure of possibilities is generated”.

1.2.1 ANOMALIES

A central concept used throughout this thesis is *anomalies*. An anomaly is defined as an invisible tension which exists when users carry out a particular activity. The readiness of objects at hand induces that most of the time users are unaware of these anomalies, until the critical time of a breakdown. Before the breakdown, anomalies are perceived as practice dissatisfactions, but they are grasped as passionate incongruence by the innovator or entrepreneur. In the forthcoming chapters we will describe various anomalies that we have identified in FTTs and will show some strategies in order to overcome them.

The concept of anomaly was introduced by Thomas Kuhn, in his book “The Structure of Scientific Revolutions” (Kuhn 1970). Kuhn presents an analysis of the evolution of the beliefs about the sciences. He described the history of science as consisting of periods of normal science interspersed with periods of great conceptual change through the adoption of new paradigms² in a scientific domain which completely

² A paradigm corresponds to a set of assumed “normal” practices; in science, what is to be observed and scrutinized, the kind of questions that are supposed to be asked and

changes the way the domain is understood. A scientific or conceptual revolution occurs only after the paradigm that has been used to explain a phenomenon has become unstable. These instabilities are usually introduced gradually, as researchers discover more and more anomalies that should be, but are not, explained by the current paradigm.

In this context an anomaly is a violation of the "paradigm-induced expectations that govern normal science". Anomalies are generally identified through empirical analyses and have formed the basis for most discoveries in the natural sciences. For Kuhn, the discovery of anomalies provides the impetus for paradigm shift within a field of study. Consequently, under the notion of Kuhn, anomalies are empirical difficulties that reflect differences between the observed and theoretically (based on a paradigm, or set of assumptions) expected data.

The concept of anomaly can be related to the concept of breakdown, which was introduced by Winograd and Flores (1986). Anomalies as "tensions implicit in a practice" are related to breakdowns, which can be defined as an "interrupted moment of our habitual, standard, being-in-the-world" and therefore visible and social agent. On the one hand, the breakdowns correspond to situations that make the practice with technical system through "interrupted moments" on the use of the system uncomfortable. On the other hand, anomalies represent a subtler phenome-

probed for answers, how these questions are to be put, how the results of scientific investigations should be interpreted.

non. They show an uneasiness that is "detected" in practice by somebody. They are not the kind of events that produce "breakdowns", but can represent potential breakdowns. Therefore, in our context of study, users in FTTs have a comfortable habit (in logging, sending messages, and answering them), and they usually do not notice when threads go off topic, or when important ideas are neglected. Within this perspective, the "implicit tensions" found through our everyday experience with FTTs are closer to the idea of anomaly, a concept which we will work with in this thesis.

In this sense Flores et al. (1997) has recently described anomalies as "disharmonies between [practitioners'] understanding of what they do and what in fact they do". Anomalies are mainly disharmonies, which occur in activities which we are involved in "in practice", more than from a distant reflection of a phenomena.

In our work we deal with anomalies in socio-technical systems. The most distinctive trait of the particular space of possibilities that socio-technical systems represent is their hybrid nature. They are large-scale, complex systems, conceived as engineering systems, with essential technical elements (which includes machinery, hardware, processes and a physical arrangement). Nevertheless, in order for them to function they depend essentially on social elements as well as on institutionalized rules.

Anomalies in socio-technical systems are not another view of anomalies, but a more granular and contextual perspective of Flores's concepts

in the particular domain of socio-technical systems. Therefore, Anomalies in socio-technical systems, based on Flores's notion of anomalies, represent a disharmony between a user's understanding of what they do in a technical system and how the system in fact represents and deals with these acts.

We will focus in sections to come on certain anomalies in a particular type of socio-technical system: Virtual Learning Communities in FTTs.

1.3 *Revealing anomalies*

According to Flores et al. (1997) working with anomalies involves three activities: intuition, concentration, and "dealing with" anomalies. The first two activities represent the stage of *identifying* or *framing* an anomaly. These activities come from an experiment in which we are involved, as Flores et al. (1997) observe: "the fact of concentrating in anomalies is not a distant reflection, but an intense practical involvement". The third activity corresponds to dealing with anomalies in order to change the disharmonic practices identified³.

³ We relate these activities (intuition, concentration and dealing with the anomalies) in the "reflection-in-action" notion. This notion was introduced by Schön (1983). It refers to momentary pauses or withdrawals from the ongoing action to enter into a 'reflective conversation with a unique and uncertain situation'. We consider that this notion represents accurately most of our researching practice. This way, under

We consider that our practice is well described by the previously mentioned activities:

1. Our first work corresponded to a practical involvement on the everyday use of some existing FTTs. From this practice we noticed certain situations that discouraged and frustrated interactions between participants, which were impossible to determine or to make explicit at that moment. In particular, the intuition of being in a computer environment with a disharmony between the user's understanding of what they do and what they actually do. The presence of this dissatisfaction made us think of the existence of anomalies in the FTTs. Nevertheless, this dissatisfaction in practice did not show its causal relationships explicitly and only after concentrating on the dissatisfaction it was possible to identify a specific set of anomalies.
2. We framed anomalies from our practical involvement, which was the core of this activity. This practical involvement was also accompanied with an observation analysis of selected newsgroups, quantitative analysis of selected newsgroups, and bibliographic analysis. These last analyses have also the role of "objectively" assessing the existence of anomalies.
3. Finally, we worked on dealing with these anomalies in order to change the disharmonic practices identified.

this conceptualization this thesis covers basically the activities that comprise the reflection-in-action notion.

Flores et al. (1997) suggest that there are three basic ways to deal with anomalies, which consists basically in resolving tensions in practice, namely articulation, cross-appropriation, and reconfiguration.

- *Articulation*: the basic pattern of the activity is not changed, but important practices or values that have become vague, confused, or lost are recovered and a new coherence is thus achieved.
- *Cross-appropriation*: practices, ideas, or tools are taken over from other activities or social worlds. This may or may not change the whole pattern of the activity.
- *Reconfiguration*: a marginal aspect of the activity becomes dominant and the entire pattern is radically transformed.

Related to this classification, we consider that our work changes some of the disharmonic practices detected, as it will be shown in the next chapters, by an articulation: The tenet of articulation is to “make explicit which is implicit”, and our work comes close to this notion.

The fundamental concern of our methodology is that our embodied effort of understanding socio-technical systems should help us to develop a predisposition to revealing anomalies, which in turn should help us to produce innovations that resolve these tensions. Therefore, a technological innovation is a process that tries to release not perceived cultural tensions (anomalies) existing in a specific socio-technical context

through “bettering up” processes, systems, or workflows, which arise in everyday life. In other words, an innovation deals with a situation not explicitly defined that somebody identifies, and takes charge of through the construction of a socio-technical system. Consequently, we focus this research on revealing and dealing with the anomalies of a specific practice in order to resolve the identified tensions.

Taking into account this view, this approach is intrinsically exploratory. The most important objective of an exploratory type of research is to familiarize itself with little known phenomena, or to deal with it from, in our case, an embodied perspective. Exploratory studies are not goals by themselves, but they must determine a trend, identify potential relations and issues between various variables, and establish the tone of more rigorous subsequent research.

We work actively on the interplay from the data and the conceptualization of phenomenon that allows exploring the data from a particular perspective in a manner related to the Ground Theory of Strauss and Corbin (1998). Ground Theory is a general inductive methodology (i.e., a manner of thinking and of conceptualizing data) to create theories well grounded in data. A remarkable particularity on the development of research that follows this kind of methodology is the deep and continuous interplay between the analysis and collection of data (Strauss and Corbin 1998). Nevertheless, we note that the purpose of our research is not the construction of a theory in itself, but the contribution of new

(and pragmatic) ways to support learning interactions in VLCs.

This perspective relates also to the methodology of design of Winograd and Flores (1986). They have proposed a design method of analysis for human activity domains, starting from the analysis of “breakdowns” in these domains. A breakdown is an “interrupted moment of our habitual, standard, being-in-the-world”. They state that design is only necessary in activities where a recurring structure of breakdown emerges: “the design must envisage the forms of rupture and provide a space of possibilities for the action when those are produced”. For us, we consider that design is necessary in activities where an anomaly is identified.

Moreover, Our proposed perspective can be viewed as a problem framing process. Framing is the interpretation of a problem using selected conceptual primitives (Dzbor and Zdrahal 2002). Framing is an important step of reasoning that precedes the problem solving process. In this vision, the proposed methodology represents the steps needed to get a problem well defined, and then, in a further stage, apply some deductive methodology such as defining hypotheses, and then testing them through experimentation. The deductive methodologies are better adapted in situations where we want to obtain scientific validations of hypotheses through an experimental process, which has an already framed and stated problem. That is, the main focus of this kind of research is the resolu-

tion of specific and already defined problems and the validation of the solutions proposed.

We consider that our research can be better characterized as a continuous process of questions and answers, which are grounded in our context of research and in the analysis of the actual human practices, which Information and Communication Technologies (ICTs) make possible through the persistence of computer communication, in order to reveal socio-technical practice anomalies. We noticed that the context of research changes and is reinterpreted in a continuous way thanks to new answers found during the evolution of the work. Consequently, our situation at this stage obliges us to change perspective. We cannot think any more in defining and validating hypotheses, if the real concern is “revealing anomalies”. Therefore, our methodology will have to be a coherent formalization of our way of acting, but as we have already mentioned, this should give us tools to support decisions made during our investigation.

1.4 Research design

The research design refers to more pragmatic aspects and the way in which we structured our research. As we said, the main goal of this thesis is the framing anomalies and the development of strategies in order to overcome them. In this context our research design is supposed to help

us reveal these anomalies. Revealing anomalies in a context of human practices can produce an intellectual endless drift if it is not sufficiently directed by an established scientific background. We aim to establish our scientific background based on the following three components: the research issue, a scientific context, and theoretical considerations. We conjecture that an orientation based on these components allows us to carry out a more effective and focused research regarding the most important aspects of our work.

1. *Research issue.* Are questions or ideas that will be explored and developed through revealing anomalies starting from the observation, the experimentation, the system development and/or information retrieval. The research issue helps us focus on the object or phenomena to be studied, which will be detailed in the next chapter.
2. *Scientific context.* Defines the practical situation of where the research issues will be studied, and connects the context to existing scientific domains. Therefore, the anomalies found are connected to situations that the bibliography of the scientific domain reveals as outstanding issues. The scientific context is detailed in chapter 3.
3. *Theoretical considerations.* Reflecting more deeply about the dissatisfactions in the FTT practice, we realized that the anomalies identified were the result of a particular way of interpreting the message exchanges: The relational aspect of message exchanges al-

lows us to make explicit a set of disharmonies. We make explicit in this work this particular style of interpretation, in what we call the theoretical considerations. They correspond to epistemological and ontological positions taken in this thesis regarding the object of research. The positions in our methodology correspond to formal points of view that give us the space of interpreting our research object. Thus, this component directly orients our research. The theoretical considerations are detailed in chapter 4.

Each component is related to the others in several ways. Whereas the research issue defines the object of interest of our research, the scientific context helps to orient this research by positioning the thesis with respect to several scientific domains, the theoretical perspectives help us, along with the scientific context, to orient the research issue.

Consequently, the proposed research design contains the following steps: (1) the establishment of the research issue and the scientific context. From the scientific context we place and focus the domain of interest and action of our research regarding the phenomena observed. (2) The establishment of the theoretical perspectives. These perspectives give us a proper vision in which to interpret the phenomena or situation to be studied. (3) The process of finding anomalies from a particular theoretical and practical perspective. This step is the core of this work. Here we must describe the anomalies

found. In this process we connect the anomalies found to existing issues on the domain (4). To become responsible for these anomalies, designing strategies in order to overcome them. (5)

Finally, we develop and test an artifact that tries to reify these strategies.

2 Research issue



Abstract: The first element that composes the research design is the research issue.

This component defines the topic that will be explored and developed through the process of revealing anomalies starting from the observation, the experimentation, the development and from information retrieval. The research issue helps us to focus on the object or phenomena to be studied.

Network technologies have enabled new web-learning based activities and the emergence of new types of communities, namely virtual learning communities (VLC). The VLC expression is used in this work to designate online social systems, where their actors are usually geographically distributed, collaborate usually via Information and Communication Technologies (ICTs), maintain a shared purpose (Mowshowitz 1997), and learn by collaborating. Nowadays, through ICTs, learners or participants can be connected from almost any place, building their own formal or informal groups. Thus, VLCs become a collection of individuals linked by a set of shared ideas and ideals, generating common references and micro-cultures (Dillenbourg, Poirier et al. 2002).

We are particularly interested in these communities and thus have focused our research on this expression of distant sociability.

The VLCs activities deal with multiple phenomena: distance, communication process, asynchronous phenomena, sociological issues, and many others. Also, VLCs include a strong technological component. To communicate, they use computer mediated communication (CMC) tools. CMC tools are the institutionalized term to designate a set of computer tools that allows users to connect and communicate to one another. In particular, we will focus on a specific kind of CMC tool, what we denote as a “Forum-Type Tool”.

Particularly, we focus our research on analyzing learning conversations taking place in VLCs that use FTTs to communicate and collaborate. Learning conversations are the ones that go further than just having an information exchange: “they allow participants to make connections between previously unrelated ideas, or to see old ideas in a new way” (Bellamy 1997).

Structuring these ideas, the issue of this research can be defined as:

Analyzing learning conversations taking place in VLCs in order to provide mechanisms to support and facilitate the emergence of these interactions among the users of CMC tools.

In the context of our academic work, a PhD thesis in computer science, we aim to build a technical environment that facilitates the emergence of learning conversations. This construction is strongly based on the tenet “facilitating interactions deals with identifying and resolving anomalies that discourage the learning conversations in FTTs”, a notion that represents the central and essential core of this research.

The two other components of our research design will specify the specific context where this work takes place and the theoretical considerations regarding our phenomena of interest.

3 The scientific context of this thesis



Abstract: The research issue we have presented can be studied from different perspectives and within several contexts. In our work, the scientific context defines the practical situation where the research issue will be studied, and connects the context to already existing scientific domains. We present the scientific context of this thesis at different levels of detail in an iterative way. Particularly, we present a broad view of the general scientific domain involved in this research: Computer Supported Collaborative Learning. Then, we detail some institutionalized research domains in CSCL. Finally, we specify the field of study, which represents the practical situation that we observe: VLCs using forum-type tools.

3.1 General scientific domain: Computer Supported Collaborative Learning

The research issue presented in the previous chapter defined the topic that will be explored and developed. Here, it will be connected to already existing scientific domains that we consider as the background of our thesis.

The general scientific domain where this work takes place is Computer Supported Collaborative Learning (CSCL). The field of CSCL advocates the design of learning environments that makes possible the support for collaboration in groups. This field was born as such in the first CSCL workshop in the year 1991, (Koschmann 1996) In part, the inspiration for CSCL arose from the research on Computer Supported Cooperative Work (CSCW). This research has revealed issues about the collaborative nature of work supported by groupware. Consequently, “in a sense, CSCL is the younger sibling of CSCW” (Lipponen 2002).

First, we present some characteristics of the domain of CSCL which are considered impor-

tant in this work from a dialectic perspective. That is, we present oppositions in different aspects of CSCL for the purpose of creating, based on these oppositions, a clear vision of the domain. We present five distinctions in the CSCL domain, which shape our notion of this domain:

(1) Regarding the role of collaboration in learning, we use a distinction “collaborative learning” and “learning in collaboration”. This will help us to state and make salient two different existing contexts: on the one hand, communities of learning in which collaboration is intrinsic to the group (as in communities of practice) and on the other hand, a group that learns using collaboration as a teaching strategy.

(2) Regarding the origin of collaborative activities, it is possible to distinguish between two existing situations related to the creation of collaboration: collaboration from a collaboration script and emerging collaboration.

(3) Regarding the role of technology in the collaboration process, we use a distinction between collaborative technology and technological setting for collaboration. This distinction, stated in other terms by Roschelle (1995), seeks to better locate the developments carried out in the domain.

(4) Regarding the support approaches we make a distinction between tutor-like support and peer-to-peer support.

(5) Regarding the goal of different supports, it is possible to distinguish between two approaches: structuring collaboration and managing collaboration.

Second, we present in section 3.1.2 some learning theories that are part of the basis of the collaborative learning domain.

3.1.1 DISTINCTIONS IN COLLABORATIVE LEARNING

3.1.1.1 COLLABORATIVE LEARNING AND LEARNING IN COLLABORATION.

We propose that the distinction between collaborative learning and learning in collaboration leads us to reveal different educational contexts in which the collective activities are carried out. In the learning in collaboration perspective, learning is interpreted basically as a process of acquiring knowledge or internalization. In this context, collaboration represents a choice or teaching strategy among others in order to achieve defined teaching goals. In this sense, learning in collaboration is “a teaching strategy in which students work together in small groups to facilitate learning” (Cooper, Robinson et al. 2004). Thus, here, collaboration is not an essential component of learning, but it represents just a teaching strategy that aims to manage the teaching resources and to coordinate tasks among participants. Even if in this type of learning there are group activities, they are oriented towards individualization. Therefore, in this context, the concept of learning is related to

a process which is concerned with the individual spirit. Thus, the issues related with this perspective of CSCL are centered on the design of environments of learning in which the participants can manage teaching resources and carry out collective actions with a priori defined goal.

In collaborative learning, on the other hand, learning is interpreted as a social process of constructing knowledge. Thus, the individual cognitive “profit” takes place primarily through the social interactions within the learning environment. In this perspective collaboration and learning are intertwined in an enactive way. That is, collaboration shapes learning at the same time that learning determines collaboration; learning and collaboration are indivisible concepts that back themselves mutually.

Here, learning is interpreted in terms of collaboration. For example, in communities of practice, learning is interpreted as a process of increasing participation in the group activity: “Conceiving learning in terms of participation focuses attention on ways in which it is an evolving, continuously renewed set of relations (...)” (Lave and Wenger 1991). In addition, collaborative learning adopts its identity from several theories. The principal theoretical basis of this perspective is set forth mainly by Lave & Wenger (1991). The issues related to this perspective of CSCL are centered on the design of environments of learning in which the communication between the participants is established and the support of the dynamics of interactions of these communities.

From this distinction, it is possible to identify the first perspective (learning in collaboration), as task-directed learning, whereas the second perspective corresponds to an interaction-directed vision of learning.

3.1.1.2 CREATING A COLLABORATION SITUATION AND AN EMERGING COLLABORATION

This distinction tries to characterize two existing situations that take place regarding the creation of collaboration. On the one hand, the creation of collaboration from collaboration scripts. A collaboration script is a “set of instructions regarding how the group members should interact, how they should collaborate and how they should solve the problem” (Dillenbourg 2002). By this perspective, the group collaborates starting from a created situation of collaboration, which is the origin of this collaboration. For example, we found the collaboration situation created by the use of Symba (Betbeder and Tchounikine 2003). Symba is a web-based framework designed to support collective activities in a learning context. In this environment the participants enter in collaboration through defining plans composed by tasks.

On the other hand, we found the emergence of a collaborative behavior between individuals can be caused by multiple reasons, such as a common interest or practice. In this case a social order emerges from their interactions, without prescription. For example, it is possible to find

that in online communities like Slashdot (<http://slashdot.org>) or some newsgroups, where the activity, the involvement and the structure of participation denote a shared knowledge among participants.

We do not want to emphasize with this distinction a difference in the “quality” of the collaboration, only to remark on the fact that it is possible to find two different origins how the collaboration is born: An origin that is “oriented” and one that is “natural”.

3.1.1.3 TECHNOLOGICAL SETTING FOR COLLABORATION AND COLLABORATIVE TECHNOLOGY

Another distinction which guides and directs our research is the one proposed by Roschelle (1995). He makes an important distinction between collaborative technologies and technological settings for collaboration: “A collaborative technology is a tool that enables individuals to jointly engage in active production of shared knowledge” (Roschelle 1995). Thus, a true technology for collaboration is one which allows participants to articulate and to transform a shared vision or experience. For example, a shared-board is a tool that allows several participants of a collective activity to build a shared comprehension regarding the object that they aim to produce. Thus, the use of collaborative ICTs in shared practices helps build a common comprehension. Otherwise, “technological settings for collaboration” are technologies which

are not directly involved in the production and construction of shared knowledge. For example, an automated agenda can facilitate the organization of the work of collaboration. But such software is not a technology for collaboration. It does not take part in the collective transformation of an issue. It simply achieves the function to program meetings for a group.

3.1.1.4 TUTOR SUPPORT AND PEER-TO-PEER SUPPORT.

The kind and extent of support mechanisms provided to the users by the CSCL platforms are a critical element in the design and conceptualization of these educational tools. These support mechanisms are a very active field of research in education technologies. Multiple strategies and developments exist in this field. However, in this multiplicity of support initiatives in collaborative learning, we can distinguish three possible approaches called as follows: “teacher-supports-students”, “automated-system-supports students” and “students-support-students”. The main difference between these approaches lies on the locus of processing of who provides the support.

The first two approaches (“teacher-supports-students” approach and “automated-system-supports-students”) are the “tutor-like” support systems based on guidance and/or guidelines. This type of support is based on the belief that just placing students in a group and assigning them tasks does not guarantee that the students

will engage in effective collaborative learning behavior. In this vein, Soller (2001) states that the new ICTs “enable students to participate in online discussions, but provide no guidance or direction to students during or after these dialogue sessions”. In this context, tutor-like systems are based on a Tayloristic paradigm, which considers that groups (social units) can be controlled mechanically “from the top”, i.e., by a teacher in the first approach, or by an automated system in the second.

In the “automated-system-supports-students” approach, the support mechanism is based mainly on giving information to participants of a group which gives them an idea of the current state of collaboration. Therefore, the forms of implementation are strongly based on the gathering of interaction traces. In this category, we can distinguish different approaches (Jermann, Soller et al. 2001) that follow this notion : Mirroring, metacognitive, and advice support approaches. Nevertheless, in this automated support approach the complete lack of human interaction and social negotiation makes significant learning difficult (Wiley and Edwards 2002).

Finally, the students-support-students approach, what we call *peer-to-peer* support has as a characteristic element the reciprocal assistance and organization between participants. Peer-to-peer support is a bottom-up approach: *One does not seek to make a system that intervenes on the actors, but a system that gives them the means of intervening by themselves*. Consequently, the strategy of support is based on the need to inform the

actors, enabling them to be conscious about their activity.

Peer-to-peer support is connected to the peer-to-peer learning perspective. This perspective essentially refers to *students learning with and from each other* without any implied authority to any individual, based on the tenet that “Students learn a great deal by explaining their ideas to others and by participating in activities in which they can learn from their peers” (Boud 2001). This perspective is coherent with the social constructivist point of view where the knowledge is socially constructed by interactions among individuals (McCarthy 1992). In this context, learning can be regarded as a result of the internalization of such social interactions (Vygotsky 1986). Moreover, peer-to-peer learning is connected to Piaget’s learning theories (Piaget 1926) that state as a fundamental assumption, that the interaction among peers while performing tasks facilitates the learning of concepts. Learning theories related to collaborative learning will be detailed in section 3.1.2.

3.1.1.5 STRUCTURING OR MANAGING COLLABORATION

Structuring collaboration is related to making decisions according to different parameters which oblige the users to follow a predefined “structure” with a different degree of flexibility (Reimann 2003). This approach is based upon the idea that structuring collaboration is a means of encouraging and fostering certain types of

conversations or interactions among participants of a group. Towards this approach, found studies that structure interactions: (1) by semi-structured communication interfaces (by sentence openers), and (2) by the application of scripts, for collaborative learning (Dillenbourg 2002).

On the other hand, managing collaboration (Reimann 2003) refers to approaches that try to manage online collaboration by means of an “intelligent support” that principally tracks the interactions between group members (Reimann 2003) in order to obtain the current state of the group. This concept is closely related to Dillenbourg’s notion of *regulating* interactions, where “The tutor has to provide prompts or cues without interfering with the social dynamics of the group” (Dillenbourg 2002).

There are three categories of tools which enter into this approach (Jermann, Soller et al. 2001): Mirroring, metacognitives, and advice systems. Mirroring systems are those which reflect the actions of the participants. Thus, in this approach the system recovers raw data and that data is returned back to the participants. The tools known as metacognitives correspond to a more sophisticated version of mirroring systems. Here the system returns to the participants the result of a model of their state of interactions. Finally, the advice systems try to guide participants through advices allowing them to improve the interactions of the group. The reader can find examples of each type of supports in (Jermann, Soller et al. 2001).

If the collaboration management is no longer realized by an artificial intelligent system or agent, but is made by the participants of a group, the managing collaboration notion becomes self-managing collaboration, where each actor manages the flow of interactions that takes place in a learning group.

3.1.2 THEORETICAL BASIS OF COLLABORATIVE LEARNING

The theoretical bases of collaborative learning are founded on several theories that try to explain how people learn together. Here, we detail four perspectives we consider important: Socio-constructivism, Socio-cultural theory, situated cognition, and distributed cognition.

3.1.2.1 SOCIO-CONSTRUCTIVISM

Constructivism has become an important perspective in educational research. Constructivism sees that knowledge is not about the world, but it is rather constitutive of the world (Sherman 1995).

Thus, knowledge is not seen like an external object to the observer, but, it is built by the individuals from their own experience. Consequently, learners become active agents, who engage in the construction of their knowledge. In an extension of this approach, the socio-

constructivism, the constructivists show a growing interest for the social context of learning. Therefore, under this perspective the importance of the interaction between pairs for a social construction of knowledge is emphasized.

3.1.2.2 SOCIO-CULTURAL THEORY

The socio-cultural theory of learning considers our society or culture as the origin of human intelligence. Under this perspective, the individual cognitive profit occurs mainly by interpersonal interactions (interaction with the social environment). Vygotsky's cultural-historical approach of learning (Vygotsky 1978) concentrates mainly on the role of language in intellectual development. Its general genetic law of cultural development stipulates that learning always occurs on two planes: initially, in the inter-psychological plan, and only later in the intra-psychological plan. As a mechanism to learn at the inter-psychological level, Vygotsky stated the existence of a concept that he named the zone of proximal development. This zone is defined as an area of activities in which individuals can work with the presence (and help) of tutors or more advanced pairs or artifacts.

3.1.2.3 SITUATED COGNITION THEORY

The situated cognition encourages learning by of immersing learners in a environment similar to the possible context in which their ideas and

knowledge will be applied (Schell and Black 1997).

This approach is closely related to situated learning. In this concept, the emphasis is put on the environment where learning takes place rather than the cognitive processes independent of the environment. In this perspective the environment is composed of a physical and social context.

“Communities of practice” (Lave and Wenger 1991) is an emerging concept within the situated cognition perspective. It postulates that the construction of meaning in a social unit is made through sharing and acting reciprocally (Roschelle 1995). Thus, based on this concept, learning is defined as an integral part of a social practice generated by participants or students. Situated learning occurs, for instance, when students work in a collaborative way on authentic tasks which take place in a real situation (Daphne 1996).

3.1.2.4 DISTRIBUTED COGNITION

Distributed cognition is an approach developed by Hutchins (1995). Distributed cognition is a new branch of the cognitive sciences which considers that the cognitive development of human beings goes beyond the borders of the individual.

The concept of distributed cognition emphasizes the interaction between the individual, the environment, and cultural artifacts. This approach postulates that the development of the

cognition of individuals is not an isolated event, but a reciprocal process with the environment. It starts from the thoughts of individuals, through teaching and reciprocal guidance with others. Three features emerge from the distributed cognition theory. First, the increasingly important role that technology plays in handling intellectual tasks to release the individual cognitive load. Second, the emphasis on the sociocultural theory of Vygotsky. Third, the change of the notion of cognition from an individual process towards cognition depending on the situation and distribution, interacting in a continuous way between the individual and the environment.

3.2 *Specific research domains in CSCL*

Specific research domains correspond to emergent even if already institutionalized areas in the last two decades of the scientific community. The following list of specific research domains is not exhaustive, but it makes salient the main research trends in CSCL we have found in the literature:

- **Awareness**, in computer system designs, aims to reduce the meta-communicative efforts needed to collaborate across physical distances and through computer-mediated means, by

the creation of different mechanism of visualization of participants' activities (e.g., Gutwin, Stark et al. 1995; Gutwin, Roseman et al. 1996; Furugori, Sato et al. 2002; Cao and Greer 2003 or Cao and Greer 2003)

- **Design of 3D environments.** This area of research aims to facilitate the development of collaborative processes by the construction of 3D learning environments that help students to acquire a spatial mental model that reflects reality and process (e.g., Fjuk and Krange 1999; Dalgarno 2002; Galea, Legarreta et al. 2002; Krange 2002; Jensen, Seipel et al. 2003 or Jensen, Seipel et al. 2003).
- **Analysis and evaluation of collaborative activities.** Different methodologies are implemented to analyze and evaluate the collaborative activities generally combining qualitative and quantitative analysis (e.g., Avouris, Dimitracopoulou et al. 2002; Martínez, Dimitriadis et al. 2002; Jeong 2003; Martínez, Dimitriadis et al. 2003 or through SNA methods (e.g., De Laat 2002; Aviv, Erlich et al. 2003; Reffay and Chanier 2003), or by means of computational modelling (e.g., Brna and Burton 1997; Gassner, Jansen et al. 2003).
- **Structuring interactions,** we found multiple works in structuring interactions from a semi-structuring dialogue perspective (Hoadley, Hsi et al. 1995; Baker, De Vries et al. 1999; Quignard and Baker 1999; Barros and Verdejo 2000; Delium 2003) or from collaboration scripts (a review of some scripts can be found in (Dillenbourg 2002)).
- **Software agents.** An agent is an autonomous system that monitors some variables (or combination of) and reacts to some thresholds activating specific functionalities. The research on software agents aims to design agents that support human learning, by interacting with students in the context of an interactive learning environment (e.g., Boy 1997; Jaques, Oliveira et al. 2002; Jondahl and Mørch 2002).
- **Knowledge representations.** This research domain aims to make a graphic representation of knowledge in order to make the thoughts of individuals and groups visible. (e.g., Belvedere system (Suthers 1995), Arguetrack (Bouwer 1999) or Sense maker (Bell 1997). Readers can find in (Sandoval, Bell et al. 2000) a review of different knowledge representations.
- **Visualizing interactions.** This area of research has not yet reached a developed state and, in a sense, is quite similar to the previous specific domain. The focus of this line of research is to make the relationships among interactions salient. Therefore, *helping the*

reader to apprehend the discussion's structure. In contrast to knowledge representation, this approach makes the relational aspects of discussions visible, not the semantic aspects. (e.g., Donath, Karahalios et al. 1999; Ekeblad 1999; Sack 2001).

We consider the following specific domains highly relevant to this work: structuring interactions, knowledge representation, and visualizing interactions. These three domains represent the domains that were studied thoroughly for this thesis as well as being a focal point of this thesis: the support of the interactions taking place in VLCs that use FTTs as the main communication tool. The contribution of this work can be interpreted primarily from the progress that we make in these specific research domains.

We present in the next sections a short review of these areas.

3.2.1 STRUCTURING INTERACTIONS

The basic approach in this domain is to label the participants' contributions through sentence openers, and in this way encourage some defined types of conversation. In this approach, various authors have created different sentence opener structures and grammars (sequences of sentence openers), to obtain a specific structure of conversation (e.g., Hoadley, Hsi et al. 1995;

McManus and Aiken 1995; Baker, De Vries et al. 1999; Quignard and Baker 1999; Barros and Verdejo 2000; Delium 2003).

SPEAKEASY is one example of this type of system developed by Hoadley, Hsi et al. (1995). Speakeasy is a structured discussion tool for learning. A structuring feature of this tool is the ability to label predefined links between messages ("And", "Or", "But", "Question", and "Summary") to indicate the link relationship. Hoadley, Hsi et al. (1995) argue that these link labels establish a relational context between contributions.

OSCAR (Delium 2003) is a Computer Mediated Communication (CMC) environment that structures the discussions by sentence openers. In addition, this tool allows users to create grammars based on "sentence openers" and relationships between these sentences. Furthermore, it allows you to structure these discussions based on these grammars. OSCAR visualizes discussions as a tree hierarchical structure of sentence openers. Structuring the discussions from sentence openers makes computer tracking of pedagogical activities possible.

DEGREE (Barros and Verdejo 2000) (acronym for Distance Environment for Group Experiences) is a collaborative environment that provides a platform for sharing collaborative experiences and analyzing the groups collaboration. This environment structures conversations through sentence openers that users must select to indicate the type of each new contribution (e.g., proposal, question, or comment).

Another work that follows this approach is CONNECT (Baker, De Vries et al. 1999). CONNECT is a tool intended to encourage *epistemic interactions*, which are explanatory and argumentative interactions. CONNECT imposes a specific structure on the students' individual and collaborative problem solving by way of a partial structuring, where students are asked to categorize their opinions with respect to their partners' sentences. The categories are: Yes, No, OK?, I don't agree, I'll do it, You do it, Hello, and Are we done?.

Another work developed by Baker is C-

CHENE (Baker and Lund 1997). Here, we focus its work on promoting "reflective interactions" in a collaborative virtual environment. Reflective interactions are "those that involve explanation, justification, and evaluation" (Baker and Lund 1997). According to the authors, the presence of reflective interactions can be potentially productive for learning. Their work shows a comparative study of a Computer Supported Collaborative Learning (CSCL) environment (C-CHENE) between an interface that allows free text to be exchanged and another that structures the interactions with sentence openers

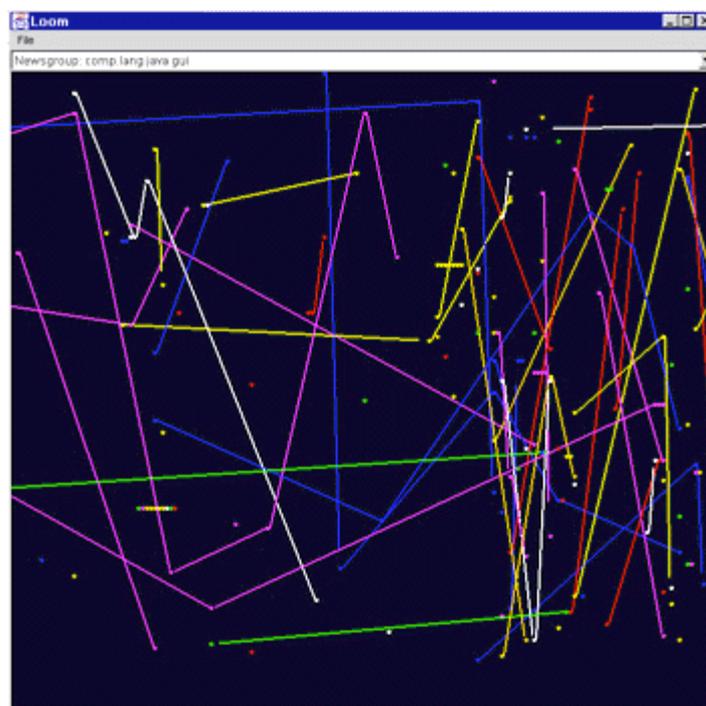


Figure 3.1. LOOM

(e.g., I propose to..., I think that..., Why?, Because..., and others). The results showed that the structured interface “promotes a task-focused and reflective interaction” (Baker and Lund 1997).

Vapillon’s work (Vapillon 2000) uses a less structured approach. His objective is not to encourage learning conversations (this author created a structured discussion tool for coordination), rather to allow users to define the threads from parts of messages. He also takes a structured approach by asking the user to create a categorization of the interactions (co-orientation, anti-orientation, interrogation among others).

3.2.2 VISUALIZING INTERACTIONS

The focus of this line of research is to make salient the relationships among interactions. Thus, the objective of this line of design is mainly “*To help the reader apprehend the discussion’s structure and history and become familiar with its community, new interfaces for viewing, searching and annotating the amassed material are needed*” (Donath, Karahalios et al. 1999).

We present three studies that illustrate the visualization of interactions.

LOOM (Donath, Karahalios et al. 1999) is a visualization tool for USENET groups. The objective of this tool is the observation and location of patterns of events of a newsgroup, such

as the entry and the exit of participants to a conversation, and the birth and death of threads.

The visualization created from the use of this tool shows a representation of links among several messages which compose the conversation carried out by a group within the USENET. LOOM aims to provide “a visual interface for browsing the newsgroups archives that will help the viewer to perceive the social patterns that are often obscured in a text-only interface” (Donath, Karahalios et al. 1999).

Figure 3.1 illustrates a visualization that users get with LOOM. Loom traces the connections between sequential posts in a thread. Here, lines connect the thread as it passes from person to person (Donath, Karahalios et al. 1999).

LINK MAP (Ekeblad 1999) is a tool that offers a graphic representation of intermessage references of a group that works distantly. The object of link maps is to represent the relationships among the messages within a group. Figure 3.2 illustrates a link map visualization that represents a conversation carried out in a mail list.

We observe in figure 3.2 a diagram which contains the whole message of a conversation and its references to other messages. Messages are represented by rectangles and placed sequentially from left to right. In the diagram, each message is placed horizontally according to their send date. The temporal axis can be compressed or expanded depending upon the flow of messages or can be visualized in a linear way.

On the vertical axis, messages were arranged minimizing the crossing of lines.

CONVERSATION MAP is a newsgroup browser that aims to make it easier for participants to understand and reflect the relationships between the participants in very large-scale conversations like large, electronic-mail lists or busy, Usenet newsgroups (Sack 2001). The CONVERSATION MAP system computes and then displays the relationships between the participants.

CHAT CIRCLES is a graphic interface for synchronous communication (Donath, Karahalios et al. 1999). In this system, each participant is represented by a colored circle on the screen in which his or her words appear. The circles

can grow and have a brighten variable depending on the periods of silence. Participants have the possibility to move their circles around the screen putting them closer to other participants. “Viewed over time CHAT CIRCLES creates a visual record of conversational patterns. One can see who are the active, animated participants and one can watch the emergence and dissolution of conversational groups” (Donath, Karahalios et al. 1999).

These visualizations aim to help users perceive patterns (message patterns and content patterns) that are not easily observed in a text-only interface. These systems constitute a type of representational guidance element for students or participants.

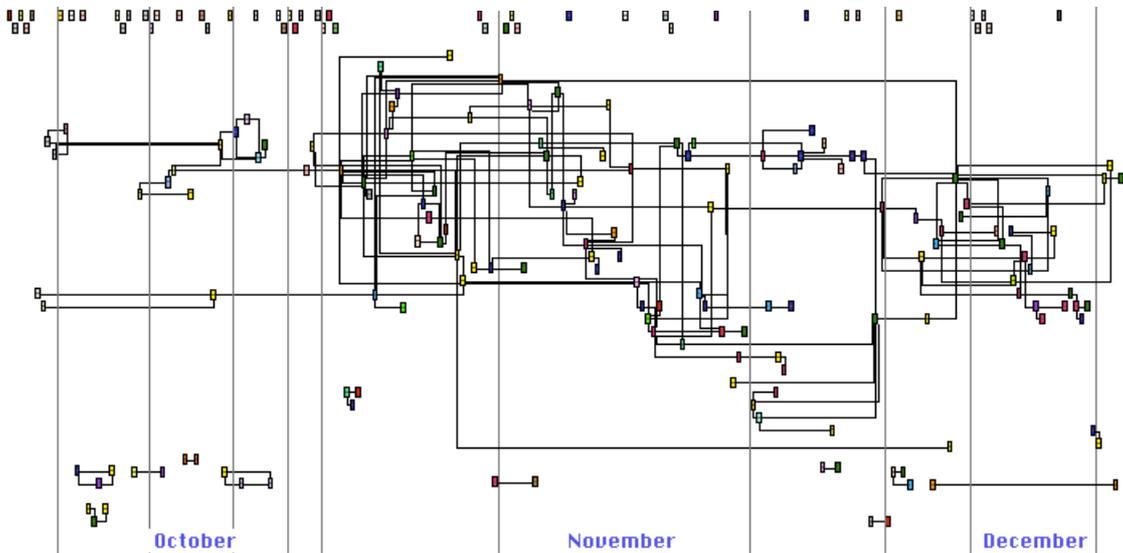


Figure 3.2. LINK MAP

3.2.3 KNOWLEDGE REPRESENTATIONS

Knowledge representations make it possible to visualize the thoughts of individuals and groups (Suthers 1999). Moreover, these representations help participants to analyze the relationships between components and between arguments. In addition, they help participants to organize their components in other ones of a higher level (Yu and Chee 1999).

In this approach, it was possible to find several studies. The BELVEDERE system (Suthers 1995) which is a system that allows the construction of “evidence maps” in a shared workspace. “Evidence maps” relate data and hypotheses by evidential relationships (consistency and inconsistency). Thus, users can inspect these displays and show them to others to get feedback and ultimately improve their knowledge.

ARGUETRACK (Bouwer 1999) is a system that supports a pair of students’ argumentation process by supplying information from various sources, providing means for structured interaction between students, and giving visual feedback from argument structure diagrams. The objective of ARGUETRACK is: (1) to facilitate dialectical argumentation between two students, who can communicate only through this system, and (2) To extract and visualize the argument structure of the propositional content of their discussion. This system allows for a restricted

natural language interface, in which the propositions are the main building blocks.

SENSEMAKER (Bell 1997) is a system that provides a spatial and categorical representation of an online debate. Using SENSEMAKER, users can visualize the group evidence items into categories and create scientific arguments based on their understanding of the topic (Bell 1997). Therefore, The SENSEMAKER system makes it possible for small groups to organize a collection of evidence associated with a specific topic and to work with *evidence dots* representing individual pieces of evidence on the Web and *claim frames* corresponding to conceptual categories (or groupings) for the evidence (Bell 1997).

3.3 *Field of study: VLCs in FTTs*

By defining the field of study, we will be able to target a specific community and its characteristics, as the study focus for this research. We note that we do not use the concept of field of study as it is used traditionally, that is, a branch of knowledge, but instead, the field of study gives us the empirical context where this research takes place.

The CSCL systems deal with different types of learning groups. In section 3.1.1.2 we outline

these different types and divide them into emergent and non-emergent groups.

The non-emergent groups correspond to those where their participants are linked by a tutor, monitor, or some kind of authority in order to learn together. That is, groups that as part of a pedagogical strategy “have to” learn together. Much of the research carried out in CSCL domain is focused on this type of group.

By emergent groups, we want to denote the groups where people enter into relationships in an emergent and autonomous fashion determined by shared interests rather than by a particularly imposed pedagogical strategy. We are interested in working in these specific kinds of Virtual Learning Communities.

3.3.1 VIRTUAL LEARNING COMMUNITIES

Network technologies led to the establishment of new web-based learning activities and the emergence of new types of communities called virtual learning communities (VLC). The VLC expression is used in this thesis to designate online social systems, where their actors are generally geographically distributed, and collaborate usually via ICTs and maintain a shared purpose (Mowshowitz 1997).

Through ICTs, learners or participants can be connected from almost any place, building their own formal or informal groups. Thus, VLCs be-

come a collection of individuals linked by a set of shared ideas and ideals, generating common references and micro-cultures (Dillenbourg, Poirier et al. 2002).

The concept of a VLC used here is closely related to the *Asynchronous Learning Network* (ALN). The ALN is an environment that “*combines self-study with substantial, rapid, asynchronous interactivity with others. In ALN learners use computer and communication technologies to work with remote learning resources [...] without the requirement to be online at the same time.*” (Mayadas 1999).

VLCs are described and detailed in several articles and books. Dillenbourg’s article (Dillenbourg 2002) is an excellent reference on the topic. Particularly, we are interested in the point of view that sees VLCs as highly decentralized groups. This decentralized vision of these groups is central in our conception of communities. In this chapter, we present three theoretical and practical points of view which are related to this conception of communities:

- VLCs as online self-organizing learning social systems. This concept, introduced by Wiley and Edwards (2002) claims to make salient a central characteristic of some VLCs. Namely that their development and organizational structure take place firstly in, and through, the community itself. This vision determined the support approach taken in this thesis (peer-to-peer support).

- VLCs as communities of practices (CoP). A community of practice corresponds to a group sharing a common practice, which allows its participants to be identified as a community. The CoP concept is vastly used in several fields. But here, the interest is in some concepts associated with the CoP. Particularly, the vision of learning as participation and the description of the dynamics of these communities that emphasizes the interactions among participants.
- The structure of VLCs as voluntary associations and small groups. With this concept, our intention is to remark on the fact that the concept of a virtual community is not always related to the situation of a permanent group of participants over a period of time. Butler (1999) states that the metaphor of VLCs as voluntary associations is better adapted to the dynamics observed in VLCs. His study gives us a statistical vision about the real structure of VLCs.

3.3.1.1 VLCS AS ONLINE SELF-ORGANIZED LEARNING SOCIAL SYSTEMS

Wiley and Edwards (2002) conceptualize some virtual social systems as Online Self-Organized Social Systems (OSOSS). The conceptualization of VLCs as OSOSS assumes that individuals are engaged, autonomous, independent, and also in-

fluence each other within a learning process. These collections of individuals, who are bound together by natural motivation and a set of shared ideas and ideals (Kowch and Schwier 1997), can be drawn together through technology from almost anywhere, and construct their own formal or informal groups.

The conceptualization of VLCs as OSOSS helps us to focus on its characteristic of self-organization. Self-organization is basically a process of evolution with minimal environmental intervention, where it is not possible to predict the effects of any external intervention. Consequently, the development of new and complex structures takes place *primarily* in and through the system itself. Therefore, OSOSS are systems that allow a social structure (i.e. the set of all relationships between a limited number of social actors) to emerge without an explicit pressure or involvement from outside the system. In other terms, the constraints to develop a specific form (i.e. organization) are internal to the system. Its organization results from the social actors' interactions. Through these social interactions, the organization in an OSOSS increases (i.e. the development of an organized structure) without being controlled by the environment or other external systems.

For example the typical characteristics of self-organized systems are: a temporal evolution, a high degree of internal autonomy, and the emergence of a global order starting from local interactions.

VLCs, whose characteristics are similar to those of OSOSS, become a semi-autonomous social system, which obtains an auto-organizational structure from their group's interactions. Learning trends in collaborative learning emphasize an active role in the learning of the group's participants and the change of the teachers' role from an instructional classical view to a view of tutor as a facilitator. Furthermore, this perspective connects directly to some learning theories and learning models that emphasize an active role in the learning of the group's participants as part of a dynamic system. In the communities of practice perspective introduced by Lave and Wenger (1991), it is stated that communities of practice are groups where the individuals share an expertise or passion about a particular topic. In this perspective, the interactions and the sharing are the basis of learning. The authors want to emphasize the transformation in the learning perspective "(...) from the individual as learner to learning as participation in the social world" (Lave and Wenger 1991). The Computer-Supported Intentional Learning Environment (CSILE) model introduced by Scardamalia, Bereiter et al. (1989) emphasizes the fact that the process of knowledge building is made through the self-regulated and active participation in the learning process.

OSOSS is not a learning theory, but proposes a theoretical view about social knowledge building, giving new interesting perspectives for analyzing the dynamics of learning in a VLC, emphasizing the self-organizing process. That

is, learning occurs principally through participants' interactions. This vision determines the support approach selected for this thesis: a peer-to-peer support.

3.3.1.2 VLCS AS COMMUNITIES OF PRACTICE

Communities of practice (CoP) are groups of people who share an expertise or a passion about a particular topic or activity, and who interact continuously. These interactions are the basis of the mutual learning of participants of a community. Thus, a community of practice corresponds to a group sharing a common practice, which allows its participants to be identified as a community (Lave and Wenger 1991). These communities meet together primarily by a specific and shared practice, and not by social or cultural determinants. The authors who introduced the concept of CoP gave a theoretical framework (Lave and Wenger 1991) that seeks to understand: (1) the structure of the communities and (2) how learning takes place in these communities. Moreover, the authors of this notion want to accentuate the change in perspective "(...) from the individual as a learner, to learning as participation in the social world". Thus, in this approach, learning is denoted by the adhesion acts of the participants towards their community.

Consequently, from a perspective of CoP, it is necessary to focus on the structures of participation generated in a collaborative learning setting. In this vain, Lave and Wenger introduced the concepts of peripheral and central participa-

tion. Peripheral participation suggests the idea that “there are multiple, varied, more-or-less engaged and inclusive ways of being located in the fields of participation defined by a community” (Lave and Wenger 1991). This concept helps us understand the relationships between newcomers and old participants. The peripheral participation is related to the “position” where the participant is located in the social world. The concept of central participation corresponds to the idea of total participation (full participation). “Full participation is intended to do justice to the diversity of relations involved in varying forms of community membership” (Lave and Wenger 1991). This notion of central participation does not involve the idea of a physical, political, or a metaphorical *center* in a community in relation to the place of the individual in the community.

We conjecture that this conceptualization of learning is not restricted only to the communities of practice, but that these structures of participation can be observed in other kinds of communities, in particular, in communities of interest like newsgroups (Lueg 2001). Communities of interest are those created from a group of participants who have a common interest and a common commitment for augmenting the knowledge of the topics of a specific field of interest. The principal difference between these two types of communities (practice and interest), is that the first is focused on learning a specific know-how, and the second deals with the learning of a specific knowledge. However,

these communities are not in opposition to each other. A community of interest can be also a community of practice. In our thesis, the construct of learning “(...) from the individual as a learner to learning as participation in the social world” (Lave and Wenger 1991) gives us new theoretical perspectives for looking at the learning process that takes place in VLCs.

3.3.1.3 VLC AS VOLUNTARY ASSOCIATIONS AND SMALL GROUPS

The usage of the word “community”, rather than a rigorous use of the meaning of this word, is conceived here to better distinguish and give a comprehensible concept of VLCs. In this sense, community is the standard metaphor used to name such online social systems. However, this metaphor is not the only existing one, since online social systems are named using several metaphors (table 3.1).

Community, virtual community
Social group
Social network
Discussion forum, Discussion group
Conference
Shared information space, Information source
Public good, Virtual common
Mass media, Communication media

Table 3.1. Metaphors used to name online social structures (Butler 1999).

In spite of the multiplicity of names, studies show (in particular (Butler 1999)) that the metaphor for the voluntary associations (VA) and for the one of small groups (SG) adapts in a better way to the structure and the dynamics of online social systems and their interactions. Indeed, in the case of VA, they adapt better to social structures that exist in newsgroups. In the case of SG, they adapt to groups that enter in collaboration starting from a defined academic framework. Butler (1999) studied 1066 online groups from newsgroups for a 130 day period, between July 23, 1997 and November 30, 1997.

In order to understand the dynamics of online groups, Butler compared them using five parameters:

- **Group size:** Indicates the number of people who are exposed to communication activity. In SG the size remains small, around seven individuals, whereas, the VA has an average of 163 participants.
- **Membership change:** through this parameter, it is possible to see the dynamics of a group according to their membership change. In the SG, groups are highly stable. On the other hand, the VA has high levels of ongoing change in its membership.
- **Communication activity:** determines the volume of activity in the online collectives. The SG shows limited sessions with high interactivity, whereas in the VA there is, in general, a reduced

volume of activity, but it is distributed over a longer time span.

- **Structure of the communications in a group:** Indicates the structure of the activity in an online group (length of threads, a number of messages in a thread, etc).
- **Participation patterns:** Indicates the distribution among the members of a group regarding the participation of its members. The two types of groups (SG and VA) present a similar distribution regarding the participation: with a restricted core of people generating much of the participation.

3.3.2 TECHNOLOGICAL SUPPORT FOR VLCS

The technological support for VLCs is principally the Computer Mediated Communication (CMC) systems. Among these systems, we found three tools through which VLCs take place: Chats, e-mails, and forum-type tools.

Chat systems make it possible to engage in a conversation with other people around the world simultaneously. In the origin of chat systems we find the IRC (Internet Relay Chat), designed by Jarkko Oikarinen in 1988. The goal of this tool was, originally, to allow groups of USENET and other online groups to communicate in real time,

and thus, to facilitate the discussions that took place there.

E-mail corresponds conceptually to an electronic version of the traditional post mail. This tool was created by Ray Tomlinson in 1971. Its implementation was the first attempt to use the ARPANET⁴ as a medium of human communication.

Finally, forums correspond to a more original creation which does not have an apparent parallel to our normal way of talking. The origins of forum systems are found in the year 1979 when two students from Duke University created a system which could give rapid access and distribution to the news. Therefore, they conceived of a system in which a person could submit news at a specific node of a network and then this news would spread to all other nodes.

The definition of forum by the Office of the French Language (Office of the French Language, 2001) is the one that we retain: "Service offered by an information server or bulletin boards in a network as Internet and which allows a group of people to share their opinions and their ideas on a particular subject, (...)"

In all of these tools (chat, e-mail, forum) a particular kind of conversation takes place: mediated written conversations. Therefore, the text is an outstanding aspect of these tools: "as a medium for exchanging ideas it has a number of

excellent qualities. It is highly adaptable - given the basic alphanumeric keyboard, people can assemble discourses on any topic. With skill, it can be quite expressive yet as a conversational medium, the austerity of the text can be detrimental. In particular, it is difficult to convey many kinds of social information, such as conversational tone, patterns of activity - even the size of the conversational group is opaque in most of the text-based forums. ..." (Donath, Karahalios et al. 1999).

These textual characteristics convey another characteristic: the persistence of mediated written conversations. This persistence corresponds to the capacity to save conversations for later use and examination. Thus, the persistence extends the conversation beyond face-to-face conversations, making it available in other places and for a long time, thus allowing for a comprehensive analysis of the conversations. We believe that the characteristic of persistence of written conversation "opens the door to a variety of new uses and practices: persistent conversations may be searched, browsed, replayed, annotated, visualized, restructured, and recontextualized, with what are likely to be profound impacts on personal, social, and institutional practices" (Erickson 1999). Consequently, starting from characteristics of the written conversation, one will be able to find new types of collaboration and assistance to collaboration.

⁴ The precursor to the Internet, ARPANET was a large wide-area network created by the United States Defense Advanced Research Project Agency (ARPA). Established in 1969, ARPANET served as a test bed for new networking technologies, linking many universities and research centers (Webopedia 2004).

3.4 *Supporting Learning Conversations: Our Position*

For the purpose of specifying our thesis, we have related our investigation to different notions and approaches presented in the previous sections of this chapter.

Regarding the different distinctions previously presented, the focus of this research is placed on:

- **Collaborative learning situation.** We aim to study communities that present a collaborative learning approach (see section 3.1.1.1). But we realize that the context of the use of supporting systems is not only limited to these communities, i.e., the system can be used in a “learning in collaboration” structure.
- **Collaboration emergent context.** We aim to study communities that present an emergent collaboration approach.
- **Design of a collaborative technology.** We aim to build collaboration technology tools. That is, build collaborative technology tools for people involved in a process constructing shared knowledge collaboratively.
- **A “peer-to-peer support” approach.** In this study, “supporting” means the creation of mechanisms that will help

students to support themselves and each other (peer-to-peer support). That is, we are not advocating the creation of automated systems that support the activity of students.

- **Self-managing interactions.** We aim to give users systems which make the self-managing of interactions possible.

In addition to this specification our work takes place and focuses on three specific domains of research, described in the previous sections: structuring interactions, visualization of interactions, and knowledge representations.

Regarding the structuring of interactions, this research takes the studies in structured learning communication one step further by promoting the learning conversations but from a more flexible approach. We develop a tool intended to facilitate the emergence and development of learning conversations through several mechanisms based on the re-organization of interactions in which the users are not forced to categorize any of their interactions. We implement an interactive graphical representation of the structure of interactions that enables users to be aware of the development of contributions taking place in the VLC.

This more flexible approach is based on three arguments. First, we adhere to the idea that the definition of categories, instead of contributing to the encouragement of some specific conversations or interactions, is a political approach for the reproduction of an established social order

(Suchman 1994). This critique takes place in the context of the categorization of e-mails from speech acts. Nevertheless, the same effects can be found in the categorization of interactions by sentence openers because in both we define categories for the contributions of participants. The main difference between these two types of categorization structures is the granularity of the contribution: e-mail or sentence. (See Suchman (1994) for a detailed criticism related to the use of categorization approaches). Second, the categorization approach is highly conditioned to the students' ability to choose the correct contribution type, which can be a major limitation of this approach (Baker and Lund 1997). Participants do not always use the sentence openers in the intended way (Bouwer 1999). Third, Robinson (1991) stated that all applications that support collaboration must manage two levels of language: the cultural and the formal level. The cultural level allows us to develop informal conversations and negotiate without restraint. The formal level allows us to establish rules in order to act. The sentence opener approach works at the formal level structuring dialogues. Due to this, the cultural level of the conversation is marginalized.

Considering what has already been mentioned, we take an approach that tries to promote the emergence and development of learning conversations by structuring conversations no longer based on categorizing, but on the organization and visualization of the interactions of participants.

Regarding the visualization of interactions, the research focus has been the visualization of the flow of interactions in order to obtain better knowledge of these interactions. In this thesis, we work in this domain with another approach: the visualizations are no longer used to just observe the interaction pattern, now participants can "work" on these visualizations. That is, the visualization is a part of collaboration. Moreover, we notice that there is a lack of research regarding this perspective in this domain.

Regarding the knowledge representations, we want to emphasize the existing knowledge of a group, but from a different perspective. We want to make evident the relational aspect of the relationships between participants without considering the semantic aspects of these relationships. Chapter 4 gives details of this perspective.

Regarding the field of study, we take a perspective on VLCs where the communities should not be controlled by interventions in a prescriptive way. The support notion cannot rest on the idea of intervention of the system. The support should be exerted by and for the participants. That is, a peer-to-peer support where participants support each other.

Our thesis focuses on two social types of structure. On the one hand, small groups, which correspond to groups that get together to make or define a task collectively. In our context of research this situation is accomplished from an academic setting. On the other hand, the voluntary associations, which correspond to users of

newsgroups, which do not correspond necessarily to academic settings.

The notion of communities, in this study, will refer to the two types of metaphors associated with online social systems: small groups and voluntary associations.

Finally we are not interested in all kinds of VLCs. We are interested specifically in the VLC taking place around forum-type tools. The term “forum-type tools” is used for text-based and asynchronous electronic conferencing systems that make use of a tree hierarchical data structure of enchainned messages called threads. We will call threaded conversations, the ones taking place in these FTTs. Two characteristics of FTT

shape the development of VLCs: the persistence of conversations, and the underlying structure of communication: Threads.

Threads, so called “derivations”, correspond to “a divergence in the interaction which is built starting with an intervention (message) which is registered at the beginning of a linear flood of exchanges and constitutes a new branch” (Vapillon 2000). The persistence of conversations is at the origin of the system of threads. Since the whole conversation is accessible, participants can react, whenever, to different parts of the conversation, originating new threads of conversation.

4 Theoretical considerations



Abstract: This chapter introduces the theoretical considerations on which this study is based. These considerations play the role, according to our methodology, of creating a point of view that guides the research of anomalies. Particularly, we adopt a structural perspective that brings forward the relational aspects of a conversation. We will not take into account its semantic aspects. The theoretical framework explained in this chapter supports this option.

4.1 Introduction

For this study, as was mentioned in chapter 1, it is necessary to have a point of view that guides the search for anomalies. This chapter completes our research design by giving the theoretical considerations concerning the phenomenon (interactions taking place in FTTs) involved in this research.

The theoretical considerations are the perspectives regarding the nature or essence of a phenomenon. Particularly, these considerations answer two questions: what is the nature of the phenomenon that I want to research? (ontologic positions) and what might represent knowledge or evidence of the phenomena which I want to investigate? (Mason 1996) (epistemologic positions). The answer to the latter must include the principles and rules through which we decide how the phenomenon will be known or revealed. Consequently, the theoretical considerations must consist of theories about the studied phenomenon and the methods of analysis through which we can perceive it, giving us a particular perspective that allows us to reveal and analyze the interactions in the VLCs,

We call interactions the learning conversations that take place in VLCs. This chapter reviews some perspectives regarding this kind of

conversations. Particularly, we propose to focus ourselves on the structural aspects of communication.

4.2 Underlying concepts

What is conversation?. Traditionally *conversation* is understood as a process of transmission of meanings. This notion is attached to the paradigm of cognitivism⁵ which defines *communication* (conversation is a process for arriving at communication) as a process characterized by the transmission of *information* (see figure 4.1). From the development of the second order cybernetics⁶, the notions of conversation, communication, and information were revised starting from the new research which shows that human beings are biologically closed systems (Maturana and Varela 1987). This fact produces a conflict in the precedent notions that adopt a position where people receive information from the external world. Therefore, we take a view of conversations as a process of communication

⁵ Cognitivism is a theoretical approach for understanding the mind, which argues that the mental functions can be understood by quantitative, positivist, and scientific methods, and that such functions can be described as information processing models.

⁶ Cybernetics is the discipline that studies communication and control in living creatures and in machines built by humans. Second order cybernetics emphasizes the involvement of observers in the system as opposed to the cybernetics of systems that are observed from the outside (Principia Cybernetica Web).

based on the notion that meanings are not transferred, translated, sent, or coded, but, they are co-built by *each* individual involved in an act of communication. Thus, in this approach, significances are not communicable but private to each individual. Therefore, significances do not reside in the words or other elements of representation. This notion is supported by the conversation theory of Pask (1976) (explained in section 4.2.3) and his two underlying concepts belonging to the same theoretical perspective: information and communication. The understanding of our conversational perspective is based on these notions. Moreover, these notions form, along with conversation theory, the theoretical perspective taken in this thesis regarding interactions that take place in VLCs.

Regarding the notion of information we consider it a change in one's mental system stimulated by a change in the external world. Regarding communication, we present some notions from Maturana related to his perspective of communication.

Therefore, we explore "the concept of learning conversations" from the theoretical basis based on these theoretical developments. Particularly, we borrow the perspective of learning conversations from Gordon Pask's conversation theory (Pask 1976).

4.2.1 INFORMATION

The traditional concept of information is associated with a metaphor. Information is a substance, which is transferred from the sender to the receiver. In spite of the generalization of this perspective in almost all fields of knowledge, there are several criticisms considering this mechanistic notion of information (Brier 1992). This way of understanding information is being superseded and displaced by a more comprehensive view regarding this phenomenon. It consists, basically, in taking into account the observer's role on the analysis of a phenomenon. In order to acknowledge different points of view regarding information, we present a taxonomy of the notions of information created by Lars Qvortrup (1993). Here, we present only a short description of categories introduced in his work.

The definitions of information go from a notion of information defined as something identifiable in the material world, to a notion of information conceptualized as a merely mental construct. In this continuum, it is possible to identify four concepts of information: information defined as something (a thing or a substance) which exists in the external world like something identifiable in the material world, independent of an observer, such as heat, electricity, etc. This vision of information is the foundation of the model of communication of Shannon and Weaver (1948).

The concept of communication and information was revised when cybernetics of second order was developed. New research showed that human beings are biologically closed systems (Maturana and Varela 1987) and that their mental operations were self-referenced. According to this view, the previous concept of information as a difference in the external world is not exact, given that the nervous system is closed. Second order cybernetics considers, as a possible conclusion, that information can be distinguished as a difference (something that can be localized) in the external world that causes an operational change (a difference) in the mental system of the observer.

A third notion of information can be defined as a change in a mental system stimulated by a change in the external world. Compared to the second definition, the logical order of both the external world and the mental system was changed, by defining information as a difference (a mental construction) which *finds* or is confirmed (or triggered) by something in the external world. In this vein, we find the contributions of Heinz von Foerster (1984).

Finally, a fourth notion of information can be defined as something which only “lives in” the human mind, such as a concept or an idea. In this perspective, information can be seen as a cognitive difference that “discloses” the external world.

We consider the third notion of information as explained above (information as a difference which *finds* a difference) fundamental to the de-

velopment of this thesis. This concept is close to and coherent with our position that in an act of communication the significances are not transferred, translated, sent or coded, but, they are co-built by *each* individual involved in an act of communication. Thus, according to this perspective, significances are not communicable; but are private to each individual. Therefore significances do not reside in the words or other elements of a representation.

4.2.2 COMMUNICATION

The second component of our theoretical considerations is communication. Different models of information are associated to different models of communication. The most expanded model in communication is the transmission model of Shannon and Weaver (1948).

This model is a transmission model because communication is reduced to a matter of transmitting information. The model was proposed in 1949 by Claude Shannon and Warren Weaver, engineers working at the Bell Telephone Labs in the United States. The model consists of a sender (a source of information), a transmission medium (with noise and distortion), and a receiver (whose goal is to reconstruct the sender's messages). Figure 4.1 shows a diagram of a transmission model.

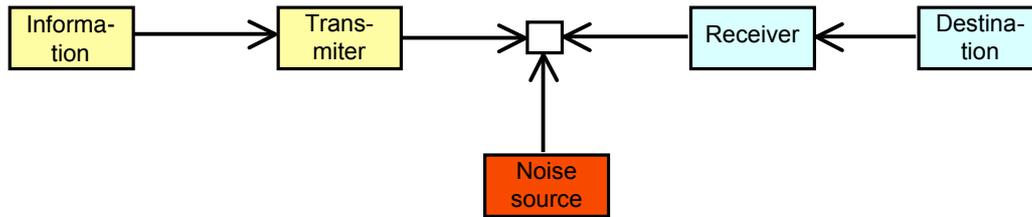


Figure 4.1. Model of communication of Shannon.

While this communication model is simple and helpful, it is not generally considered as a viable modern understanding of human communication. Today we find several criticisms to transmission models, mainly: The lack of context, in the transmission models the context is not considered; the relationship between sender and receiver, these models do not take into account, for example, the power relation between sender and receiver; and this model does not pay attention to the effect of the “channel” used (phone, mail, or face-to-face).

We understand communication differently from these transmission models. Our understanding of communication is based on Maturana, who sees communication as a process. Maturana and Varela’s research aimed explaining how biological processes can originate the phenomena of knowledge and language (Maturana and Varela 1980; Maturana and Varela 1987).

Maturana and Varela carried out biological experiments. Their conclusions contradicted the traditional notion which states that the environ-

ment specifies its own characteristics to the nervous system. They showed that the structure of the environment cannot specify changes in the nervous system, but can trigger them. The nervous system compensates for these disturbances (produced in the environment) in such a way, that for an external observer it would seem as if the subject had internalized something from the environment.

Maturana (1978) applied these ideas to explain the process of communication. He considers that communication is a phenomenon which corresponds to a process which starts with pre-communicative or anti-communicative interactions which belong to a state that he called “the establishment of ontogenetic structural coupling”. If this process created a behavioral coordination between the participants (what is called consensual domain), communication would take place. Communication, in this perspective, is a coordinated behavior mutually *triggered* among members of a social unit. An observer will consider this coordinated behavior as a sequence of linguistic disturbances, giving them a semantic

and a contextual value. Viewed as such, the conversation is the mechanism by which the reciprocal coordination of behaviors takes place; therefore conversation will be the mechanism for achieving the communication. We understand conversation from this perspective and the conversation theory of Gordon Pask helps us formalize this perspective.

4.2.3 CONVERSATION AND LEARNING: CONVERSATION THEORY.

Gordon Pask's conversation theory (Pask 1975) aims to explain learning in human beings as well as in machines. His motivation was the creation of a learning conversation between the computer and humans. The fundamental idea which is present in all his writings is that learning occurs through conversations about a discussion subject, which is used to make knowledge explicit. The process of learning (developing a coherent set of shared understanding of topics which were not previously understood by a student) is a process of conversation with and about topics. In this context, a conversation is the interactive process of the presentation and re-presentation of the development of understandings among individuals through exchanges, leading to a shared agreement (or sometimes disagreement). This is, a conversational co-construction of human understanding.

Pask thinks that, in order to facilitate learning, the subject of discussion must be organized (or represented) according to the shape of an *entailment mesh*, which shows what must be learned. The entailment mesh is a framework upon which the learning strategies of a conversation can be plotted. It has dense regions representing topics joined by coherence, held apart by distinctions and reachable by many paths. That is, the entailment mesh is made up of abstractions and distillations of processes of thought, called "concepts", "subjects", "analogies", etc. The entailment mesh makes it possible to represent thoughts in a "tangible" way. The entailment mesh also represents a principle of organization for structuring contents. In a conversation, according to this theory, answers depend on the interpretation of another person's behavior, and meanings are negotiated through the conversations. That is, the existence of different perspectives on the same problem or subject matter is implicit in Conversation Theory.

This perspective is basically a constructivist view about learning:

- The entailment mesh of concepts provides different perspectives on the same subject that reflect individual styles.
- Learning does not occur in one person but in a system composed of two (at least) interacting subsystems (participants).

Moreover, we have realized that conversation theory does not refer to any type of coding (the

idea of coding in communication is a basic notion in the transmission models of communication as described by Shannon and Weaver (1948) and Wiener (1948)).

“Unfortunately, this comprehensive and potentially valuable theory of human learning and communication is presented in a way which makes it difficult to understand and, consequently, the work is not widely appreciated” (Mitchell and Grogono 1993).

We present a practical model of conversation inspired by the conversation theory of Pask. This conversation model was created by Glanville (1996). His main ideas are: the private nature of meanings and the separation of a conversation into various levels that exist in communication. Glanville provides us with a model for the apparent sharing of meanings between the participants of a conversation.

According to Glanville, a conversation is realized without any type of coding, which requires making our own meanings in our understanding about any subject. Viewed as such, the conversation leads, necessarily, to interpretation and construction. Thus, the conversation itself will be the result of interpretations and constructions by the participants. According to this perspective, coding in communication is an exceptional and impoverished case of communication. In his argumentation, he observes: “indeed, coding becomes, in the best case, not more than one particular case - and strongly limited - of something much more general (in the same way that the mechanics of Newton is taken as a

special case - and strongly limited - mechanics of Einstein)” (Glanville 1995).

In order to explain the Glanville’s model, we present an example of conversation. A conversation is frequently about something, and it takes at least two participants, which take a part from a representational media (language), to interact. “One participant (A), having something (some idea/concept/observation) to communicate, presents it to the other participant (B) through the chosen representational medium, frequently spoken language (...). The other (participant B) makes whatever sense he will of this, creating his own idea/concept/observation (of the originator’s idea/concept/observation) responding with another presentation made to be sent back to the originator (A) of the communication (...).

The first participant (A) makes his own sense of what is presented back to him, and, if he finds that it is near enough to what he originally wished to say, he can believe that he has communicated the something he wished, in the first instance, to communicate to the other participant (B). If not, he can try again with a modification or alternative to his original presentation - or even repeat the original” (Glanville 1997).

We note that a “difference” between the concepts of each participant is an outcome of the comparison between concepts of each participant on themselves. However, conversation is not related to the creation of parallel personal meanings as we might think, but it is related to a process of negotiation of the agreements be-

tween themselves. The concept of negotiation will correspond, within this framework, to a process of creation of new representations, in order to decrease the difference between the meanings of the participants and to come to an agreement. This notion of negotiation is intimately linked with the two additional levels of this model of conversation. The *metaconversation* (in which monitoring and error regulation occurs) and the *subconversation* (which provides the context).

The metaconversation is developed in the same way as the conversation already described, “it consists in the representation made backwards and forwards between” participants. Nevertheless, the role of metaconversation is the negotiation and manipulation of “errors” (differences among participants). This level allows participants to debate their differences in such a way that they can make new representations in order to eliminate or to decrease the difference between their meanings and to come to an agreement. In conversations, we are supposed to be able to move ourselves easily between the two levels (conversation and metaconversation).

Subconversation gives a base, a context that allows participants to talk about subjects. We note the dynamic nature of the subconversation: as the conversation advances, the context changes in a parallel way.

4.3 *The structural perspective of conversations*

Conversation, from the theoretical considerations described above, does not indicate anything about meaning. It does not suppose meanings are “communicated” or that the act of communication has a direct relationship with meaning. According to this perspective, *meanings are not communicable; we build them in a personal way through conversation*. In a conversation we make our own meanings. Meanings are not part of the public domain, but, are built from us within the framework of the conversation (Glanville 1997).

This same notion goes also across the selected perspectives of communication and information. That is, the notion of incommunicability of meaning. The consequence of this notion is that conversation is not fundamentally a sharing of meanings but a process of individual negotiation (with oneself) of meanings triggered by the interactions with other participants of a conversation. The incommunicability of meanings, the semantic value of interaction differences among participants involved in a conversation, and the impossibility, as observers, of interpreting messages in the same way, lead us to understand and analyze interactions from a relational perspective.

In this sense, we no longer interpret the conversations as semantic chains of participants' contributions, but take an approach where we interpret interactions in a purely relational way. That is, we think about interactions just as links between messages in conversations.

Particularly, relational aspects refer to explicit links between messages created by the users. That is, in the case of a FTT, the link is produced by an explicit action of a participant that relates the messages by answering a preceding message or by creating a new one.

Even if this position can be seen as a radical one (in the sense of not taking into account the semantic aspects of interactions), we take it with some subtleties. We take the relational approach as "one way" possible to interpret interactions. This way of thinking is aligned with the theoretical considerations explained in this chapter. In this sense, we do not try to oppose the relational and semantic perspectives, as it may be understood in traditional terms, but view these approaches in a dialectic way. For example, we can consider the light that must be either a wave *or* a particle from a formal thinking. But, from a dialectical point of view the light is both wave

and particle. In our opinion interactions have a semantic and a relational nature, and we only work with the relational aspect.

From the study of these interactions (in a relational perspective) and the network of relations that generate them, we wish to reveal certain knowledge about the group. We find in network analysis a method to study the collective activities that adapt to our point of view. Consequently, the relational perspective used in this thesis will be supported principally by a network analysis of interactions.

Network analysis deals with the issues of representation of networks and it takes into account the relationships between the data: relational data.

The relational data correspond basically to links that connect a participant to another. This type of data cannot be reduced to personal properties of data. Thus, the relationships are not properties of objects (in this case, participants), but of a system of objects (in this case participant messages between participants). Through this analysis the relationships are treated as existing links among several participants.

II

RESEARCH FINDINGS AND PROPOSALS

5 Anomalies in VLCs



Abstract: This chapter introduces, from a structural perspective, the set of anomalies found when using FTTs that VLCs utilize, through different sources of analysis. We conjecture that the anomalies are visible by finding what we call structural incongruencies. Consequently, this chapter details a set of four incongruencies found in the VLCs that use FTTs. (interactional incongruence, turn-taking incongruence, convergence incongruence, and group perception incongruence).

5.1 Introduction

Anomalies are defined as subtle and invisible tensions which exist when users carry out a particular activity. For phenomenological reasons, people are commonly unaware of these anomalies. Nevertheless, they are found at the origin of work practice dissatisfactions. We conjecture that if we can identify what we call structural incongruencies, anomalies become visible. Structural incongruence is a difference between the expression of the users actions and the perception of the structure of interactions that turns out to be a salient product of these actions in the current FTTS. Therefore, in this work we look for structural incongruencies as a way to make anomalies salient.

We employed these three sources when starting to unveil anomalies on current FTTS:

- Observation analysis of selected newsgroups.
- Quantitative analysis of selected newsgroups.
- Bibliographic analysis.

Observation analysis took place principally in a selection of eight USENET newsgroups. In order to determine work practices in the VLC, we studied a collection of Usenet newsgroups. This option is not in opposition to our aim of

studying VLCs. Research has shown that some newsgroups can be considered as a community (Roberts 1998). In particular, we observed the *humanities.philosophy.objectivism* newsgroup. This group manifests certain characteristics that help to identify structural features of the group communication throughout. In particular, this group has a very high activity (83 messages per day) and the thread length is also very high too (16), compared to the average thread length of all other newsgroups (2.036 messages) (Butler 1999). In this newsgroup, we have a high percentage of users who post more than one message compared to other newsgroups. That is, there is a core of stable and active users. The length of each message is 44 lines. This fact, along with the long thread length, indicates a very high amount of on-topic discussion.

The quantitative studies are based on the analysis of FTTS interactions of a set of eight selected newsgroups⁷ (the most active and having longer threads length) in order to unveil evidence of anomalies based on solid data from real usage.

In our thesis, the bibliographic analysis plays the role of confirming the anomalies found, as well as connecting them to existing issues in the domain.

⁷ comp.ai.philosophy, humanities.lit.authors.shakespeare, humanities.philosophy.objectivism, sci.anthropology.paleo, soc.culture.french, talk.origins, talk.philosophy.humanism, talk.politics.guns.

5.2 *Incongruencies in VLCs*

In VLCs, almost all actual learning comes about during conversations developed using communication tools. These include forums, newsgroups, and other written media of asynchronous communication. Using these tools, the development of conversations is necessarily modeled by the underlying technological hierarchical structure: the threads. These tools “change the conventional rules of discourse, including coherence in the conversational thread, and frequency in turn-taking, and permitting asynchronous and concurrent threads” (Patel, Kaufman et al. 1999). Carrying out a conversation through a fixed structure, in addition to the changes on conversational rules introduced by FTTs, generates anomalies.

The current representation of threads is mainly a historical heritage. We believe it is time to study it deeply and to propose a way of overcoming these anomalies. We particularly concentrate on four specific incongruencies we have identified, since they are related to our aim at facilitating the emergence and development of learning conversations.

First, the fact that the current FTTs have an *interactional incongruence* derived from the difference between the message unit that users can handle and the one they can make reference to.

This incongruence causes information loss and reference confusion. Second, the fact that current FTTs encompass a *convergent incongruence* triggered by the lack of a mechanism to manage the convergent interactions taking place in FTTs, such as consensus, connecting ideas or making a synthesis. Third, the fact that current forum-type systems bring a *turn-taking incongruence* caused by the disruption between (a) the temporal and thread order of messages, and (b) the management of parallel threads. Fourth, the fact that the current FTTs bring a *group perception incongruence* caused by the deficient perception of the interaction structural regularities taking place in a group.

5.2.1 INTERACTIONAL INCONGRUENCE

It has been detected that within a message we can find several topics that appear and develop as threads (Vapillon 2000; Condon and Cech Forthcoming). Users usually answer by choosing a fragment of the message that they want to answer. This segmentation is done by (a) selecting a part of the message, or (b) selecting several parts of it when answering several paragraphs (the left side in figure 5.1). However, the segmentation is not visible in the current implementation of systems based on message threads, since this only denotes the link relation between messages, and does not take into

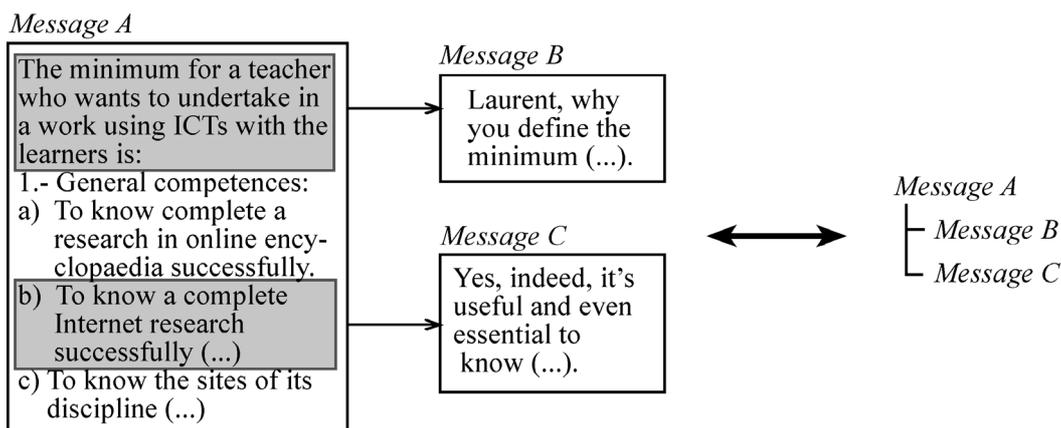


Figure 5.1. Multiple segmentation of a message by answering several paragraphs

account the specific parts selected by users (the right side in figure 5.1). Consequently, when examining a discussion through the current tools, topics are not easily localized because they are buried in the rest of the message content.

We formalize this situation by introducing the idea of *granularity of exchanges*. This idea deals with the notion of the minimal unit of exchange that users can manipulate and make reference to. If we analyze FTTs using this perspective, we realize that there is a difference between the *manipulation granularity* and the *reference granularity* of the messages. The manipulation granularity refers to the minimal unit that users can actually “manipulate” in the FTTs. Users can manipulate the messages by segmenting them into topics, and answering only parts of a message, but they are unable to create the references for these selected parts be-

cause in the current FTTs the reference granularity (the minimal reference unit) is the whole message, therefore the references are carried out only between messages and not by parts of them. Consequently, the threads in FTTs hide the true relations among the topics. We call this difference between manipulation granularity and reference granularity the *interactional incongruence*.

Interactional incongruence involves two problems for the emergence of learning conversations. Initially, the topic definition, which is not possible to define in current FTTs, is an important element for encouraging learning conversations (Bellamy and Woolsey 1998). Secondly, it has been shown that the establishment of a “common ground” encourages collaborative learning and learning conversations (Bellamy

and Woolsey 1998; McLoughlin 1996; Mäkitalo, Salo et al. 2001).

However, it has also been shown that FTTs force users to maintain a specific structure of communication that is imposed by the underlying technology, which may discourage the establishment of this common ground (McCarthy, Miles et al. 1991). In this sense, the current structure of FTTs makes it difficult for the emergence of learning conversations. A tool with a more flexible structure, where participants can define their own threads with more specific topics, could facilitate the establishment of this common ground.

5.2.2 CONVERGENT INCONGRUENCE

Collaborative learning activities include “divergent interactions” such as brainstorming, which is a highly generative and dispersed interaction that does not tend to build collective results and “convergent interactions” such as the process of synthesizing, summarizing, reaching a consensus, and connecting or integrating different ideas. Moreover, different authors have observed the lack of mechanisms for convergence of FTTs (Eastmond 1994; Rocco 1996; Hewitt 2001). These studies show that virtually all of the messages in a FTT can be characterized as add-on style responses (Hewitt 2001) without obtaining consensus. In an empirical study, Rocco (1996) finds that consensus convergence

and social enforcement were weaker in a FTT than in a face-to-face context.

The lack of convergence can be partially related to the intrinsically divergent representations used in FTTs (Hewitt 2001). The threaded structure of conversations in current FTTs makes convergence difficult. The data structure of threaded conversations is a tree structure that diverges naturally on multiple branches from the top-level message (initial message). Even if the messages convey synthesis, consensus, or other convergent interactions among different branches of a thread, these cannot be visualized on the data structure (in the current FTT, users can only reply to messages), and consequently, they are “buried” among all the messages.

In this thesis, we named as convergent incongruence the fact that users have convergent interactions (as part of their collaborative conversations), but these are not supported by the current FTTs structures.

In collaborative learning and learning conversations, convergence is a very important process. It refers to: “How can two (or more) people construct *shared* meanings through conversations, concepts, and experiences?” (Roschelle 1992). Effective convergence within a VLC is essential in bringing ideas together that intellectually lift the group (Hewitt 2001).

Moreover, convergence is an essential process for learning conversations because these conversations should lead, through interactions among participants, to shared agreements about concepts (Pask 1976).

5.2.3 TURN-TAKING INCONGRUENCE

Turn-taking refers to those alternated turns that group members take in a conversation in order to communicate with each other in an orderly way.

Making reference to what is understood by turn-taking incongruence, we refer to two related incongruencies in the management of turn-taking in FTTs. These incongruencies have serious consequences for the emergence of learning conversations. The turn-taking in spoken conversations is a process that takes place in an orderly fashion. In each turn the participant speaks and then the other responds, and so on. Therefore, conversations are oriented as a series of successive and negotiated steps or turns, thus the turn-taking becomes the basic mechanism of conversation organization (e.g., Sacks, Schegloff et al. 1974).

The turn-taking system in CMC tools is substantially different from face-to-face communication (e.g., Murray 1989; McKinlay, Procter et al. 1994; Garcia and Jacobs 1999; McElhearn 2000 or Shetzer and Warschauer 2000). The communication carried out using these tools follows a multidimensional sequential pattern (through parallel threaded conversations), rather than a linear sequential pattern, with “complex interactions that result in layered topics, multiple speech acts, and interleaved turns. The turn-taking model does not adequately account for this mode of interaction” (Murray 1989).

In FTTs the ultimate linear nature of face-to-face conversations is destroyed by the generation of multiple parallel threads, making the on-line conversation grow in a dispersed manner. This fact makes it difficult to form a mental representation of the discussion (Pincas 2001) given that users need to bind different contributions of participants together, which is not obvious when using the current FTTs.

We conjecture that the lack of linearity and the dislocation of turn-taking are related through two incongruencies. First, the sequential incongruence (see section 5.2.3.1) that corresponds to the dissociation in threaded conversations between the temporal and the thread order of messages (figure 5.2). Second, the temporal incongruence (see section 5.2.3.2) that corresponds to a dissociation between a particular work pattern (McElhearn 2000) (users do not send messages in a regular frequency, they answer generally in a buffer-like way to different threads) and its representation on FTTs. Both incongruencies will be detailed later on.

The importance of orderly turn-taking can be found in Roschelle (1992) who noticed that through iterative turn-taking structures, “students are able to build on each other’s ideas and intentions, draw new ideas into a common conceptual frame, and repair divergences” (Roschelle 1992). These iterative turn-taking structures are completely dislocated in threaded conversations in the FTTs, because of the lack of linearity (we note that there is a similar dislocation in chat conversations produced by the

disrupted turn adjacency (Herring 1999)). These situations generate deterrents having direct consequences on collaborative learning and the learning conversations on which it is based. This dislocation prevents the participants from building their own “adequate mental representation of the virtual space and time within which they interact” (Pincas 2001). Therefore, students have a weaker perception of the global discussion, since “in order to communicate and learn collaboratively in such an environment, participants need to engage in what they can perceive as a normal discussion” (Pincas 2001).

5.2.3.1 SEQUENTIAL INCONGRUENCE

In threaded conversations, several authors have observed a dissociation between two possible views in current FTTs. The temporal and the

thread order of messages (Herring 1999; Davis and Rouzie 2002). This dissociation is caused by the dislocation of the factors of space and time in most of the threaded conversations visualizations. In FTTs, users are able to look at the same conversation from two different viewpoints: messages ordered by time or by threads (figure 5.2).

This dislocation makes conversations not as seamless as they should be: sorting by threads makes the tracking of timely exchanges difficult. Along these lines, Davis and Rouzie (2002) note “as messages can be added to any node in a thread at any later date, students often failed to follow the development of a particular debate” (p. 12). But, sorting messages by time does not allow users to regard the actual placement of a message in the threads.

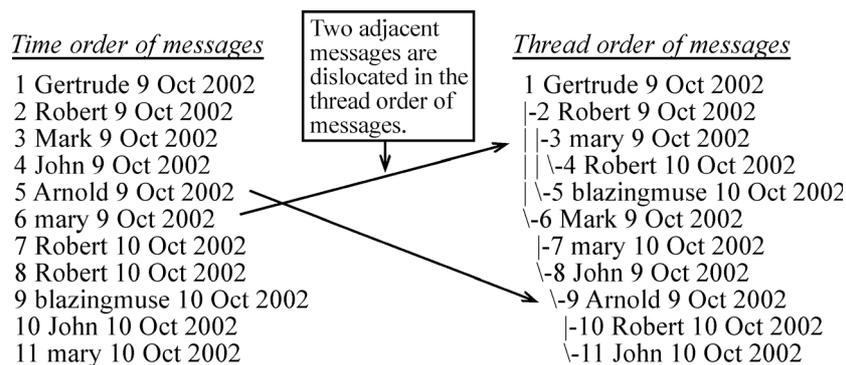


Figure 5.2. Dissociation in threaded conversations between the temporal and the thread order of messages.

5.2.3.2 TEMPORAL INCONGRUENCE

Some authors have observed that users have a particular work pattern (McElhearn 2000): users do not send messages in a regular frequency, but tend to answer in a buffer-like way. They successively concentrate their replying activity on sending several messages in a short period of time in order to bring their interventions in a conversation up to date (consecutive messages). In these responses, they sometimes answer two or more consecutive messages in different threads. In order to confirm this temporal work practice in the VLC, given such little existing evidence, we studied a collection of Usenet newsgroups. The research has shown that some newsgroups can be considered as a community (Roberts 1998).

The objective of this empirical study is to analyze participants' actions, in order to find *recurrent sequences of work practices* (work patterns) (Singer and Lethbridge 1998). The work practices analysis is the starting point for finding technical solutions that facilitate the execution of these work practices.

A quantitative approach to data collection has been pursued to identify temporal work practices. We analyze the temporal behavior of participants, particularly, their participation on threaded conversations, and how the way of participating denotes a specific time management pattern of users of FTTs.

For this quantitative study, we selected data from a collection of threaded conversations be-

longing to some open access newsgroups. The process of selection is developed in two steps. First, the detection of newsgroups with the characteristics of interactivity of a VLC. Particularly, we took into account the length of threads and the activity of groups. Next, the detection and selection of threaded conversations in these newsgroups in which there is a high level of exchanges. The newsgroups that play the role of a dynamic FAQ (a question and one or two answers) are far from the notion of learning community that we sustain, that is where there is a complex and a rich exchange of interactions in relation to the topics of interest.

We selected eight newsgroups⁸ that are particularly active and have a number of messages per thread that largely exceeds the average for newsgroups. This analysis covered roughly 50,000 messages in a 4-month time span.

Figure 5.3 shows the average volume of messages per month sent in the analyzed newsgroups. We note that the average (1628 messages) of the selected newsgroups is very high compared to the monthly average of newsgroups noted by Butler (50 messages) (Butler 1999).

In relation to the thread's length, the thread's length average in the newsgroups is 2,036 messages (Butler 1999). The selected newsgroups for this work largely exceeded this mean (13.25). Quantitatively, these newsgroups have

⁸ comp.ai.philosophy, humanities.lit.authors.shakespeare, humanities.philosophy.objectivism, sci.anthropology.paleo, soc.culture.french, talk.origins, talk.philosophy.humanism, talk.politics.guns.

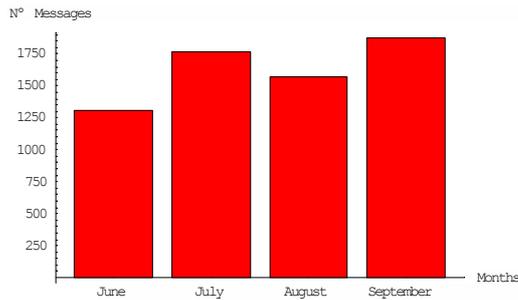


Figure 5.3. Monthly average of messages of selected newsgroups

an active and in-depth communication among their members, which indicates the level of engagement in the community.

This selection ensures our election of communities with a *very high amount of on-topic discussion*. The thread lengths reveal a more in-depth commentary related to a specific topic. Also, it is recognized as a measure of the interactivity (Rafaeli and Sudweeks 1997).

Selection of threads. The second stage of selection is related to choosing threads from a minimal threshold length in the selected newsgroups. Here, we are interested in long threads in order to look at the work patterns in those with a high complexity and interactivity. These threads are those that contain a reasonable number of messages. This quantitative study is better focused because of this selection. A discussion with only three or four messages does not enable us to discover these work patterns. Thus, we think that this process of detection and filtering does not decrease the validity of our results, but it places the research in our interest field. Our

interest is in providing new tools for a better managing of discussions that have complex interactions (highly interwoven conversations) in VLCs.

Finally, we set the minimal thread's length limit to 10 messages, so only these sorts of conversations were considered. With this criterion, we discarded only 20% of the messages (the first bar of figure 5.4) from this study. These discarded messages were of 1 or 2 thread length. We only wanted to concentrate on threads with a *very high amount of on-topic discussion*. Figure 5.4 shows the number of messages for a given thread length.

In the quantitative study, we concentrated our attention on the results related to the temporal behavior of users in delivering messages. First, we paid attention to an interesting fact, which is recurrent throughout the analyzed threads: a high percentage of participants answer messages in a buffer or digest-like way (they send several messages during a short time). The analyses show that a fraction of messages, in the selected

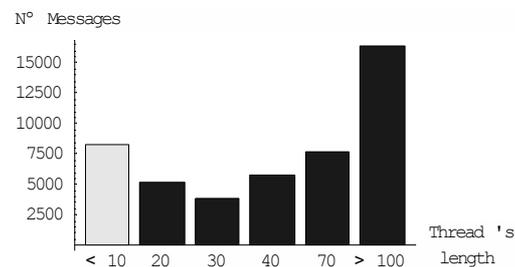


Figure 5.4. Number of messages in relation to thread's length.

newsgroup, is sent consecutively by a specific participant answering different branches on different threads. Figure 5.5 shows the proportion between the messages sent by participants in a thread and the part of these messages that have been sent by the participants consecutively in each of the eight selected newsgroups. 25 % of the sent messages in the selected newsgroups follow this work pattern.

In a deeper analysis of the consecutive messages, we found that the mean period of time was 14 minutes. This period confirms the notion that these consecutive messages are being sent in a digest-like way by the participants.

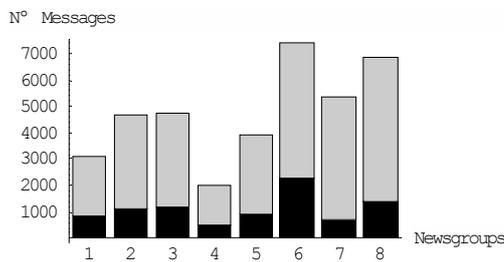


Figure 5.5. Number of messages sent by participants in each newsgroup (The black fraction of each bar represents consecutive messages)

Figure 5.6 shows the histogram of the time that passed between consecutive messages of all groups selected in the analysis. The distribution of the period between adjacent messages can be well characterized by a log-normal distribution. This quantitative study illustrated a particular work practice. Namely that users do not send all these messages in a regular frequency, but an-

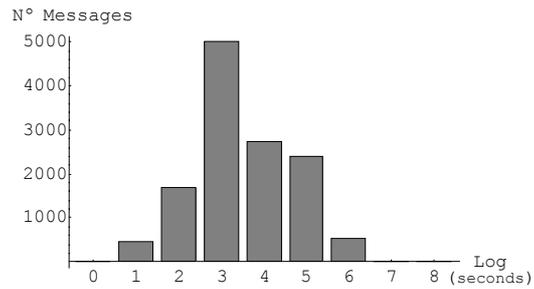


Fig. 5.6. Log-normal distribution of time passed between the adjacent messages

swer generally in a buffer-like way. They successively concentrate their activity of sending messages in a short period of time and then bring their interventions in the conversation up to date. In these actualizations, sometimes they answer two (70% of cases), three (22% of cases) or more (8% of cases) messages in different threads. This work pattern has also been identified by McElhearn (2000). Nevertheless, it is not possible to be easily aware of this work pattern in the traditional FTTs. Figure 5.7 reconsiders figure 5.2, but here we aim to focus on the consecutive messages. Therefore, this figure shows a traditional interface of newsgroups. The left side of figure 5.7 shows 8 messages in temporal order. The right side of figure 5.7 shows the same 8 messages in thread order. We realize that the two temporally consecutive messages sent by “Robert” are situated in different threads. We also note that the FTTs do not have a temporal structure that presents this temporal behavior.

In current FTTs, the temporal proximity of consecutive messages, which are placed in the thread hierarchy without considering their temporal closeness, remains implicit. Consequently, the interventions of users are dislocated and distributed. This fact increases the dislocation of threaded conversations and entails a blurred notion of traditional turn-taking rules, which is a process that takes place in an orderly fashion. That is, each turn each participant “speaks” and then the other responds and so forth. The importance of a clear structure of turn-taking in conversations has been stated in section 5.2.3.

5.2.4 GROUP PERCEPTION INCONGRUENCE

We notice that users in face-to-face interactions

are able to perceive the structural regularities such as the level of interactivity in the group (e.g., if it is talkative or not), its clusterability (whether it has different subgroups), role of participants (e.g., identification of the group leader), as well as others. Nevertheless, for those who communicate through FTTs, it is difficult to perceive these structural properties.

The lack of perception of these structural regularities can be an element that diminishes the social presence of a group. The social presence is a measure of the feeling of community that a participant experiences in a virtual environment (Tu and McIsaac 2002). Social presence corresponds to the social climate that exists within an CMC environment (Gunawardena 1995) and this corresponds to the degree of awareness of a participant in his or her interactions with others and their consequent appreciation of the interpersonal relationships that are constructed from these interactions.

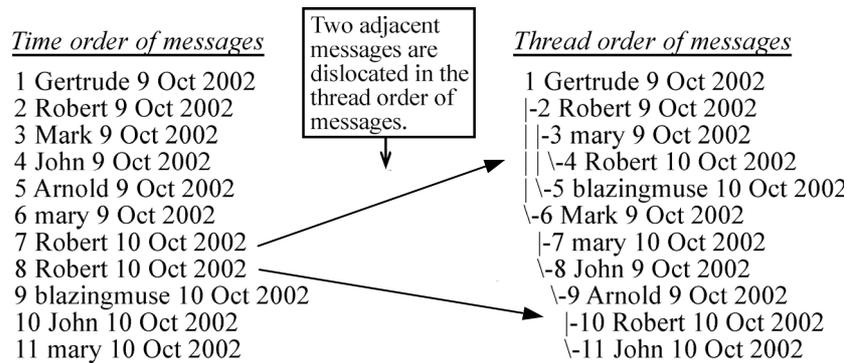


Figure 5.7. Dislocation in threaded conversations of consecutive messages.

Social presence has a great influence on the online social interaction of participants (Tu 2002). The importance of social presence within educational environments has been indicated by several authors. Garramone Harris et al. (1986) assert that the lower the level of social presence, the lower the interaction in the group. Gunawardena (1995) indicates that the social presence is

needed to improve learning. Hample and Dallinger (1995) indicate that an insufficiency of social presence could lead to high levels of frustration, and low levels of effective learning. Wegerif (1998) indicates that the formation of a community feeling is the first step needed in carrying out learning in collaboration.

6 *Supporting learning conversations: Structural awareness support*



Abstract: This chapter proposes the creation of a structural awareness support as a means of supporting learning conversations. The structural awareness perspective tries to overcome some anomalies detailed in the previous chapter from a structural and a peer-to-peer support perspective. The proposals are implemented in a FTT called Mailgroup.

6.1 *Structural awareness*

6.1.1 DEFINITION AND BASIC CONCEPTS

Here, we propose a peer-to-peer support (see section 3.1.1.4) approach called *structural awareness*. Structural awareness deals with the knowledge about structural features or activities of a group. The notion of structure corresponds to a set of relationships between participants of a group. Thus, structural awareness emphasizes the presentation of the group structure to their participants from a static and dynamic viewpoint. The objective of structural awareness is to make salient the structural properties of a group to its participants in order to promote collaborative interactions. Structural awareness is a strategy for overcoming the anomalies found in the previous chapter.

This option is mainly based on two ideas: (1) we are interested in studying and supporting the peer-to-peer learning perspective. We think that this approach of learning is also accompanied by some theories of CSCL, such as the social constructivist one which states that knowledge is socially constructed by the interactions among individuals. Moreover, we think that there is insufficient research on this peer-to-peer approach

in the domain of supporting interactions. (2) Looking at the structural perspective of interactions, we see that it is motivated by the notion of communication that considers that the semantic value of interactions is relative and multiple according to each participant (Pask 1976; Maturana 1978). Therefore, the semantic value of interactions is a distinction made by an observer that sees the conversation where these interactions take place. The semantic value for the observer is not necessarily the same as for the participants involved in the communication. Particularly, the Pask's theory of conversation (1976) indicates that: (1) meanings are not communicable, (2) we build meanings individually through a conversation. Consequently, a conversation is not fundamentally for sharing meanings but it is a process of individual negotiation (with oneself) of meanings triggered by the interactions of the rest of the participants of a conversation. This incommunicability of meanings, and its consequent variation of the semantic value of interactions for all participants involved in a conversation, lead us to take a perspective that analyzes interactions just taking into account the links between messages as means of obtaining knowledge about a group (see chapter 4). Moreover, we think that there is a lack of research on structural perspectives as they applied to the domain of supporting interactions.

6.1.2 THE STRUCTURAL AWARENESS DESIGN

Our research line, that aims to support the interactions taking place in VLCs, does not seek primarily “to describe” the structures of interactions of an external observer, but give users a support system. Hence, the structural perspective allows us not only to reveal anomalies, but also, in a context of support to VLCs, give users a structural awareness, and therefore a better understanding of their interactions from this point of view.

The foundational idea of structural awareness support is making salient to users some structural aspects, features of the group. Structural awareness is a *peer-to-peer support* element for the VLCs. We do not seek to build a system that intervenes on the actors, but a system that gives them the means for intervening by themselves.

This idea is based on the fact that a proper knowledge of the interactions structure helps users to be conscious about their activity and being conscious of their activities they will obtain benefits to the self-management of interactions. Making salient the structures of interactions helps “people make sense of the activities around them, and so help them to coordinate their work with others” (Fisher and Dourish 2004).

The use of structural awareness is close to the homograph concept of Gutwin, Greenberg et al. (1996). According to these authors structural

awareness is “knowledge about such things as people’s roles and responsibilities, their positions on an issue, their status, and the state of various group processes”.

Nevertheless, this homograph concept conveys different objectives than ours. Our concept of structural awareness aims at users being aware of their activity THROUGH their structure, and not as in Gutwin’s concept, where users are aware OF their structure.

Moreover, Gutwin’s concept is focused principally on a layer of analysis of social interactions, where the focus is on revealing the participant’s attributes with respect to the group and their relationships according to the processes they achieve. Similarly, we found the work of Erickson Halverson et al. (2002) which proposes the “social proxy” notion, which is a minimalist visualization of people and their activities. Other strategies of awareness can be found in Prasolova-Førland (2002). We propose here, to focus on a multilayer analysis of the structure of social interactions. That is, to study structural interactions at different levels of granularity. In the first level of analysis, we analyze the interactions structure that belongs to the collective attributes as a whole. In other words, we study a layer of structural properties of a group. In an intermediate level, we agree with the analyses carried out by Gutwin, analyzing the structural attributes of participants with respect to their group. These structural attributes of participants form the second layer. The last layer is situated at the level where users

interact directly with their structures of interactions. Through a multilayered system, as the one proposed here, we obtain more legible virtual environments (Boyd, Lee et al. 2002).

In our thesis, we call the first two layers “observation levels”, given that we propose, with the implementation of these two layers, the creation of a mechanism for observing: (1) the structural properties of a group, and (2) the individual attributes. We call the last level the “interactional level”, given that we propose functionalities that allow users to interact with the structure of exchanges that the group generates. Consequently, we propose an integrated approach that aims to support learning conversations at these different layers. This support will be implemented in an experimental FTT tool we call Mailgroup.

6.1.3 CONCEPTUAL BASIS OF STRUCTURAL AWARENESS

The structural awareness approach is well grounded on the *micro-macro link* notion. The micro-macro link is a sociological concept that establishes the theoretical foundations for the relationship between the interactions structure of a community (macro level) and the local interactions among the participants (micro level). We found an example of this type of influence in the works of Pierre Bourdieu (1988), which explains the effect of societal structures on the be-

havior of individuals and vice versa. This influence is well established in social sciences: “The individuals initiate, construct, maintain and finish relations that determine the global structure of a network, and the structure of social networks provides and limits opportunities of individual choices” (Stokman 2001).

The concept of the micro-macro link allows us to focus on the interdependency between the structural regularities of the group and the activities of the participants. Indeed, several learning theories emphasize the influence of social interactions on individual learning. From the perspective of communities of practice, for example, it has been stated that sharing and interacting are the foundations of learning in these communities (Lave and Wenger 1991). Learning should change “(...) from the individual as learner to learning as participation in the social world” (Lave and Wenger 1991). Consequently, we intend to establish the link between the macro and micro levels of the VLCs through structural awareness support.

Structural awareness is connected to Dourish awareness notion (Dourish and Bellotti 1992), which states that awareness is essential in collaborative activities because it gives users an indication of how to correlate and coordinate their activities with others (Dourish and Bellotti 1992) and aids in the process of creating a community conscience. This fact has been indicated as an important element in group learning. For example, in Freire’s theory of Conscientization, promoting the development of a student’s

social conscience through structural awareness can stimulate learning (Stage 1999).

6.2 *The proposed structural awareness support*

6.2.1 PRINCIPLES

Structural awareness encompasses different strategies which aim to make more congruent the VLC users' actions and perceptions of these actions that take place in FTTs, thus overcoming the identified incongruencies (see chapter 5).

These strategies try to facilitate the emergence of learning conversations. In particular, the structural awareness will be reified through (a) different strategies that enable the participants to perceive their interactions in a more congruent and concise way than current FTT structure, by being able to see the *structure of their exchanges* visually ordered. We conjecture that using the proposed structure of exchanges users may be able to overcome the interactional, convergence, and turn-taking incongruencies stated. Thus, we show the structure of exchanges of a group, enabling the participants to perceive all their interactions through a graph-like visualization. This visualization provides particular mechanisms for maintaining a higher coherence

between these interactions and their visualization. (b) A set of indicators about certain characteristics of a group, which allows users to get information highlights, which is not salient in VLCs, related to some group structural properties and individuals structural attributes. We have implemented an observation level of the communicational activity based on quantitative indicators (the complexity and cohesion of group and individual status indicators).

All of these strategies aim, according to our structural perspective, to show different aspects at different layers of the group structure of interactions, in order to help users to perceive their interactions from this perspective. We conjecture that this perspective can give users new elements for their peer-to-peer support of learning conversations that take place in VLCs.

6.2.2 PROPOSED STRATEGIES

We propose several strategies that makeup the structural awareness support. Each of these strategies, which are implemented on the Mail-group FTT, aims to overcome an identified anomaly.

Regarding interactional incongruence, we propose changing the current minimal unit of exchange (the message) for a new minimal unit, the topic. The topic is a subset of a message, generally a smaller portion of it, which has been selected by a user. This change will allow us to

make reference to any segment of the message and thus easily track every participant's intervention throughout his interactions. The localization is carried out through the *What You Answer is What You Link* (WYAIWYL) principle. Therefore, the participants, in order to respond to a specific topic, must explicitly select it. We note that the topic is not an "object" previously defined (a topic is only a part of a message), but becomes a visible object once it is selected through the WYAIWYL principle.

We propose a tool that allows users to create a link between the selected topic and the answer. Therefore, threaded conversations can be defined by the users from the selected topics. It is important to note that we do not use any semantic text analysis method for locating the topics: They are defined by the participants. Thus, the WYAIWYL principle (Reyes and Tchounikine 2003) allows users to define their threads freely, thereby overcoming the interactional incongruence.

Regarding turn-taking incongruence, we propose a visualization of threads that aims to overcome the sequential incongruence, so one can quickly and graphically visualize the flow and patterns of online discourses at the same time. We will merge both types of existing views (the time order and the thread order of messages) in a single view that graphically depicts both concepts, as presented in the next section. Moreover, we propose the creation of a structure called *session* that aims to overcome temporal incongruence. This structure intends to model the

turn-taking behavior and make the particular rhythm of answers visible. A session is "a period of time (...) for carrying out a particular activity" (Cambridge Dictionary 2004). In our context, a session corresponds to a group of messages sent by the same participant consecutively in a short period of time. In other words, it is a new structure that holds together the messages sent almost at the same time.

We propose a tool that integrates this structure. This structure corresponds to columns (Figure 6.1) that package the messages in a parallel and linear way. These arrangements seek to reduce the dispersion and the dislocation of threaded conversations, by augmenting the linearity of conversations and allowing one to start or to maintain parallel discussions in a unified visualization.

The introduction of the session construct in FTT changes the concept of turn-taking in threaded conversations given that now it is possible to visualize the communication turns from sessions (packaged messages) and not from the individual messages. These two strategies (merging time order with the thread order of messages, and the integration of session construct on a FTT) seek to reduce the dispersion and dislocation of threaded conversations, by augmenting their linearity and making it possible to start or maintain parallel discussions in a unified visualization.

Regarding convergence incongruence, we propose a new functionality that allows multiple threads to merge into a single one. The result of

this operation is properly visualized through the visual space in the proposed tool. Consequently, all users will be aware of the existence of convergent interactions and also they can inspect the convergent interactions and react to them.

Regarding the group perception incongruence, we propose the creation of an observation level which allows users to get summarized information related to some structural properties that are not salient in VLCs. Here, we have implemented an observation level of the communicational activity based on quantitative indicators (complexity, cohesion, and status indicators). This level offers some synthesized group behavior information about users, which is neither easy nor transparent to obtain from the level where the message interactions actually take place in an asynchronous and text based communication. The purpose of these indicators is to give some specific profiles of the participant's collaboration and social structure, which participants can use as structural awareness elements.

In summary, in contrast to a common threaded conversation tool (like current FTTs or newsgroups), the proposed tool increases the interactional coherence by facilitating the topic location in the conversation through the WYAIWYL principle. It increases the turn-taking coherence, by allowing (a) the connection of message precedence (time adjacency) with patterns of threads (turn-taking adjacency) within the same visualization; (b) to start and maintain parallel discussions in a unified visualization. It also increases the convergent coher-

ence by connecting different threads and visualizing these convergent interactions; (c) to increase the perception of the structural group activity with the visualization of indicators.

6.3 *Prototype Implementation*

In this section, we illustrate and explain the actual implementation of Mailgroup, a system that reifies the proposed strategies that aim at facilitating the emergence and development of learning conversations. Mailgroup is a FTT that can be seen as an e-mail tool specially designed for forum-based interactions. Mailgroup allows the establishment of communication for an electronic learning community. Mailgroup is standalone software (such as an emailing client application), which needs to be installed on the personal computers of participants. It connects to a list server, which through a mail-list, distributes messages to all participants. Mailgroup is compatible with actual list-servers. That is, it is a client application that adds all functionalities detailed in this thesis without modifying the characteristics of a list server.

When loading Mailgroup, users get an interface that allows them to browse, read, reply, and create messages via its graphical user interface. With graphical visualization of Mailgroup, users

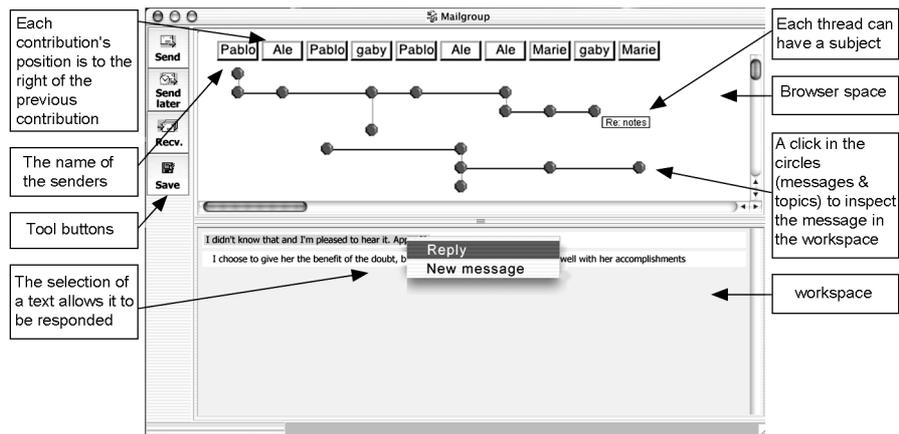


Figure 6.1. Mailgroup interface.

can visualize and interact with their threaded conversations in a graph-based view. The intention of Mailgroup is not to change the temporary organization of threaded conversations, but to make salient this organization that remains implicit in other FTTs. However, it is known that in systems new use practices emerge. That is called the process of *instrumentalization* (Rabardel 1995).

6.3.1 PROTOTYPE INTERFACE

Figure 6.1 illustrates the current prototype interface, which is composed of the following two parts: The top of the window displays the *browserspace*, where learners browse the messages that will be shown in the *workspace* (the

window at the bottom). In the workspace, learners inspect, reply, and create messages.

The system generates the graphical visualization of the new topics and answers created by users.

The browserspace shows the whole discussion, represented by a graph. Vertices (the circles in figure 6.1) represent the topics of a conversation, and the edges represent the links between these topics. The lines placed between the vertices of different columns represent the links explicitly created by users between two topics. The tree structures of the browserspace are interactive, since users can click on the vertices and look at the topic contents in the workspace.

6.3.2 THE CONSTRUCTION OF A THREADED CONVERSATION

The construction of a threaded conversation is based on the participants' reactions to messages. Here, users have the possibility: (1) to create new messages; (2) to reply to messages; (3) to answer a part of a message by segmenting them as they please, and then choosing the topics

situation when a user (participant "B") answers part of a message (a specific topic) from participant A. Figure 6.2.(1) shows participant A's message contents in the way that user B sees it in the workspace. The message is displayed in the browserspace as a vertex placed right at the bottom of the sender's name, where the column corresponds to the *session* construct. Figure 6.2.(2) illustrates: first, an action of participant B who reacts to one part of participant A's mes-

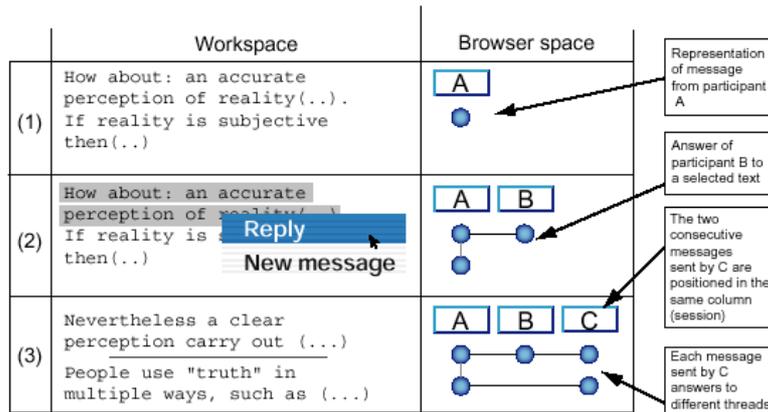


Figure 6.2. Dynamics of construction of threaded conversations.

which they want to react to, with the desired granularity through the WYAIWYL principle. The proposed visualization and the implementation of the session construct ensure the linearity of the threads development.

Figure 6.2 illustrates the relationship between the action of participants carried out in the workspace and its representation in the browserspace. In particular, this diagram represents a

sage by selecting it and answering through a contextual menu (answering and linking the parts of a message by selecting them is a function implemented in Mailgroup, which reifies the WYAIWYL principle); second, in the browserspace one can see the effect of this action. As a result, a new column is added to the right-hand side. Now, the original message shows two vertices connected by a vertical line:

(a) one corresponding to a selected part of a message and, consequently, related to the answer of participant “B”; (b) the other vertex, which corresponds to the rest of participant A’s message (i.e. the part that has not been answered by anybody). The presence of this vertex would seem to be disconcerting, since it does not really represent a topic (since it has received no response), but its presence contributes to making visible the texts in messages that have not been selected. In spite of the division of a topic into two sub topics (one answered and the other without any answer), it is always possible to respond or to make different subdivisions in the original message. Thus, users can get the original message (without divisions) by clicking on the head of each column (where the names of senders appear).

Figure 6.2.(3) shows a new session created by participant C who has written two messages (an-

swers, in this case) in his session. We observe that each answer from participant C responds to different threads, but the answers maintain a temporal coherence (they are in the same column) and threads can grow in a parallel and linear way. Therefore, the session construct “packages” the messages in columns. The workspace of 6.2.(3) shows both answers from participant C. As we see, for users the construction of a session is a very simple and transparent process. They only have to write their new messages or answers to other messages, and then to send them all clicking on the button “send”. The messages sent in this way are displayed only in one column, see figure 6.3.

Therefore, in threaded conversations, we preserve the “linearity” of face-to-face conversations by the visual awareness of the session construct and the topic concept integration so that users can be more aware of the interventions oc-

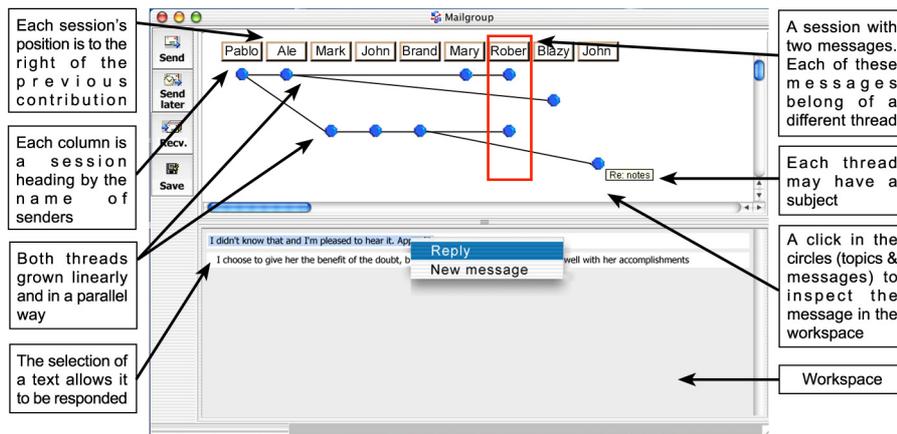


Figure 6.3. The session construct in the Interface of “Mailgroup”.

curing in the group.

Figure 6.4 shows the same structure of messages on a traditional FTT and Mailgroup. In the graph visualization of Mailgroup, users can observe the “growing linear development” of threads. Moreover, if there are two or more threads, they can visualize them in a parallel way thanks to the implementation of the session construct. If a user contributes with more than one message to a session, their messages are placed in the same column. Thus, users can perceive time order and thread order of messages in a single visualization. Moreover, with the WYAIWYL principle the threads become threads of topics and no longer chains of mes-

sages with unknown meaning. With this visualization, users can be more aware of the structure of the interactions of their community.

6.3.3 THE DYNAMICS OF THE CONSTRUCTION OF CONVERGENT INTERACTIONS

Users have the ability to build convergent interactions (merge different threads) by sequentially choosing the topics that they want to connect (through the “add to consensus” menu item). Then, they can build the consensus with the

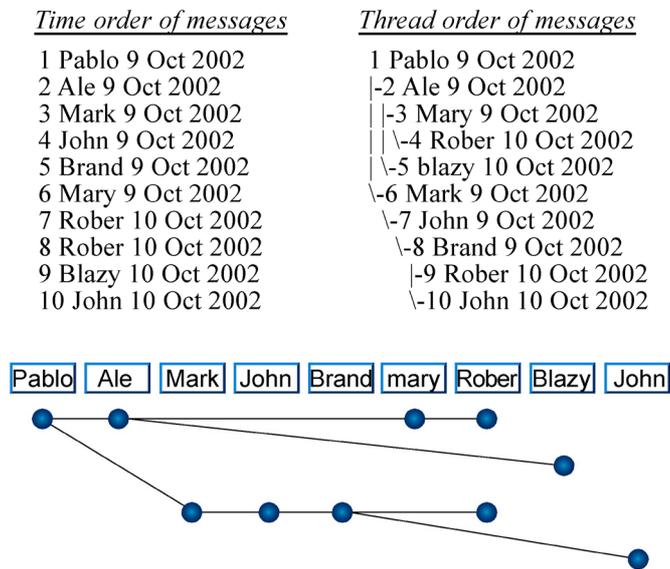


Figure 6.4. The same structure of messages on the current FTT and Mailgroup.

“create consensus” menu item. That is, building a convergent interaction is a two-step process. First, the user adds the topics or messages that she wants to link, through the “add to consensus” menu item, as many times as she wishes. Therefore, it is possible to create consensus among many messages or topics. Second, through the “create consensus” menu item, the consensus is effectively created and visualized by the users.

tent of a message from participant B, which is added by participant D to a convergence accessing the contextual menu over this message (first step for building a consensus). This action does not change the visualization of the browserspace because the system expects the creation of a convergence.

Figure 6.5.(2) illustrates the content of a message from participant C, which is added by participant D to a convergence by accessing the

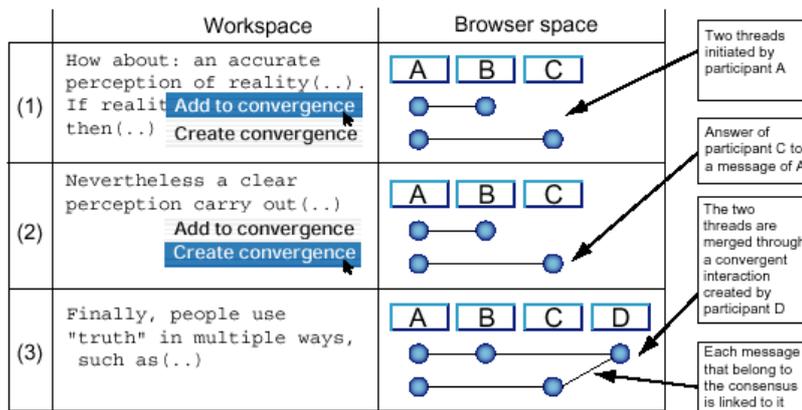


Figure 6.5. Dynamics to create a consensus.

Figure 6.5 illustrates the dynamics of building a convergent interaction. This diagram in particular represents a situation where a user (participant D) built a convergent interaction from a message of participant C and B, each corresponding to different threads.

Figure 6.5.(1) shows two very simple threads initiated by participant A with one reply in each thread (the message from participant B and C). The workspace of figure 6.5.(1) shows the con-

item “create convergence” in the contextual menu over this message. The menu item “create consensus” has two functions: (1) it adds the selected message to a consensus, and then (2) it creates the consensus in the browserspace (the second step for building a consensus). As a result, a new column is added to the right-hand side with the links that represent the convergent interaction.

Figure 6.5.(3) illustrates in the workspace the message from participant C. This message can be seen in the browserspace as a convergent interaction, since several links of different threads end in this message

We observe that convergent interactions are not limited to two messages. Users can access the menu item “add convergence” as many times as they want. In addition, users can add to a consensus not only messages, but also parts of them. In order to do this, users must simply select the text, and then select the “add convergence” item.

6.3.4 STRUCTURAL INDICATORS

Regarding group perception incongruence, we aim to create a structural awareness by creating an observation level that tries to rescue the indicators of the macro level group structure by quantitative indicators.

Quantitative indicators are based on social network models (SNA), which use sociograms and sociomatrices as data. In forum-type tools a sociogram consists in a graph like representation, where actors are viewed as vertices, and the interactions between the messages are the links. A sociomatrix is a matrix representation of sociograms (for the construction of sociograms and sociomatrices see (Wasserman and Faust 1997)). Thus, a sociomatrix M of rank n is constructed from the interactions of a group,

where n is equal to the number of participants. Each cell (M_{ij}) indicates the strength of the relationship between participant i and j . The matrices of interactions used in our analyses are asymmetric ($M_{ij} \neq M_{ji}$) in regard to the directionality of the references between the messages. So that, there is a clear differentiation between sender and receiver.

Traditionally, in SNA analysis, participant relationships are the references between the messages. Nevertheless, in this thesis, we take another approach, taking advantage of a WYAIWYL principle. Our SNA models make use of the notion of interaction as the links between the topics of messages and not only as links between these messages. We consider that this fact provides a more reliable analysis.

We note that indicators, which represent the state of a variable, have a symbolic existence in the situation that indicators try to measure. That is, a variable obliges us to look at a process from a particular point of view, which must be useful for us. But the existence of this variable does not imply that the process contains this variable.

We introduce the concept of epistemological space of indicators in order to state, at least in a theoretical way, the limits of indicator interpretation: From an unspecified environment we can obtain an infinite number of indicators or parameters; i.e., we can measure this environment from various points of view. This fact is the result of the continuity of the environment, and the indicators correspond to the discreteness of a particular environment. Each indicator will give

us information about a variable (or a set of variables) within an infinite of possible variables, and each indicator has a space of interpretation of its value; for example, from the value of a car's temperature, we cannot deduce its level of gasoline, but, we can suppose that it could be a lack of oil; that is, there is a space of interpretation of each limited indicator. This space of interpretation will be called epistemological space, since it is the space of knowledge which can be drawn from an indicator. A consequence of our approach (the comprehension of a phenomenon by means of parameters or indicators) is of an ontological nature. That is, we could only completely comprehend the phenomenon by taking into account all these infinite variables from the environment. This task would bring us back to the cartography paradox of Borges (in the "Rigor de la Ciencia" of J.L. Borges (1999) he tells the task to make a plan of a city so precisely that its construction took the actual size of the city). Thus, this system based on parameters is essentially incomplete. However, even if a system built from parameters has an ontological limitation regarding the phenomenon which we would like to study, it is possible to compensate this lack by identifying the pertinence of parameters in their context of use. Thus, taking again the example of the temperature of a car, this indicator represents a small part of parameters that can be revealed. However, to users, this indicator makes sense and is useful in knowing the state of the car. Consequently, we are engaged in a process of constructing indicators

through a dialectical method between the pertinence of indicators in its context of use, and its epistemological space.

We have identified in this work three indicators that reveal some parts of the social structure inherent to a community: *complexity*, *cohesion* and *status*. The first two are the group level indicators, whereas the last one is a participant level indicator. These indicators illustrate some group social structure characteristics. In particular, from these indicators, users can obtain information about: (1) the degree of complexity of interactions makes explicit the level of difficulty in following all conversations of a specific VLC based on their level of interwoven interactions. (2) The degree of cohesion of a group makes salient how strong the social relations in a group are. And (3) users can obtain information about the position of participants according to their interactions (status).

All this information is obtained from a relational analysis of a web of interactions, and does not refer to the semantic difficulty of messages. The information presented to the community through these indicators concord with our theoretical notions of *peer-to-peer* support: the indicators are shown to users all the time. These indicators do not imply any tutor-like notions such as a model of "correct" behavior, or an evaluation between this model and the community behavior. Here, users can use the information as they wish, principally because information has an amount of *interpretative flexibility*. In other words, it can mean different things to different

individuals or different communities, and its use continues to be interpreted and reinterpreted by overtime.

6.3.4.1 COMPLEXITY

In many domains complexity is a notion used to describe the object or process properties. This notion comes from the Latin *complexus*, which means “interwoven”. Basically, complexity is the degree of difficulty of a system or a system component, determined by factors such as the number and intricacy of interfaces, the number and intricacy of conditional branches, the degree of nesting, and the types of data structures (Evans and Marciniak 1987). In the same vein, complexity can be understood as the degree of difficulty to “understand” a system (IEEE 1990).

We understand complexity as the degree of interweaving of a system. The way we applied this concept in the field of study (VLCs in FTTs) was by obtaining the complexity of graphs generated from the exchanges of participants of a group. Particularly, the complexity indicator is linked to the cardinality of the interaction structures or the richness of group interactions.

The complexity indicator intends to make explicit the level of difficulty associated with following the conversations of a specific VLC by analyzing the level of interwoven interactions. This “level of difficulty” is obtained from a relational analysis of a web of interactions, and

does not make reference to the semantic complexity of messages. Therefore, this indicator returns to the participants a value of “the number of structures of interactions that can be found in a VLCs”. A group with a low value of complexity can be interpreted as one with a fixed hierarchy of message exchanges or a very simple conversation with a limited number of question-answer exchanges (i.e., a poor interaction among the participants). In contrast, a high value of complexity represents a conversation highly overlapping that can be a disturbing element or even inhibits the development of conversations because of the difficulty in managing of the threaded conversations. Also a high value of complexity would indicate the presence of many parallel and deep threaded conversations at the same time. This indicator is related to the communication load of threaded conversations (Jones, Ravid et al. 2001). The communication load is the processing effort to deal with a set of communications (Jones, Ravid et al. 2001). Consequently, users should be reorganizing their future interactions in a simpler structure.

There are several measures of complexity (e.g., (Everett 1985), (Butts 2000)), such as the Lempel-ziv complexity or the *orbit information* complexity. In this thesis we propose the complexity of induced subgraphs as the measure to obtain the complexity of a group. This measure accurately catches the feature that we want to emphasize with the complexity notion: The number of different existing interaction structures in a VLC. Its value corresponds to the car-

dinality of the set of all the induced non-isomorphic subgraphs of a graph, (S_G). An induced subgraph is a subset of vertices of a graph G . That is, it is the graph that remains after eliminating a set of its vertices. Therefore, the complexity of a VLC will be given by the equation (6.1).

$$C_{vlc} = |S_G| \quad (6.1)$$

In order to compare the complexity value among groups with different structures and sizes, we must normalize its value. Therefore, we divide the equation (6.1) by the number of all induced subgraphs existing in a graph G . So that, the normalized complexity will be given by the equation (6.2).

$$\bar{C}_{vlc} = \frac{|S_G|}{|I_G|} \quad (6.2)$$

6.3.4.2 COHESION

Cohesion is a concept related to the diffusion of information in a group (Wasserman and Faust 1997). In a cohesive group the information is extremely likely to be distributed for the entire group. This fact improves the communication, the coordination and the influence within the group. This indicator is also associated with the concept of solidarity in a group. Analytically

speaking, solidarity includes two components (Moody and White 2000): an ideational component which is related to the psychological identification of the community members, and a relational component concerning the connections between the community members. Cohesion corresponds to the relational dimension of solidarity. This indicator gives a measure of how strong the social relationships are in order to keep the group together.

From this indicator, users can perceive the group solidarity level, manifested by the ability of the group to hold their members. A group with a high value of cohesion is a group that holds social relationships among almost all participants. Consequently, the group could face the departure of some of its participants without destroying it.

There are several models for obtaining the degree of cohesion of a group (Wasserman and Faust 1997). Bock and Husain propose to iteratively build sub-groups so that the proportion between the number of links in the sub-group and links between the sub-groups does not decrease with the addition of new members. This model is composed of two components (Wasserman and Faust 1997): the measurement of the group cohesion (centripetal property), and the measurement of the link dispersion towards the participants outside the sub-group (centrifugal property). Reffay and Chanier (2002) obtain the group cohesion by measuring the degree of reciprocal relationships that take place in a forum among participants.

Moody and White (2000) introduce another concept of cohesion, which is defined as the minimal number of participants who, if removed from the group, would disconnect it. This approach led to obtain hierarchically nested groups, where highly cohesive groups are built over less cohesive ones. We seek to make salient this notion, which corresponds to the definition of k -connectivity (a graph is k -connected if there are at least k independent paths connecting every pair of participants in the graph) in graph theory. This indicator expresses the property of

We consider that a cohesion model must take into account the group structure as a whole. Thus, we modify the original cohesion model (the minimal number of participants who, when removed from the group, disconnect it) in favor of a concept of cohesion as the minimal number of participants who, when removed from the group, disconnect it completely. This model provides a more robust measure of cohesion, even for groups with weakly connected participants.

To calculate cohesion, we apply the original

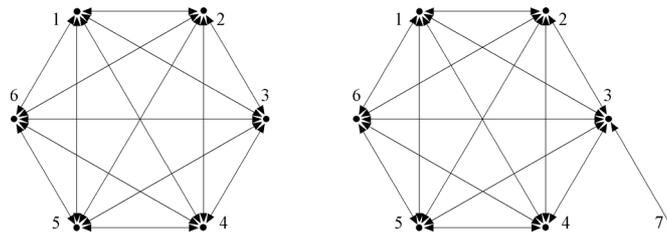


Figure 6.6. Issues with slightly connected participants on the cohesion value

certain groups to hold their members. Nevertheless, this model of cohesion is very sensitive to participants slightly connected in the group. For example, a group with a complete network configuration (see figure 6.6) with 6 participants has a k -connectivity value equal to 5. Now then, if we add another participant to this group (participant n° 7 in figure 6.6) with only one link, the k -connectivity value decrease to 1, i.e., a very low cohesion degree for a highly connected group. Therefore, the real group cohesion is hidden.

algorithm in an iterative way to the groups that remain connected. The sum of the values of the k -connectivity of each iteration will give the final measurement of cohesion. In order to compare the cohesion values for groups of different sizes and structures of participants, these values are normalized. Two normalization methods are necessary. The first one is related to the number of iterations executed in the algorithm (i.e., the number of iterations to obtain a group completely disconnected), and the second to the number of participants. The maximum value for

the cohesion is produced by the complete graph. Thus, for a complete graph composed by n participants (K_n) the cohesion of a group ($C(K_n)$) is $n-1$ and we obtain a graph completely disconnected after j iterations. We will assign to this graph structure a value of cohesion equal to 1. Then, we divide the cohesion by the maximum value for the cohesion and the number of iterations. Equation (6.3) shows the normalized cohesion value:

$$\bar{C}(G_n) = \frac{C(G_n)}{(n-1)^*j} \quad (6.3)$$

6.3.4.3 STATUS

In a community, the concept of status represents the “prestige” of a specific participant. The status of a participant is related to his participation in a community as well as the status of the participants with whom he/she communicates (Wasserman and Faust 1997). This concept is not a simple account of the number of user interventions, because it also considers the prestige of his entire neighborhood.

Starting from the participant’s status we can find each participant’s position in relation to the whole community, and the social structure of this community. Moreover, this indicator is related to a concept of learning in communities of practice (Lave and Wenger 1991), where learn-

ing is conceived of in terms of participation. In the context of the communities of practice, learning can be interpreted as an evolution of the status of a participant from a peripheral participation (low status) towards a central participation (high status) within his/her community. Through the status indicator, we can measure these evolutions. This model gives participants and tutors an element for comparison between their position in the group and a quantitative measure of their evolution.

There are several models for obtaining the status of participants in a group, each of them is based on a different notion of status. The *Betweenness-centrality* model takes into account the degree of dependence of a given vertex and the other vertices, quantifying how much a vertex acts like a “bridge” for subgroups of vertices (Wasserman and Faust 1997). Here, the important idea is that a participant is central (high status) if it is *between* many participants.

The *Closeness-centrality* model, is based on the vertex distance and focuses on how near a participant is to the others. Here, a participant is central if he/she can quickly interact with the rest of the group (Wasserman and Faust 1997).

The *Degree-centrality* model takes into account the direct relationships between two participants. In this type of measure, a participant is central if he/she has many links with the remaining participants (Wasserman and Faust 1997).

The *Eigenvector-centrality* model is more refined than the others, and considers not only the

associations with the adjacent vertices, but also the status of these vertices. Consequently, “an actor’s status is increased more by nominations from those who themselves have received many nominations” (Bonacich and Lloyd 2001). From its structural nature, one says that the eigenvector-centrality measures the “prestige” of participants.

Here, we will concentrate on the *Eigenvector-centrality* model because it is the only status model that establishes the value of a participant prestige taking into account the other participant’s status. In addition, this model can take advantage of many numerical methods existing to obtain the eigenvectors from a matrix.

For a sociomatrix A of size n (n participants) that represents the interactions among the participants of a specific group, A^t is the transposed matrix of A , and λ are the eigenvalues of A . In the equation (6.4) the vector c corresponds to an eigenvector of the sociomatrix A . Each component of this eigenvector c corresponds to the prestige of each participant. That is, if $c = (c(v_1), c(v_2), \dots, c(v_n))$, the status of participant i is $c(v_i)$.

$$A^T c = \lambda c \quad (6.4)$$

In spite of the precision of this method to obtain the status values of participants in a group, it makes sense only for the symmetrical sociomatrices ($A \rightarrow B \equiv B \rightarrow A$, for example, somebody’s brother is a symmetrical relation). In our case, the matrices of interactions in the

FTT are asymmetrical ($A \rightarrow B \neq B \rightarrow A$, answering a message is an asymmetric relation). The alpha-centrality model introduced by Bonacich and Lloyd (2001) presents a generalization of the eigenvectors’ model for asymmetrical matrices. Bonacich makes the assumption that the status of a participant depends on two parameters: the external initial status of a participant and the status that is formed starting from the interactions among the participants. By adding the external idea of status to the traditional concept of eigenvectors (based on equation (6.4)), we obtain equation (6.5). The complete description of this method is found in Bonacich and Lloyd (2001).

$$c = \alpha A^T c + e \quad (6.5)$$

In this equation, A is a sociomatrix. c is a vector of participant’s status, and α is a parameter which reflects the relative importance of the external status versus the internal status to determine the final status. We can also interpret α as the status degree of transference from one person to another. The solution of the equation (6.5) for c gives us the vector c , which indicates each participant’s status for the asymmetrical relations.

Among the outstanding characteristics of this indicator we emphasize the following: first, the status is not related to participation (e.g., in the star graph (figure 6.7), the most central participant has the greatest value of status and he/she has never participated), but is associated with

the impact of the interventions of a specific participant on the activity of the group (participant's visibility); second, this index can be dichotomized as follows: "one part due to the status that an actor gets from another actor, and one due to the status that comes back to the original actor after being initially sent to the other actor" (Wasserman and Faust 1997).

6.3.4.4 HYPOTHETICAL SOCIAL NETWORKS

Figure 6.7 and 6.8 illustrate six hypothetical social networks with six participants each, and the associated status values for each participant ($c = \{c(v_a), c(v_b), c(v_c), \dots, c(v_f)\}$), where $c(v_i)$ is the status of participant i . For simplicity, par-

ticipants in all these social networks have the same initial status, that is, e is a vector of ones.

In the star network we can observe the central position of participant "6" in it. This fact is reflected by his/her high status value. The same result is obtained in the hierarchical network. Nevertheless, the low value of cohesion of the star graph structure allows us to suppose that it is fragile, given that all interactions pass through participant "6". Also, this configuration has a very low value of complexity that denotes the simple structure of the group and the easiness to follow a conversation with this network structure. In the circular network, all participants have the same status values because each of them has the same link number and structure.

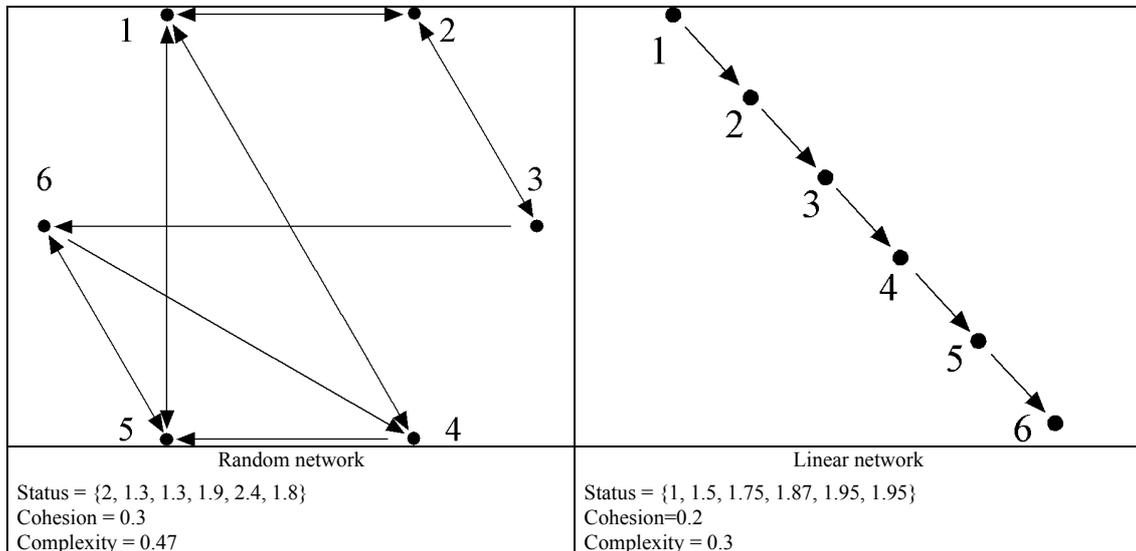


Figure 6.7. Hypothetical networks

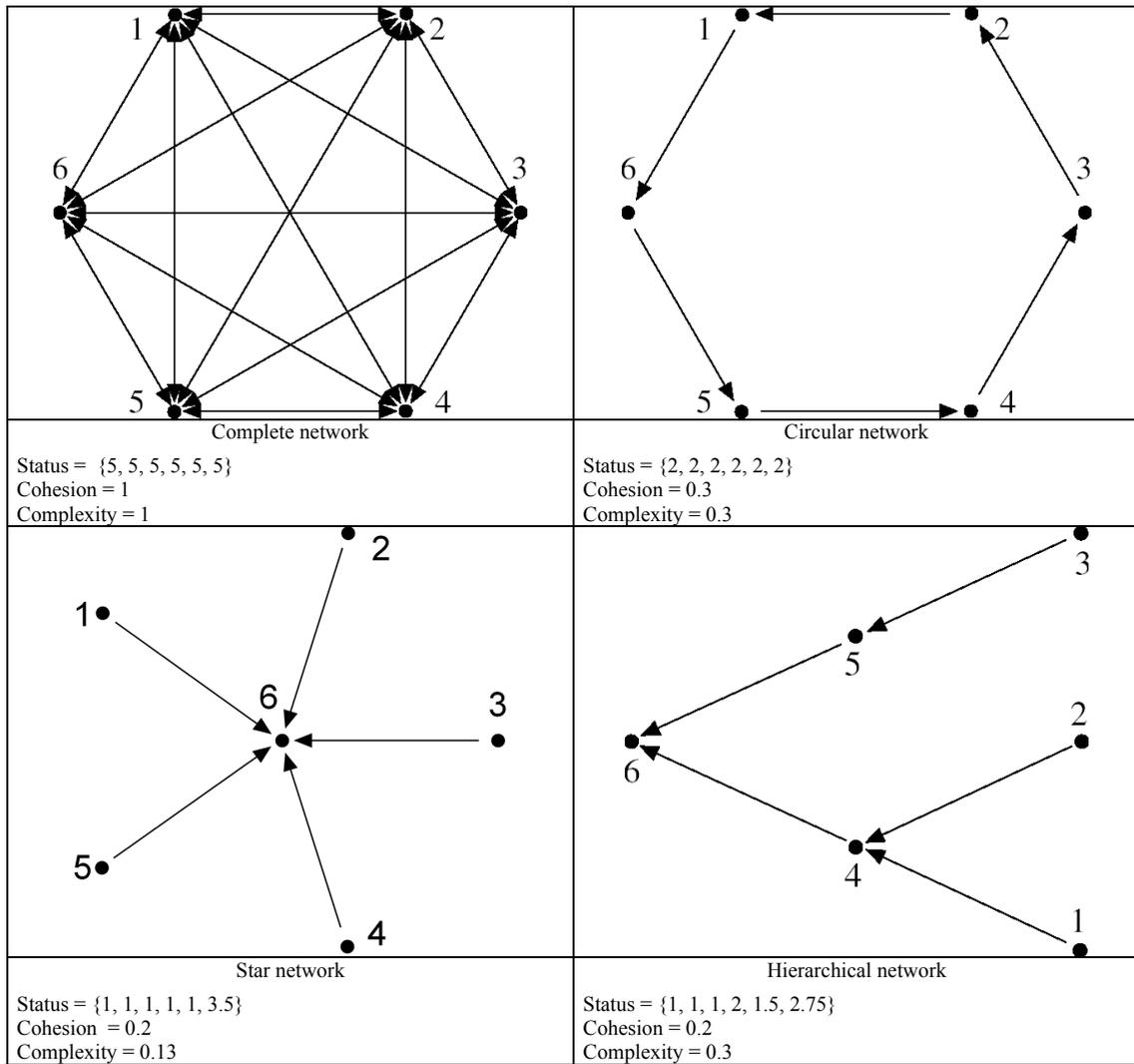


Figure 6.8. More hypothetical networks

The highest cohesion value is obtained for a complete graph. This fact represents a group highly robust with multiple channels of communication among participants. For the complete

graph, we also obtain the highest value of complexity, which indicates the intertwined conversations that take place in this network structure.

6.3.4.5 INDICATORS IN MAILGROUP

The results of the proposed structural models are integrated in the “Mailgroup” forum tool.

Participants are able to access at any time, through a menu item, the values of status, cohesion, and complexity. Values are shown as bar graphs. Mailgroup shows a single bar repre-

senting the group cohesion (group-level indicator), and individual bars representing the each participant status value (participant-level indicator).

Indicators show values between 0-100 indicating in this way a low or a high degree of a specific attribute (cohesion and complexity). Users visualize these indicators through a bar graph as shown in figure 6.9.

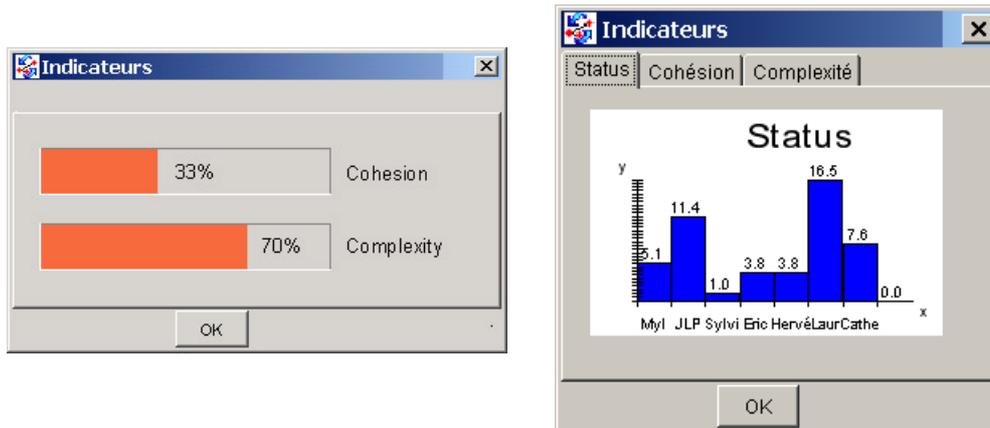


Figure 6.9. Indicators in Mailgroup.

III

IMPLEMENTATION AND TESTS

7 Mailgroup Environment



Abstract: This chapter details technical aspects of the Mailgroup FTT prototype, including its programming, as well as how users can use it to communicate.

7.1 Mailgroup overview

In this chapter, we illustrate and explain the implementation of Mailgroup, an implemented system that reifies the proposed strategies (previous chapter), which aim at facilitating the emergence and development of learning conversations. Mailgroup is a FTT that can be seen as a Mail tool specialized in forum-based interactions. Therefore, Mailgroup allows an electronic learning community to communicate. Mailgroup is a standalone software (such as an emailing client application), which must be installed on each participant's personal computer. Mailgroup

allows participants to be connected to a mail server, which through a mailing list distributes the messages to all participants.

When loading Mailgroup, the user gets an interface (figure 7.1) that allows him/her to browse, read, reply, and create messages via its graphical user interface. The graphical visualization of Mailgroup allows users to visualize, and interact with the threaded conversations in a graph based "outline" view.

7.1.1 PROTOTYPE INTERFACE

Figure 7.1 illustrates the interface of Mailgroup. This interface has two main areas of interaction: (1) The top of the window displays the browserspace, where learners browse messages. (2) The window at the bottom is the workspace,

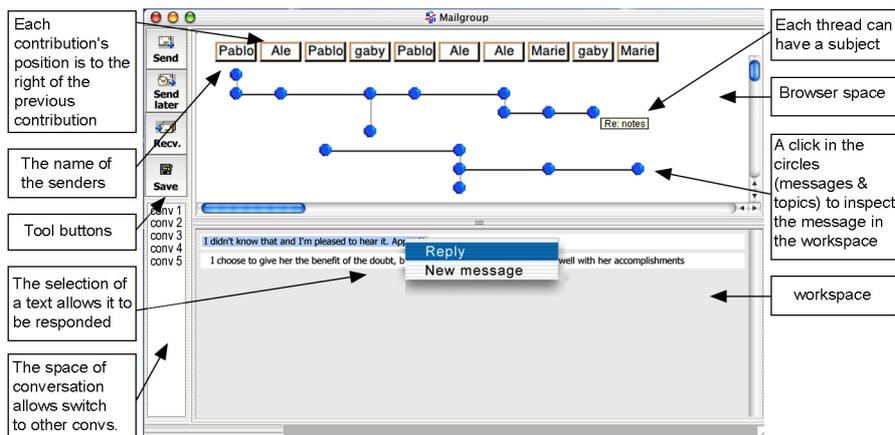


Figure 7.1. Mailgroup

where learners inspect the content of messages, replying and creating new messages. At the left side, there is a toolbar with some functions that Mailgroup implements.

The system generates the graphical visualization of answers and new topics created by users (interactions among users).

The browserspace represents, through a graph, the whole discussion: “Vertices” (the circles in figure 7.1) correspond to the topics of a conversation, and “edges” correspond to the links between topics. The lines placed between the vertices of different columns correspond to the links explicitly created by users between two topics. Tree structures of the browserspace are interactive, since users can click on the vertices and look at the content of each topic in the workspace. Users can access a contextual menu in the workspace, which gives the users the functions needed to manage the conversations. The features of the structure of these graphs are detailed in chapter 6. In this chapter, we focus principally on the implementation aspects of these functionalities.

7.1.2 USE CASES IN MAILGROUP

The important use cases of Mailgroup are listed below. Figure 7.2 illustrates these use cases.

- Receive messages: users can receive messages from a mail list which they have to subscribed to.

- Send messages: users can send their messages to a mail list
- Browse messages: users can browse (and read) all messages that the browserspace displays.
- Compose messages: users can create new messages, reply (even to just a part by the WYAIWYL principle) of a previous messages and create convergent messages.
- Attach files: users can attach files to the new sessions.
- Save messages: users can save sessions and their messages in order to send them later.
- Manage a conversation: users can create and select different conversations.
- Manage pop-up messages: users can create, send, receive, and read pop-up messages.
- Setup account: users can set their parameters, such as SMTP server name or their username.
- View Structural indicators: users can see three structural indicators (cohesion, complexity, and status)
- Undo actions: users can undo all activities presented in “Compose messages” use case.

In the following sections, we detail the implementation of all these use cases. We note that “Manage Pop-up messages” and “Manage a

conversation” correspond to the new functionalities that emerged from the tests carried out.

7.1.3 BASIC ARCHITECTURE

Mailgroup is a software written in Java 1.3. This software contains around 6,000 code lines. It is built in an email client configuration. That is, it is a standalone program (installed on the personal computer of each user), which connects to

a server to send and receive messages. We use a standard list-server to deal with and distribute Mailgroup messages (figure 7.3).

If a user creates and sends a message, it is received by the list-server, which distributes the message to all the users subscribed to the list.

If the new user joins an existing group, she gets, in the current configuration, all previous messages sent in the list. Thus, users are obliged to receive all messages within the discussion.

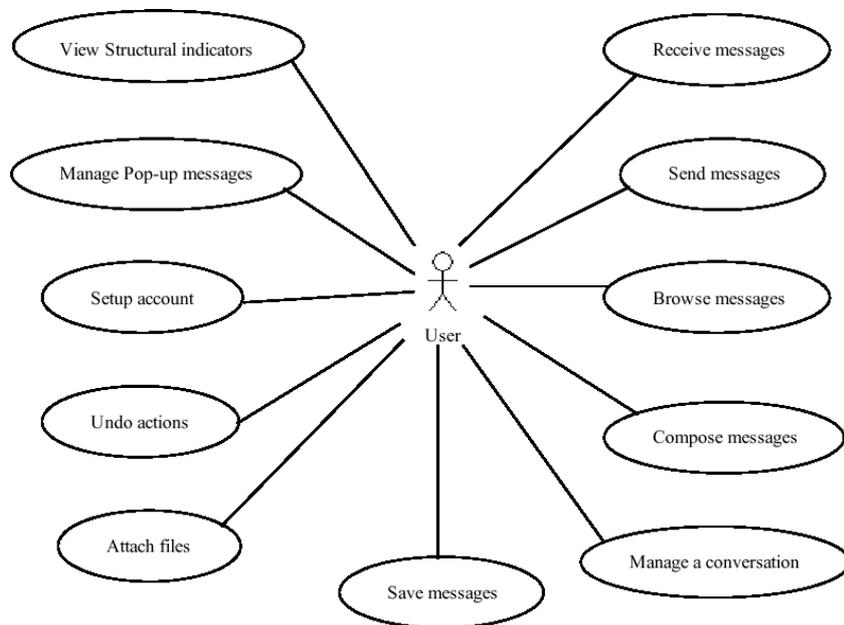


Figure 7.2. Use cases in Mailgroup

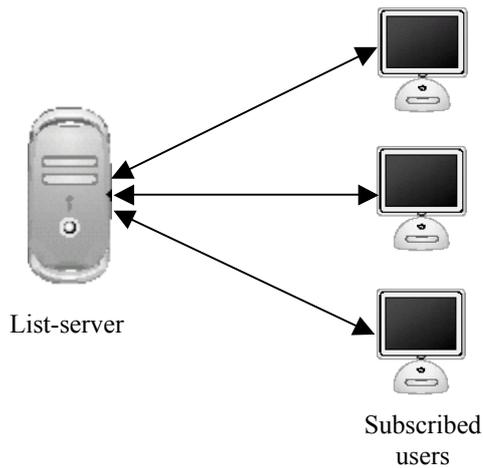


Figure 7.3. Operation of mailing list

7.2 Mailgroup components

Mailgroup is made up of four components. Each of them has specific functions and task. Moreover, the development of these components is based on several existing APIs: (1) Mailing component, this component added the messaging capacities to Mailgroup, such as sending and receiving messages. This component is based on JavaMail API. (2) The visualization component adds the graph visualization capacities, and allows the interaction with the graph. This com-

ponent is based on GFC API. (3) The SNA component adds the capacities of dealing with SNA algorithms. This component uses the JAMA (Java Matrix Package) API. (4) The message editing component allows users to create, answer, browse, and read messages. This component is based on the typical classes of java swing classes and some AWT (Abstract Window Toolkit) classes. Figure 7.4 illustrates these components and their relationship with the application use cases.

7.2.1 MAILING COMPONENT

The messaging component is responsible for sending, receiving, and handling messages. This component uses the JavaMail API in order to add electronic mail capacities to Mailgroup. In this section, we present JavaMail API. Then, we explain the implementation of several functions in Mailgroup (sending, receiving, and handling messages).

7.2.1.1 JAVAMAIL

JavaMail is an API (Application Program Interface) designed to add electronic mail capabilities to java applications. JavaMail provides classes that allow users to deal with the mail functions

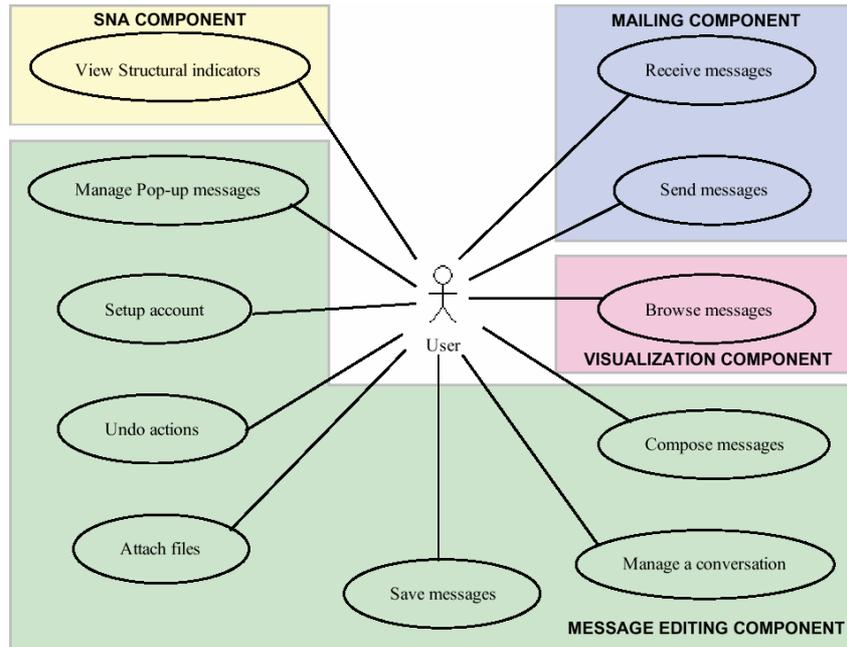


Figure 7.4. Relation between the Mailgroup components and Mailgroup.

and protocols. Moreover, developers can subclass JavaMail classes to provide implementations of particular messaging systems, such as IMAP4, POP3, and SMTP.

JavaMail has layered architectural components. The *abstract layer* declares classes, interfaces, and abstracts methods intended to support mail-handling functions that all mail systems support. The *Internet implementation layer* implements a part of the abstract layer using the RFC822 and MIME Internet standards. The *JavaBeans Activation Framework (JAF)* encapsulates

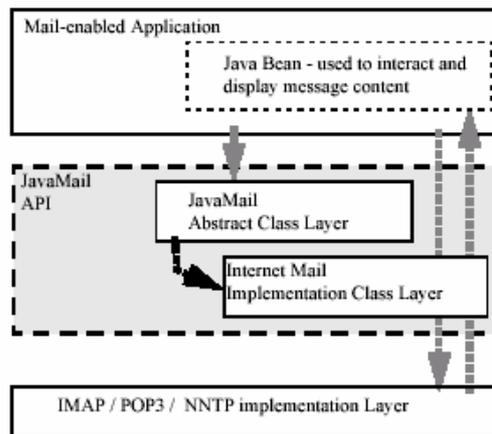


Figure 7.5. Layered architecture of Javamail

message data and handles commands intended to interact with those data.

JavaMail based applications have a layered architecture (figure 7.5). The JavaMail clients use the JavaMail API and it is implemented by the “Service Providers”. This architecture allows clients to use JavaMail API to send, receive, and store messages using different data-types from different message stores and different message transport protocols (Sun Microsystems 2000)

The most important classes used by JavaMail are (Sun Microsystems 2000):

- The **Message** class: This is an abstract class that defines the content and set of attributes for a e-mail message. The attributes of the **Message** class specify addressing information and define the content structure. The content is represented as a **DataHandler** object that wraps around the actual data.

- The **Store** class: It defines a database that holds a folder hierarchy with its messages.
- The **Transport** class: It models the transport agent that routes a message to its destination addresses. This class provides methods that allow users to send a message to a list of receivers.
- The **Session** class: It defines global and per-user mail-related properties that define the interface between a mail-enabled client and the network. JavaMail system components use the **Session** object to set and get specific properties.

The standard mail handling process for a typical client application performs the following functions (figure 7.6):

- To create a mail message, which con-

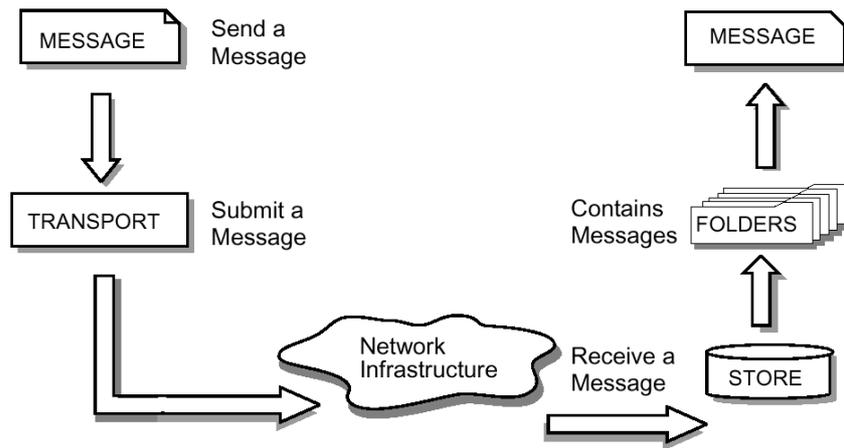


Figure 7.6. The message-handling process

sists on a collection of header attributes and a block of data.

- To create a Session object, which allows the authentication of the user, and controls the access to the message store and transport.
- To send the message to its receiver's list.
- To retrieve a message from a message store.

7.2.1.2 MAILGROUP MAIL STRUCTURE

In this section, we present the structure of Mailgroup mails. It is needed to build a particular conversation structure in order to manage a con-

versation structured by topics and sessions, and visualized in a graphically.

Figure 7.7 illustrates a conversation that takes place in Mailgroup. Looking at the figure we observe that (1) messages are always part of a session (column); (2) messages can be divided into submessages (i.e., topics); (3) the original message divided into topics is linked by a vertical line; (4) it is possible to link messages and topics, (5) if a message is divided into topics, each of these topics preserves the link with the previous message; (6) each message has a subject; (7) it is possible to create convergent interactions.

We considered all of these features to model Mailgroup messages; hence, we built four classes: *Index*, *Session*, *messages* and *partitions*.

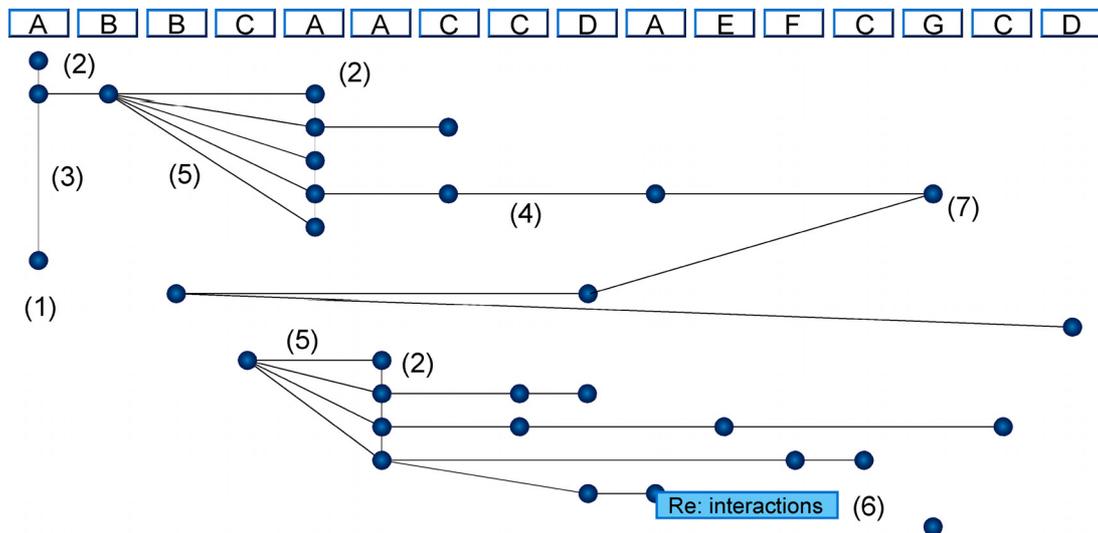


Figure 7.7. A Mailgroup conversation.

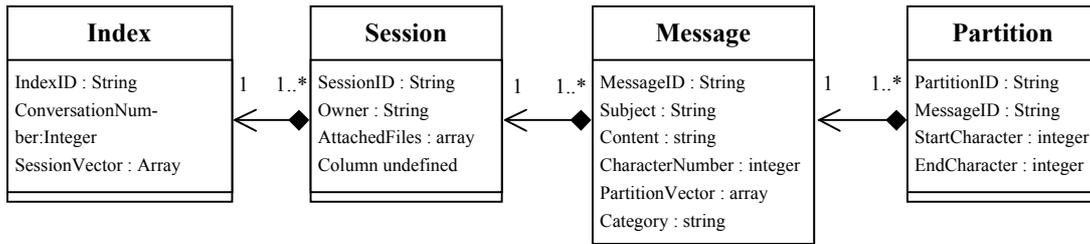


Figure 7.8. Classes and their relationships.

Figure 7.8 illustrates the relationship among classes. Each *Index* object contains several *Session* objects, which contain several *messages*. Each *message* may contain several *partition* objects. The selected topics (the selected part of a message) are represented as *partition* objects. That is, the separation of messages is only visual. A *message* object is never divided. The creation of a topic will generate a new partition object, which can be added to the partitions-Vector variable of a *message* object.

Index Class: index class contains all the session elements. This class has the following attributes:

- IndexID: Represents the identification number.
- ConversationNumber: Represents the conversation number (each conversation space possesses a conversation Number).
- sessionVector: This attribute corresponds to an array containing a list of *session* objects of a conversation.

Session Class: Each time that a user opens Mailgroup a new *session* object is created. When a user quits the program, the current *session* object is destroyed. If a user sends his/her messages, the *session* object is destroyed and then another one is created. Hence, we can differentiate different connections to the server as different sessions (different columns, in the *browserspace* (Figure 7.7)).

Session class has the following attributes:

- SessionID: Represents the identification number, which is built from a combination between the date and hour the session was created and the user-name.
- Owner: The sender nickname in a session.
- AttachedFiles: This attribute corresponds to an array containing a list of the file names attached to a session (files are always attached to sessions, not to messages or topics)
- Column: This attribute corresponds to an array containing the *message* objects list that belongs to a session.

Message Class: These class objects conserve the content of a message and the links with others. A new message object is created when (1) a user creates a new message, or (2) a user answers a message or a part of one.

Message class has the following attributes:

- **MessageID:** Represents the identification number of each message.
- **Subject:** it is the theme of each message. Topics maintain the same subject of the message they belong to.
- **Content:** It is the text contained in a message.
- **CharacterNumber:** It represents the number of characters contained in a message. This parameter is highly relevant to the system given that through this variable it is possible to split the topics of a message correctly.
- **PartitionsVector:** This attribute corresponds to an array containing a *partition* object list.
- **Category:** This attribute shows whether the message is a *new* message or *reply* (convergent interactions have a reply category).

Partitions Class: This class contains the information that makes it possible to link messages. The partitions objects contain all information related to the message partitions. These objects refer not only to explicit partitions de-

veloped by a user, but also, indicate to the systems the partitions that have not yet been set.

Partition class has the following attributes:

- **PartitionID:** PartitionID is the identification number of each link.
- **MessageID:** This attribute corresponds to the identification number of a message that provokes the partition of the original message.
- **StartCharacter:** This attribute corresponds to the position of the first character of a selected topic starting from the beginning of the message content.
- **EndCharacter:** This attribute corresponds to the position of the last character of a selected topic starting from the beginning of the message content.

7.2.1.3 SENDING MESSAGES

Sending messages in Mailgroup is a straightforward two-step process. First, the data to be sent is prepared. In this step, session and message objects created in a session are selected and serialized. Second, the serialized objects are attached to a message and this is sent to a mail server. We detail this process in the next sections.

7.2.1.3.1 Preparing the data

When a user creates a message (M1) and sends it to a list-server, this is distributed to the inbox of all subscribed users. When a user receives the

messages stored in his/her inbox, two situations can happen:

1. M1 is a new message created from a “new message” item of the contextual menu. (i.e., without links to other messages).
2. M1 is an answer or a convergent message, that is, M1 has one or more links with other previous messages.

Then, when a user sends his/her new contributions the system selects the objects that must be sent to other participants depending on situation one or two. In the first case, the sent objects are only the new messages packaged in a session object. In the second case, the system sends the new messages and the new *partition* objects of referenced messages. These partitions objects include the information related to the links between the new message and the previous one (referenced message). We note that sent *partition* objects refer to the *partition* objects of already segmented messages and they do not refer to the *partition* object of new messages.

After this process, messages (packaged into sessions) and partitions are serialized. Serialization is a process of saving the current state of an object to a stream (sequence of bytes), and restoring an equivalent object from that stream (code 1). Hence, we can reuse objects that only exist as long as the Java virtual machine (JVM) is running, later. Thus, *session* and *partitions* objects are serialized and stored in a persistent container (a file on the hard disk) that allows the

object to be stored after the current JVM session is finished.

Serialized objects become files named with the SessionID, MessageID, or PartitionID depending upon the serialized object type, by this notation Mailgroup can easily find files on the disk.

```
FileOutputStream f = new FileOutputStream("/tmp/serializedobjects");
ObjectOutput s = new ObjectOutputStream(f);
s.writeObject("partitionID");
s.writeObject(new Partition());
s.flush();
```

Code 1. Serialization

7.2.1.3.2 *Sending mails to a mail server*

To send a mail to a server, we created a MimeMessage⁹ object and we added it to the message parts, each of them represents one serialized object. Code 2 illustrates this process.

```
// create a message
MimeMessage msg = new MimeMessage();
msg.setFrom(my_address);
msg.setRecipients(list of recipient address);
msg.setSubject("M-FoRuM");
msg.setSentDate(new Date());
// create and fill the first message part
MimeBodyPart mbp1 = new MimeBodyPart();
DataSource source = new FileDataSource(list of serialized object to send);
// set to content of message part.
```

⁹ MimeMessage class, that extends the Message class (of javamail) to implement the RFC822 and MIME standards.

```

mbp1.setDataHandler(new DataHan-
dler(source));
mp.addBodyPart(mbp1);
// add the Multipart to the message
msg.setContent(mp);
// send the message
Transport.send(msg);

```

Code 2. Steps for sending a message.

7.2.1.3.3 Receiving mails

Receiving messages in Mailgroup is the inverse process of sending mails: (1) receive mails from a mail server and deserialize the objects contained in these mails. (2) We process new mails in order to update the visualization with the new sessions, messages, and partitions objects.

Receiving mails from a Mail server. To receive a mail from the server, we connect to the mail server from Mailgroup through JavaMail API. We use the POP3 protocol. Code 3 illustrates the basic steps for connecting to a server.

```

// Connect to the POP3 server
    Session session =
Session.getDefaultInstance(props,
null);
    Store store = ses-
sion.getStore(provider);
    System.out.println( "usernam
" + username );
    System.out.println( "pass  " +
password );
    System.out.println( "host  " +
host );
    store.connect(host, username,
password);
    // Open the folder
    Folder inbox =
store.getFolder("INBOX");

```

```

    inbox.open(Folder.READ_WRITE);
    // Get the messages from the
server
    Message[] messages =
inbox.getMessages();

```

Code 3. Steps for connecting to a server

Now, all messages are stocked into an array of messages, for each of these elements we deserialize the content, through code 4.

```

FileInputStream in = new FileInput-
Stream("messages[n].content");
ObjectInputStream s = new Object-
InputStream(in);
Partition session = (Ses-
sion)s.readObject()
Partition session = (Mes-
sages)s.readObject()
Partition partition1 = (Parti-
tion)s.readObject();

```

Code 4. Deserialization of files

Processing new mails. New mails can contain either only serialized message objects (if a user has composed a new message), or messages and partition objects (in case a user had created a reply).

In the first case, the system receives the new session containing the new messages. Then, it is added to the end of the *index* list object. Then, the new session is saved on the reception side through a serialization process to become a persistent element (a file). In this way, this session will be available for the users each time that Mailgroup starts.

The second case deals with one of the major programming issues: synchronizing messages among different users. Two problems take place on synchronizing issues. (1) When two or more users answer the same message at the same time (Multiple answers problem) and (2) When two or more users select different topics of the same message at the same time (overlapping topics). Nevertheless, the proposed architecture of messages helps us to manage these situations.

Multiple answers problem. The “multiple answers problem” (MAP) takes place when two or more users answer the same message or topic and try to share these new messages. In this situation, each user receives the new sessions of other participants. Each session is processed sequentially from their arrival order (FIFO). Each session is added to the sessionvector vector of index object and then serialized.

The system gets all mails partition objects and attaches them to the partition list of an answered or segmented message. To detect answered messages, we observe the MessageID attribute of partitions objects. This addition is interpreted by the system as a new link. Algorithm 1, explains the necessary steps for managing this situation.

Algorithm 1. Synchronizing: MAP.

Input: new mails with MAP

Output: sessions correctly updated

Assign $i \leftarrow 0$, object[] \leftarrow serialized objects, $n \leftarrow$ length of object[].

For each i to n

- a. if object[i] is a session object
 - a. deserialize
 - b. Add session to index object
- b. If object[i] is a partition object
 - a. deserialize
 - b. search for a message with the messageID equal to messageID attribute of partition object (object[i].messageID)
 - c. add the object[i] to partitionsVector of message found .

Overlapping topics. The possibility that users select the message topics as they wish might produce an overlap among topics that is important to manage. Figure 7.9.(1) shows participant A’s message. User B has selected a part of this message. The result of this action is presented in figure 7.9.(2). At the same time, participant C is answering participant A’s message, but he/she is partitioning messages in another way (figure 7.9.(3)). The result of this action is presented in figure 7.9.(3).

Then, once each user sends his/her sessions and receives the other ones from the rest of the participants, the system must manage this concurrent situation.

The basic rule for overcoming this situation is that “the overlapping topics represents different topics”. In this way, users can visualize their selected topics entirely. Algorithm 2 illustrates the steps of this process. The implementation of these concurrent situations is a simple method that takes place on the *processing new mails*

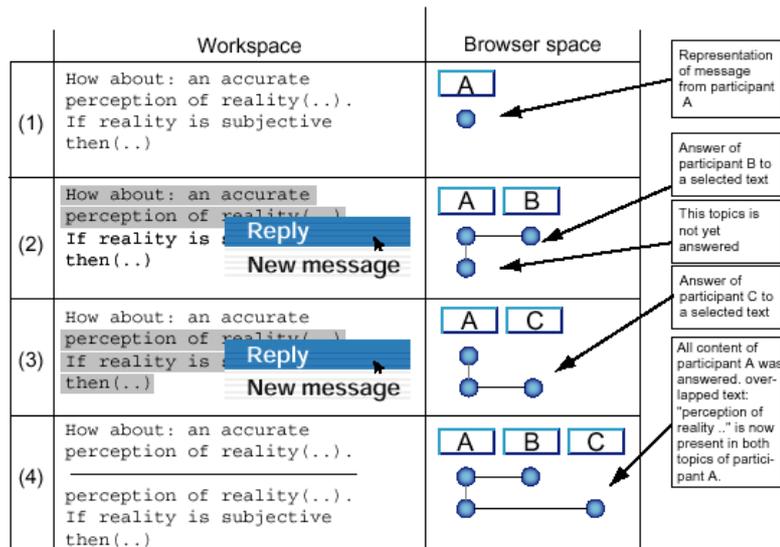


Figure 7.9. Overlapped messages

process (this process will be discussed in sections to come). This method compares the message object partitions, and if there are overlapping topics, it adds the new link to the message partitionsVector. The first selected character determines the horizontal position of overlapping topics.

If a user wants to look at the original message, he/she has only to click on the heading column (this function will be discussed in other sections).

We note that in the current state, and given our synchronizing system of messages among different participants, the message visualization is subtly different for different users. In all concurrent situations this difference occurs. Nevertheless, the messages order does not change the

conversation development. For example, figure 7.10 shows a conversation that involves three participants ("A", "B" and "C") as is seen in the browserspace of two different participants. The browserspace shows the interactions that represent two reactions to a message sent by participant "A". Participant "B" and "C" react to different topics in the message sent by "A" (for this reason in the first session the message is divided

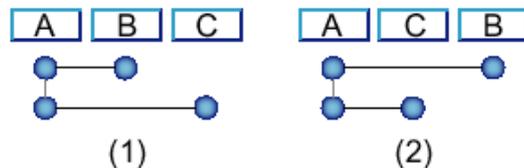


Figure 7.10. Browserspace of two different users

Algorithm 2. Synchronizing overlapped topics.

Input: new mails with overlapping topics

Output: sessions correctly updated

Assign $i \leftarrow 0$, $object[] \leftarrow$ serialized objects, $n \leftarrow$ length of $object[]$.

For each i to n

- a. if $object[i]$ is a session object
 - a. deserialize
 - b. Add session to index object
- b. If $object[i]$ is a partition object
 - a. deserialize
 - b. search for a message with the messageID equal to messageID attribute of partition object ($object[i].messageID$)
 - c. Assign $j \leftarrow 0$, $PartitionV[] \leftarrow$ partitionVector of message found, $m \leftarrow$ Length of $partitionV[]$
 - d. For each j to m
 - i. If $partitionV[j].Startcharacter$ equals $object[i].startcharacter$ and $partitionV[j].Endcharacter$ equals $object[i].Endcharacter$
 1. this is a MAP situation that is managed by the algorithm 1.
 2. $j \leftarrow j+1$
 - ii. if $partitionV[j].Startcharacter \leq object[i].startcharacter < partitionV[j+1].Startcharacter$
 1. Add $object[i]$ to partitionVector in position $j+1$.
 - iii. else Add $object[i]$ to partitionVector in position $m+1$

into two topics). In the browserspace on the left, we see the participant B's browserspace and on the right we see the interactions representation of participant "C". We can observe that the temporal order of reactions of participant "B" and "C" is not the same, this fact is produced when a participant reacts to a message and his/her reaction is placed to the right of the existing sessions. Now, if two participants react at the same time, each of these reactions will be placed at the right of existing sessions, in their respective browserspaces. When the messages are shared

the new sessions are placed at the right of the existing sessions. This method helps us to solve problems of synchronizing messages among different participants.

7.2.2 MESSAGE EDITING COMPONENT

The message-editing component allows us to create, answer, browse, and read messages, as

well as undo these actions. This component is based on java swing classes. Swing is a part of the Java Foundation Classes (JFC) (the standard API for providing graphical user interfaces (GUIs) for Java programs).

In this component, two major activities take place in Mailgroup. (1) Reading messages and (2) creating or replying messages. In this section, we show and explain the functions that allow the interaction between Mailgroup and users. Moreover, we present, as a part of this component, several functionalities that emerged from the tests carried out (c.f., chapter 8): Spaces of conversation, Pop-up messages, and the titles change of conversations.

7.2.2.1 READING MESSAGES

Mailgroup allows two different modes of reading messages shown in browserspace: (1) reading messages from their threads and (2) reading from sessions.

Reading from threads. This mode makes it possible to get, with a one click on a specific message, all the child messages of the thread. A Depth First Search algorithm determines the message order in the workspace. The selected message is a “virtual root”, which is examined first; then the right child of the root; then the right child of this node, etc. until a leaf is found. When algorithm reaches the leaf, backtrack to the lowest left child and repeat. Figure 7.11 illustrates a conversation and the messages dis-

played on the workspace from this type of algorithm (algorithm 3). Messages are placed sequentially on the workspace. Replies are subtly indented to make salient the hierarchy of messages.

Algorithm 3

Input: A specific vertex

Output: messages are placed sequentially on the workspace

1. Assign $S \leftarrow$ the selected vertex (S), $\text{indent} \leftarrow 0$
2. Start at vertex S .
3. PutTextInworkspace(S, indent)
4. Find (or explore) the first vertex that is adjacent to S .
5. Assign $S \leftarrow$ the vertex found, $\text{indent} \leftarrow \text{indent} + 1$
6. PutTextInworkspace(S, indent)
7. Repeat with this vertex and explore the first vertex that is adjacent to it.
8. For each vertex found : PutTextInworkspace($S, \text{indent} + 1$)
9. When a vertex is found to have no unexplored vertices adjacent to it then backtrack up one level
10. Assign $\text{indent} \leftarrow \text{indent} - 1$
11. Done when all children have been discovered and examined.

The PutTextInworkspace(S, indent) is the function that puts the content of vertex S in the workspace indented by the value of the indent variable.

Figure 7.11 shows the way messages are displayed from the thread order. A message marked as (1) has been selected (clicking on it) to be inspected by a user. This message is then displayed in the workspace and the subsequent

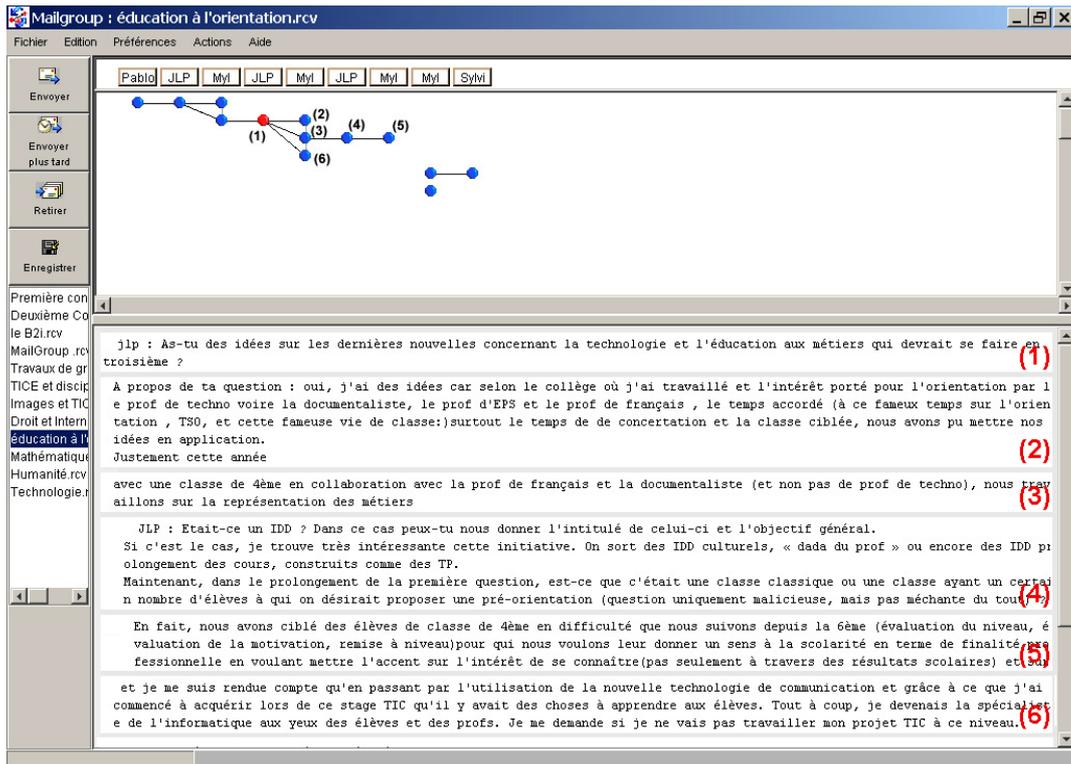


Figure. 7.11. Reading messages from threads.

messages in the message tree are also displayed in the order shown in the figure. If there are many messages in the tree-like structure of a message, these will not be displayed all at once, because displaying all structures makes reading the messages difficult. Then, our system limits the display up to the sixth message of a thread.

Reading from sessions. This mode of reading makes it possible to get, with a single click on a column heading button (where the name of session's sender is placed), all messages that

belong to this session. This mode allows reading messages without their topic partitions. Then, from this mode of reading we can select other topics, or create overlapping topics. Figure 7.12 shows the messages displayed in the workspace when a user clicks on the "JLP" column heading (a "JLP" session).

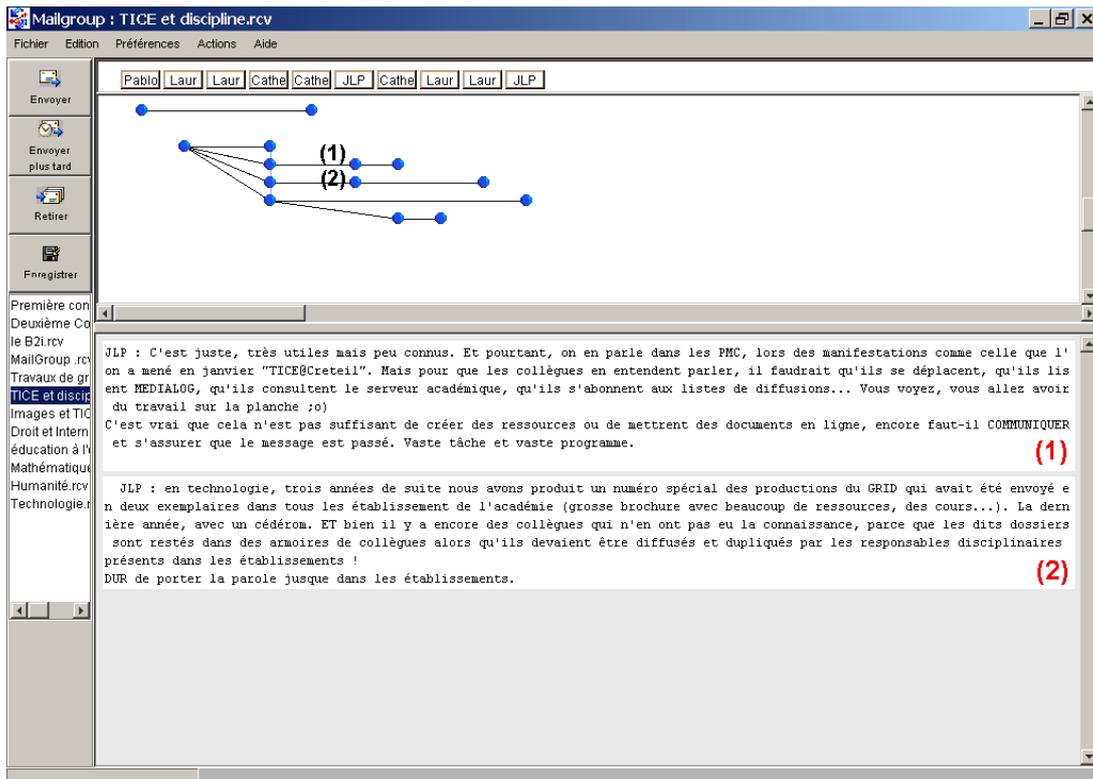


Figure 7.12. Reading messages from sessions

7.2.2.2 CREATING OR REPLYING TO MESSAGES

To create a new message, users can access the contextual menu (i.e., figure 7.9.(2)) through a right-click on the workspace. By selecting the item "new message" the user obtains a new message. This new message is represented as a new vertex in the browserspace, placed in the

column corresponding to the *active session* (the last column to the right). In the workspace, users get a textbox where they can write a message. The active session is the one where the user is currently working.

To create a new message, Mailgroup creates a *message* object that is attached to the active *session* object, in this way, messages are included in the message structure. If a user wants to reply to a message, he/she must right-click on this message, then select "reply message". Also,

users can select a part of a message and react to it through the same process of replying to an entire message. This process has been detailed in chapter 6.

The implementation of this function is as follows: (1) the system detects the identification number of a replied message (each textbox in the workspace has the same identification name that its corresponding vertex in the *browser-space*). (2) The system detects the position of the first and the last character selected starting from the beginning of the message, if there is no selection (i.e., a reply to the whole content of a message), the first character is zero and the last character is the length of the whole message; and (3) The system also creates a *message* object, which is attached to the active session. The system creates a *partition* object with the **start-character**, **endcharacter** and **messageID**. This partition object is added to a **partitionsVector** of a replied message

7.2.2.3 ATTACHED FILES

Mailgroup allows users to attach files to new sessions. When a file is attached, through the “add attach” menu item, a clip is displayed in the heading of the session (figure 7.13). Users can get the attached files through a right click on the heading. We note that the files are attached to a session and not to a specific message. This was a decision taken initially, and we are reconsidering it for the next versions of Mailgroup, thinking that files should be attached to a mes-

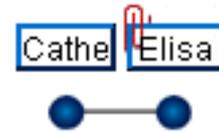


Figure 7.13. Attached file visualization in Elisa's session.

sage and not to a session. Nevertheless, the architecture of this program allows us to change this characteristic without much programming difficulty.

7.2.2.4 UNDOING FUNCTIONS

The undo operation is one of most appreciated functions of the ergonomic interfaces. Mailgroup implements the undo feature for several functions of this component: to create and reply to messages, to add and create convergence, and to attach files. We use the **UndoManager** in order to remember a sequence of actions. **UndoManager** manages actions. It makes it possible to undo as many actions as the users want. Code 5 illustrates how we make a request to the **UndoManager** from the “add convergence” function. In this code, we see that a selected message is added to an array (ArrayCon). If a user wants to undo his/her add convergence action, he/she goes to the Undo item menu, which calls the `undoManager.undo()`. This function calls the `undo()` function of `UndoableAddConvergence` class and removes the messages previously added. The other undo functions are implemented by the same method. We should note

that if a message has already been sent to the list-server, it is not possible to undo this operation.

```
void AddConvergence_actionPerformed(ActionEvent e) {

// we call UndoManager to track a sequence of actions
undoManager.undoableEditHappened(new UndoableEditEvent(this,
    new UndoableAddConvergence(s.getName(), consensusArray)));
    UpdateMenus(); }
```

```
class UndoableAddConvergence extends AbstractUndoableEdit {
    protected String refUnidad;
    protected ArrayList ArrayCon;

    public UndoableAddConvergence(String alias, ArrayList ArrayTemp)
    {

// SelectedVertex is the selected vertex to be added to convergence
        SelectedVertex =
alias.concat("*0-").concat(Integer.toString(Frame1.s.getText().length())).concat("%");

        ArrayCon = ArrayTemp;
        ArrayCon.add(SelectedVertex);
    }
```

```
public String getPresentationName() {
    return "AddConvergence";
}

public void undo() {
    super.undo();
    ArrayCon.remove(SelectedVertex);
}
```

code 5. call UndoManager from the “add convergence” function

7.2.2.5 CONVERSATION SPACES

We have implemented new functionalities in Mailgroup, as a result of its use in a real situation. From its experimental use, we observed the need to create as many spaces of communication as different discussion themes that took place in Mailgroup.

Although a new theme can be created as a new message that generates new threads in the same space of conversation, there are themes that are semantically far from existing conversations, for example, a first conversation dealing with the use of Mailgroup, and another that deals with the specific themes of a collaborative activity. Consequently, the different types of themes are placed in different conversation spaces. In the current version, Mailgroup can manage up to 18 conversations, because this is

the maximum number of conversations that can be placed in the conversation bar.

To users, a conversation space represents a new browserspace, where they will find the exchanges related to the selected conversation. Users get each conversation spaces from a list of conversations that is displayed on the interface (figure 7.14).

The system allows users to manage and create new conversations. The implementation of this feature is made through the incorporation of a flag on each session class (ConversationID) that allows users to differentiate between conversations, when users receive messages.

7.2.2.6 POP-UP MESSAGES

In order to accomplish the new requirements, we implemented an additional feature. The new features aim to overcome some breakdowns of this software detected in the test stage related to sending and receiving non-persistent messages: users needed to send messages with an ephemeral character. That is, messages related to specific information, an alert, an advice, etc., messages that are once read disappear definitively and are not added as messages in any conversation space.

We implemented a feature that allows users to create messages that will be displayed only once (when a user receives messages) as a small

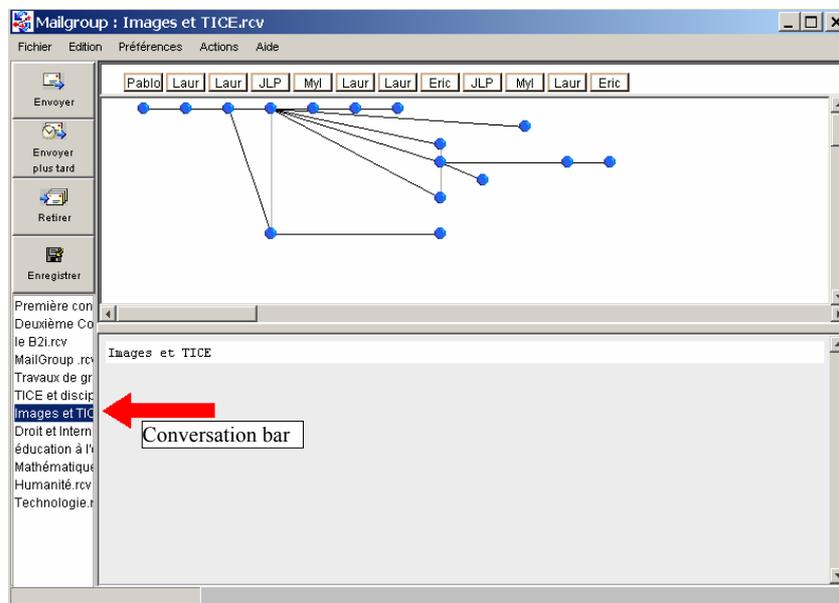


Figure 7.14. Conversation space in Mailgroup.

pop-up dialog box. After the visualization of this message, it is definitively discarded.

In order to implement this function we created a new class (`popupmessage`). Each pop-up message (figure 7.15) is a new *popupmessage* object that is serialized when a user sends the session. On the reception side, this message is deserialized and displayed in the interface of all users.



Figure 7.15. Dialog box allowing the creation of Pop-up messages

7.2.2.7 MODIFYING CONVERSATION TITLES

The selection of a conversation title is sometimes a difficult decision. Most of the time, the conversation topics change during their devel-

opment. In fact “the true” topic generally emerges from the interaction. Consequently, it was necessary to change the conversation title for other more pertinent titles. For these reasons, the system must allow for the determination of a conversation title retroactively and a member of the group must authorize its modification (in fact we chose the author of the conversation).

Figure 7.16 shows the dialog box with a new button that allows users to change the title.

7.2.3 VISUALIZATION COMPONENT

The visualization component adds the graph visualization capacities, allowing for interactions with the graphs. This component is based on the Graph Foundation Class API (GFC). In this section, we present GFC, and then explain the implementation of visualization in Mailgroup.

7.2.3.1 GRAPH FOUNDATION CLASS

The Graph Foundation Class (GFC) is a theoretical graph class library for Java that allows programmers to work, draw and lay out graphs. GFC is a graph drawing-oriented package released by IBM. Nowadays, this class has been deprecated. So, readers interested in these functionalities should use the JUNG (Java Universal Network/Graph Framework) graph library.

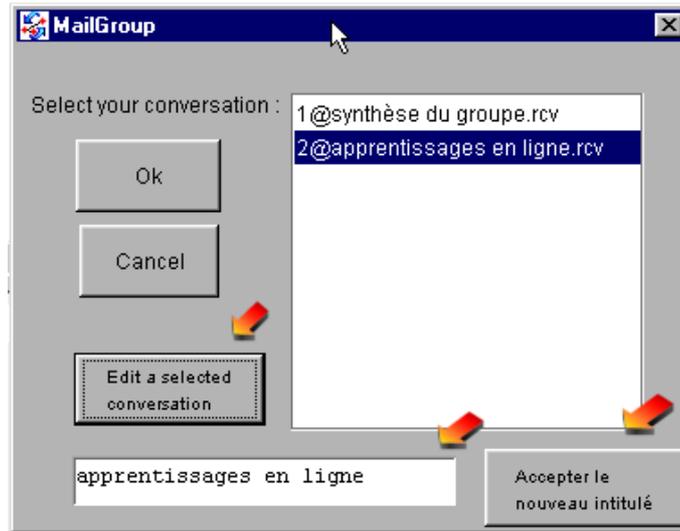


Figure 7.16. Dialog box of conversations

The GFC classes consist of three packages. The first one comprises the classes that support the data structure and combinatorial aspects of graph theory. The second one is a suite of classes for drawing graphs, vertices, and edges in a variety of ways. And the third one is a collection of classes for laying out graphs in a variety of styles. It is known that drawing a graph is the act of rendering the graph, whereas laying out refers to the location and shape of graph

elements.

GFC classes are organized as shown in figure 7.17. The base abstract class is GraphObject. The concrete classes Vertex, Edge, and Net are derived from it. The Net class refers to the most general kind of graph, which may contain parallel edges and self-loops. The Walk class is a structure that is overlaid on graphs and is supported by methods and internal data structures that are different from those for graphs.

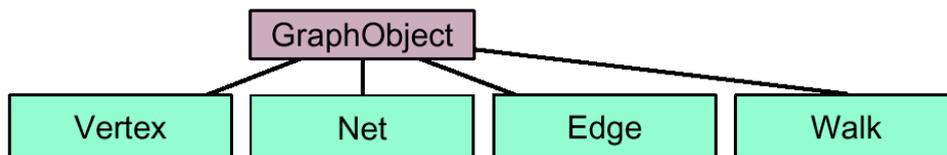


Figure 7.17. Classes of GFC

7.2.3.2 GRAPH VISUALIZATION IMPLEMENTATION

The process of visualizing a graph in Mailgroup consists of two steps: (1) transforming the Mailgroup message structure into a graph structure, and (2) laying out the graph in the browserspace.

7.2.3.2.1 *Transforming the Mailgroup message structure*

In order to create the graph visualization, we must transform the hierarchical structure of messages of Mailgroup into a graph structure. First, we recover all the sessions that will be displayed in the browserspace (The hierarchical structure of messages is stocked in the index object). Next, for each session object we examine its messages and its partition elements. Then, we create a vertex for each element of a partition object and we set four variables to each vertex: (1) the name of the partition (partitionID), in order to obtain later the text that points to this partition when a user clicks on it; (2) the session order number, that corresponds to the time precedence order. This variable helps us to place messages in the corresponding columns of their sessions. The links among the vertices are created with the partition objects (stocked in the partitionsVector) of each message. (3) The sender's nickname of this vertex. (4) The vertices category (new message or reply). Algorithm 4 illustrates this process.

7.2.3.2.2 *Laying out the graphs of interactions*

Laying out the graphs of interactions is another principal programming issue. This problem deals with the messages location in the browser-space. The vertical position of vertices is fixed by the session which each vertex belongs to. Nevertheless, regarding their horizontal position, vertices can be placed without major constraints (see figure 7.18).

Then, we use these degrees of freedom of the horizontal position to create an algorithm in charge of placing messages in a specific position taking into account the two desirable *lay out conditions*:

- Trying to preserve the positions of messages already placed. This condition is based on the idea that the earliest structure of messages represents a group history. The fact that changing the position of a message at different times can be a perturbation element to the threaded discussion (e.g., the users can no longer find a message that was placed in a specific location in the browserspace).
- Trying to diminish the crossing lines between messages. These lines make it difficult to follow references between messages (see figure 7.19).

Algorithm 4.

Input: index object

Output: graph object

1. Assign $i \leftarrow 1$, $n \leftarrow$ Length of sessionVector (attribute of *index* object)

2. For each i to n

a. Assign $j \leftarrow 1$, $m \leftarrow$ length of Column of sessionVector[i]

b. For each j to m

I. Assign $k \leftarrow 1$, $p \leftarrow$ Length of *PartitionsVector* of Column[j]

II. For each k to p

aa. Create a vertex V_x

bb. Assign vertexVariable1 \leftarrow partitionID

cc. Assign vertexVariable2 $\leftarrow i$

dd. Assign vertexVariable3 \leftarrow sessionVector[i].owner

ee. Assign vertexVariable4 \leftarrow Column[j].category

ff. Create links between vertices of the same message (the vertical

lines between vertices that belong from a same message).

gg. Create link between V_x and vertex referenced in MessageID attribute. If this last vertex has not been created yet, the link is stocked in an array.

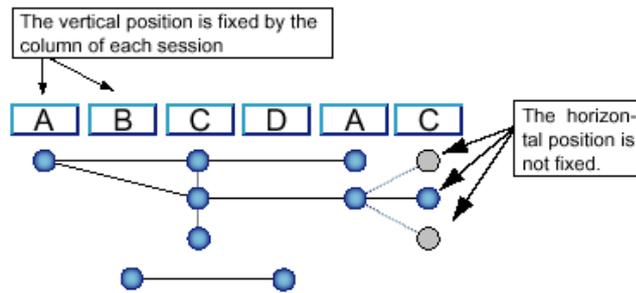


Figure 7.18. Laying out graphs of interactions



Figure 7.19. Graphs with (out) cross lines

With simple algorithmic rules, we can lay out messages which fulfill, to the best of its ability, these lay out conditions.

1. Each message “fills” the horizontal line where it is placed. That is, new messages of future sessions cannot be found in the same horizontal line of a previous message
2. The answers to messages will be placed in the same line as the referenced message.
3. New messages will be placed in the next free bottom line.

We use an algorithm based on a Depth-First-Search (DFS) (algorithm 5).

Algorithm 5. Lay out the graph of interactions

Input: graph of interactions

Output: Graph in browserspace

1. Assign $i \leftarrow 0$, $j \leftarrow 0$, $M[i] \leftarrow$ all vertices of graph with `vertexVariable4` (category of message) equals “new”.
2. For each i to length of $M[i]$
 - a. Pick as the source vertex the $M[i]$ vertex to start.
 - b. Assign position of $M[i] \leftarrow (i, j)$.
 - c. Find the first vertex that is adjacent to $M[i]$ with a different `vertexVariable2` (i.e., ver-

texts that must placed in different columns or sessions).

- d. Assign $Vf \leftarrow$ vertex found.
- e. Assign position of $Vf \leftarrow (Vf.\text{vertexVariable2}, j)$
- f. Repeat with this vertex and explore the first vertex that is adjacent to it
- g. Assign to each vertex found the position (`Vertex-Found.vertexVariable2, j`)
- h. When a vertex is found to have no unexplored vertices adjacent to it then backtrack up one level
- i. Assign $j \leftarrow j + 1$
- j. If there is a next vertex that is adjacent to $M[i]$ with the same `vertexVariable2` (i.e., vertices that must placed in the same columns or sessions).
 - i. Go to c.
- k. Assign $i \leftarrow i + 1$

7.2.4 SNA COMPONENT

The SNA component adds the capacities to deal with SNA algorithms. In this component, the system gets the graphs of interactions of users and interprets them from three indicators: complexity, cohesion, and status. Then, the system displays the values of these indicators to users. This component relies strongly on the JAMA API. In this section, we present JAMA API.

Then, we explain the implementation of selected indicators in Mailgroup.

7.2.4.1 JAVA MATRIX PACKAGE (JAMA)

Jama is a basic linear algebra package for Java. This package provides user-level classes for constructing and manipulating real matrices. Among its capabilities we can note the following:

- Object manipulation: constructors, get, set, copy, clone
- Elementary operations: addition, multiplication, normalization, transposition, etc.
- Decompositions: Cholesky, LU, QR, SVD, eigenvalue.
- Linear equation solution: regular and least squares.
- Derived quantities: condition, determinant, rank, inverse.

JAMA encloses six java classes:

CholeskyDecomposition: This class allows programmer to formulate a Cholesky Decomposition.

(For a symmetric, positive definite matrix A , the Cholesky decomposition is the lower triangular matrix L so $A = L*L'$.)

EigenvalueDecomposition: This class allows programmer to get the eigenvalues and eigenvectors of a real matrix.

LUDecomposition: This class allows programmer to build a LU Decomposition (For an

m -by- n matrix A with $m \geq n$, the LU decomposition is an m -by- n unit lower triangular matrix L , an n -by- n upper triangular matrix U , and a permutation vector piv of length m so $A(piv,:) = L*U$. If $m < n$, then L is m -by- m and U is m -by- n .)

Matrix Jama: The Java Matrix Class provides the fundamental operations of numerical linear algebra. Several methods implement basic matrix arithmetic, including matrix addition and multiplication, matrix norms, and element-by-element array operations.

QRDecomposition: This class allows programmer to get a QR Decomposition (For an m -by- n matrix A with $m \geq n$, the QR decomposition is an m -by- n orthogonal matrix Q and an n -by- n upper triangular matrix R so that $A = Q*R$).

SingularValueDecomposition: This class allows programmer to get a Singular Value Decomposition (For an m -by- n matrix A with $m \geq n$, the singular value decomposition is an m -by- n orthogonal matrix U , an n -by- n diagonal matrix S , and an n -by- n orthogonal matrix V so that $A = U*S*V'$).

Mailgroup, in their SNA component, extensively uses the Jama matrix and EigenvalueDecomposition classes

7.2.4.2 SOCIAL NETWORKS INDICATORS

Mailgroup implements three indicators: (1) Status of participants, that aims to get the centrality degree of each participant, (2) Complex-

ity, that shows the degree of interwoven of conversations, and (3) cohesion that presents the level of cohesiveness of a group. To implement the SNA indicators we use intensively the JAMA package.

To calculate these indicators, we obtain the *sociomatrices* from the interactions among participants. A sociomatrix is a matrix representation of sociograms. A sociogram consists of a graph-like representation, where actors are viewed as vertices and the interactions between messages are the links.

We obtain the sociomatrix from the graphs of interactions (the output of algorithm 4), through an algorithm BFS that traverses the whole graph.

Thus, from the interactions of a group, a sociomatrix M of rank n is constructed, where n is equal to the number of participants. Each cell (M_{ij}) indicates the relationship strength between participant i and j . The interactions' matrices used in our analyses are asymmetric ($M_{ij} \neq M_{ji}$) on account of the directionality of the references between messages. That is, the sender and the receiver of a message are clearly differentiated. Thus, we estimate the different indicators from sociomatrices.

7.2.4.2.1 Status

In chapter 6, we showed that the vector C of status is obtained from equation (7.1)

$$c = (I - \alpha A^T)^{-1} e \quad (7.1)$$

The process of implementing this indicator is as follows: (1) we verify the value of α in order to obtain the principal eigenvalue and the α value (that can be always smaller than the principal eigenvalue). Only in cases where the eigenvalues have a very low value (< 0.0001) we set the α value to 0.2 in order to avoid negative values of status. (2) We formulate the operations to solve equation 7.1. (3) The resulting vector is displayed in a graph bar, where each bar represents the status of a specific participant. Algorithm 6 illustrates the process of obtaining the status.

Algorithm 6. GetStatus

Input: Graph $G=(V,E)$

Output: Value for Status of G .

1. Assign $\alpha \leftarrow 0.2$
2. GetEigenvalues(G) (Function of JAMA package)
3. If Eigenvalue principal (E_p) > 0.001 then $\alpha \leftarrow (0.9/E_p)$
1. We calculate the vector c from equation (7.1), e is a vector of "1" (i.e., all participants start interactions with the same status).

7.2.4.2.2 Cohesion

In chapter 6 we showed that cohesion is the minimal number of participants who, if removed from the group, disconnect it completely, that is, all participants become disconnected. To calculate cohesion, we apply the k -connectivity algorithm iteratively to the groups that remain connected. The sum of the value of the k -connectivity for each iteration will give the final

measurement of cohesion. To compare the cohesion values for groups with different numbers of participants, these values are normalized. The maximum value for the cohesion is produced by the complete graph. Thus, for a complete graph composed by n participants (K_n) the group cohesion ($C(K_n)$) is $n-1$. We will assign to this interaction structure a cohesion value of 1, which will be the maximum value for the cohesion. Equation (7.2) shows the normalized cohesion value:

$$\bar{C}(G_n) = \frac{C(G_n)}{n-1} \quad (7.2)$$

To calculate this indicator we use the *max-flow* algorithm (Esfahanian). We can formulate the max-flow problem as follows. In a directed graph, where edges are labeled with capacities, and there are two distinct nodes, the source and the sink, the flow among vertices is specified by the following rules:

- The flow does not exceed the capacity for each edge,
- The sum of the incoming flows equals the sum of the outgoing flows for each edge, except for the source or the sink.

The aim is to find a flow that maximizes the incoming flow at the sink.

Algorithm 7. GetCohesion.

Input: Graph $G=(V,E)$

Output: Value for Cohesion of G .

1. Assign $i \leftarrow 1, j \leftarrow 1, n \leftarrow$ number of vertices of G . $C[]$ Sociomatrix of G , Connectivity $\leftarrow 0$, Number of iteration $\leftarrow 1$, AllConnectivity $\leftarrow 0$.
 1. For each i to n ,
 - a. For each j to n
 - I. Assign connectivity \leftarrow MaxFlow ($C[i,j]$)
 - II. If connectivity $>$ MaxFlow ($C[i,j]$) then assign a new value connectivity \leftarrow MaxFlow ($C[i,j]$)
2. Identify the cut-node(s) at the current level of connectivity.
3. Set Number of iteration \leftarrow Number of iteration +1, AllConnectivity \leftarrow AllConnectivity + connectivity.
4. Generate new graph components based on the removal of these cut-nodes.
5. If the resulting graph(s) is neither complete nor trivial, we obtain the connectivity for these graphs by (1) (if there is more than one resulting subgraph, the connectivity value of the iteration is the average connectivity of subgraphs)
6. Cohesion \leftarrow Allconnectivity/ $((n-1) * (\text{Number of iteration}))$

7.2.4.2.3 Complexity

In order to obtain the complexity, we get the collection of non-isomorphic graphs S_G and the collection of all induced subgraphs, I_G of a graph G . The complexity is given by the equation (7.3).

$$C = \frac{|S_G|}{|I_G|} \quad (7.3)$$

Algorithm 8 illustrates the process to obtain the complexity. Algorithm 9 (SeekIsomorphic) is used in algorithm 8.

Algorithm 8. GetComplexity.

Input: Graph $G=(V,E)$

Output: Value for Complexity of G.

1. Assign $i \leftarrow 1$, $n \leftarrow$ number of vertices of G, graphNonIsomorphic $\leftarrow 0$. graphIsomorphic $\leftarrow 0$

1. For each i to n ,

a. Assign $C[] \leftarrow$ All combinations of subgraphs of G with i vertices

b. For each $j \leftarrow 0$, $Nc \leftarrow$ Length of array $C[]$.

I. Assign graphNonIsomorphic = graphNonIsomorphic +1.

II. Assign isIsomorphic \leftarrow SeekIsomorphic ($C[j]$, $C[]$).

III. if isIsomorphic then

a. graphIsomorphic \leftarrow graphIsomorphic+1. End For.

2. Complexity \leftarrow graphIsomorphic/ graphNonIsomorphic

Algorithm 9. SeekIsomorphic

Input: Selected subgraph with i vertices, All combinations of subgraphs of G with i vertices
Output: isIsomorphic (Boolean variable).

1. Assign $i \leftarrow 1$, $n \leftarrow$ number of combinations of subgraphs of G with i vertices, $C[] \leftarrow$ All combinations of subgraphs of G with i vertices, $Cs \leftarrow$ Selected subgraph with i vertices, isIsomorphic \leftarrow false.

2. For each i to n

a. Compare Cs to each permutation of $C[i]$.

b. if Cs is equal to a permutation of $C[i]$ then Cs is isomorphic

c. Assign isIsomorphic \leftarrow true. End

For.

8

Use analysis and tests



Abstract: This chapter details the tests realized with Mailgroup.

8.1 Introduction

This chapter details the tests realized on the implemented tool (Mailgroup) as well as shows the analyses from its first use in real contexts.

Even if this chapter shows practical concerns regarding this tool we try explicitly to avoid the use of the word “experimentation” and use the word “tests”, since experimentation refers to the process of validating hypotheses generally in controlled scenarios. However, in our case (tests) we do not have any explicit hypotheses to validate through an experimental process, but we made the tool available for use in a real context in order to record what it is used for and also to infer some impacts from its use.

This position concords with our methodological approach: “we do not attempt to build experimentations but to design, implement and test innovative frameworks designed to provide data that will enable us to progress in our conceptualization of the domain and its intrinsic phenomena, as a first step to prepare the putting into practice of the hypothesis and experimentation paradigm”.

Then, we consider this approach not as an alternative to scientific experimentation but as the first step for obtaining the hypotheses that will be evaluated in later experimental studies.

We tested Mailgroup in order to: (1) test the system usability and (2) obtain the first corpus that allows us to analyze how Mailgroup is used and what is going on when people use this system.

The tests were carried out at two different times throughout this thesis, with different groups and objectives. First, an early test developed in Chile that aimed to get the feeling of users towards the proposed tool. Second, a test carried out in France, with a deeper and more complete usability study and corpus analysis. In addition to these intention differences, the two tests present some practical differences. The first test was carried out in several small groups (around 4 participants), but the second test had only one, numerous group (15 participants). Also the tests were carried out with different types of participants. In the first test the participants were students, whereas in the second test, they were teachers. Moreover, the first test was carried out by using a more structured approach of collaboration than in the second one. In relation to the tool used, the second test had a Mailgroup version with some more extra features than the first one: it had the possibility of creating conversation spaces and creating pop-up messages, and it presented an interface differentiation between topics and messages (c.f., section 8.2.4).

In spite of differences between the two tests, they presented similarities, principally regarding their overall context: both tests were developed as a distance and collaborative activity.

8.2 *The first test with Mailgroup*

8.2.1 TEST CONTEXT

An empirical study was designed in order to collect feedback of the actual characteristics of our prototype from the user's perspective. In this study, nine groups of 3 or 4 students (32 participants in total) were recruited. They were to second year undergraduate students, who voluntarily carried out, for one month, a distance collaborative activity. The students' activity objective was to carry out a collaborative evaluation of several educational software packages from a list of given criteria. During this study, the tool was used just as the medium of communication and discussion, not as a point of concern in itself. We did not want the students to discuss the tool, nor think about it. We were interested in evaluating just how they could "work it out".

To achieve the test, we took a structured approach to collaboration (even if our interest was to give new tools to emerging learning communities, which do not present a structure of interaction a priori), which divided the activity into several stages that students had to carry out. The

emergent and auto-organized nature of learning communities makes highly unsystematic their establishment, which makes it difficult to systematize the study of Mailgroup use in these communities. Then, the fact of having a controlled context facilitates the attainment of the test objectives in a context of a scientific thesis (very limited time and resources).

We conjecture that this change does not reduce the validity of our test; the interactions taking place in the groups also take place in virtual learning communities. Being conscious about the differences between our test group and the real target group, we nevertheless conjecture that the results can be transferred to learning communities.

8.2.2 THE CREATION OF THE ACTIVITY

The objective of this test is to carry out an evaluation of several educational software "virtual books", starting with the given criteria. The pedagogical objective of this test is to give participants a "vision" based on several criteria, with which participants can analyze and evaluate the educational software. The test finishes when there is a consensus in the application of the criteria between participants for the analyzed software.

At the end of the activity, participants must rank the analyzed software.

The presented activity intrinsically must be carried out in a group; students will form groups of three or four people. Each group will have to work with a limited quantity of educational CD or Web sites, which will be chosen from a proposed list (see appendix I). The criteria to evaluate the software are in the same appendix. The creation of this activity was directed by an implementation plan. Figure 8.1 illustrates this plan.

The implementation plan includes four stages:

1. Identification of a subject
2. Establishment of objectives and tasks.
3. Organizational decisions
4. Selection of evaluation and tutoring types.

Each of these stages is detailed in the next sections.

8.2.2.1 IDENTIFICATION OF A SUBJECT

In this stage, there are two possibilities: to give students a range of subjects which they must choose from or to give participants a specific subject on which they must work. We decided to impose a subject for the activity, given the limited time to carry out this test, and also because the organization of a subject by the participants at the beginning of the test without knowing the software could cause the entire activity to fail.

8.2.2.2 ESTABLISHMENT OF OBJECTIVES AND TASKS

In this stage, we will define the didactic objectives of the activity, as well as the collaboration objectives.

8.2.2.2.1 Didactic objectives

The pedagogical objective of this test is to give participants a “vision” based on several criteria, with which the participants can analyze and evaluate educational softwares.

8.2.2.2.2 Collaboration objectives

This test tries to develop social competences in participants, such as the sharing of information and working in groups. This objective can be achieved by designing an activity with several levels of interdependency:

- Task interdependency
- Resources interdependency
- Information interdependency
- Social interdependency
- Evaluation interdependency

8.2.2.3 ORGANIZATIONAL ISSUES

For the implementation of the activity there were several issues regarding the organization that will be detailed in the next sections.

8.2.2.3.1 Structure of the group

In order to create this activity, we selected a collaboration structure to be use on the group.

There are several possible collaboration structures. In particular, we take ideas from two interaction structures: Group investigation and Jigsaw.

Group Investigation is a collaborative learning method developed by Sharan and Sharan

(1992). The core concept of this method is the active participation of students in their learning. This method is as follows: the teacher starts by proposing a subject or a question to the whole class. Students must exchange ideas on the proposed subject, and they are encouraged to say

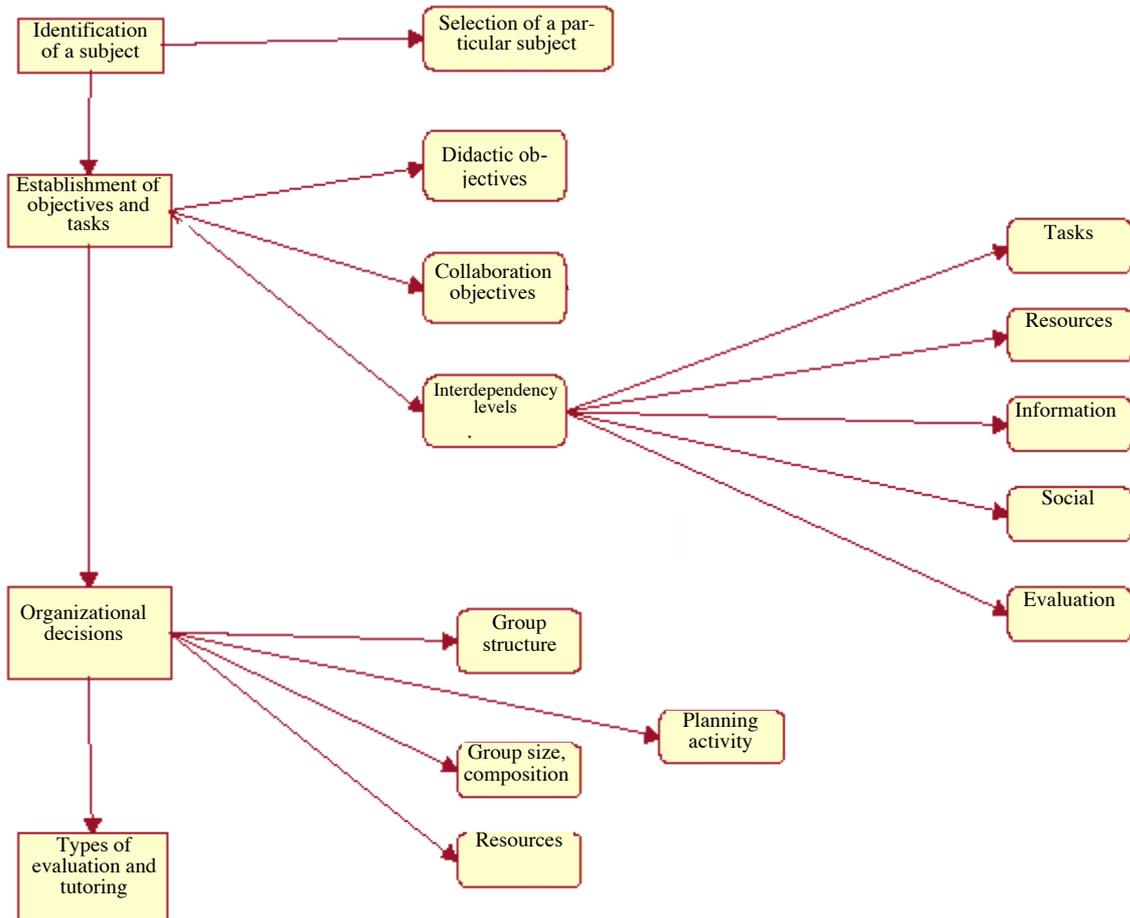


Figure 8.1. Implementation diagram of the first test

whatever they know, whatever they think, and whatever is interesting to them. Then, the class is divided into teams according to common interests. Students decide which aspects will be studied, how to do it and how to divide work among the members of the team. After having collected the necessary information, they share their discoveries and prepare a final report, which is presented to the whole class. The students also take part in the evaluation of this activity.

The method “jigsaw” (Aronson and Patnoe 1997) is a way of structuring collaborative learning. This method makes it possible for members to divide the task, so each participant becomes an “expert” in a certain field. This method contains several stages.

- The students get together in groups. Each of them receives materials or picks a task, which must be different from those of others students of the same group. Individually, the student explores its material or carries out the task.
- The members of each group who received the same material or achieved the same task meet in a group to continue to work and to help each other.
- When they finish, they come back to their respective groups and take part carrying out a common task. Each student communicates the information or shares the material that only he/she understands or has.

- The teacher randomly asks questions to the groups, which answer the questions or carry out a defined task.

We take both structures as a basis for the creation of a collaborative activity. We follow the group investigation structure, integrating into the test structure the information division and collaborative preparation of a report stages. Nevertheless the activity is defined and limited by the activity’s monitor, who leaves students fewer opportunities to investigate. Under this perspective, the proposed activity follows the notions of the Jigsaw method; in particular, through the creation of an individual stage and then, a stage of sharing opinions.

8.2.2.3.2 Group size and composition

The groups were composed as such in order to decrease the possibilities of face-to-face contacts among participants of the same group. Thus, we tried to compose the groups with students of different ages and different backgrounds. Regarding the group size, we selected groups between three and four participants.

8.2.2.3.3 Creation of the necessary resources for the activity

For the development of this activity it was necessary to create different resources. All documents were on the experiment Web site. The documents were: user and installation of Mail-group manual, List of CD’s and Web sites, and Description of the activity. All the original documents can be found in Appendix I (only Spanish language version).

8.2.2.3.4 Construction of the activity plan

The activity was structured in stages, each stage is described in the next section. Figure 8.2 illustrates the plan given to participants:

- Information stage: In this stage, the participants must learn a list of software evaluation criteria, do a personal (individual) comprehension activity, and then a shared one, through the interaction with other participants using Mailgroup as the means of communication.
- Exploration and analysis of the suggested CDs and Web sites stage: In this stage, each participant must explore and analyze the proposed CD's and Web sites. This stage is done individually.
- Interaction stage: this stage includes the publication of personal evaluations, confrontation, discussion, and ex-

changes of opinions related to their evaluations.

- Results release stage: Each group must hand in a document, which will include the results of the analyses and the arguments justifying all conclusions of the group.
- Evaluation stage: The evaluation of the test focuses on two areas: the process of collaboration carried out by the group, and the returned results. In relation to the process of collaboration, aspects like participation, degree of compromise, responsibility, and group's capability to solve conflicts will be evaluated. In relation to the second area (the returned results) the evaluation is focused on the application of the criteria on the software. In this activity, both areas are equally important.

ID	Etapas	Duración																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Etapa de información	3d	■	■	■													
2	Etapa de exploración y análisis	4d		■	■	■	■											
3	Etapa de interacción	5d						■	■	■	■	■						
4	Etapa de entrega de resultados	2d															■	■
5	Etapa de evaluación	1d																■

Figure 8.2. Schedule of the activity

8.2.2.4 METHOD SELECTION OF TUTORING AND EVALUATION

In this test we did not use a system of tutoring. Thus, there is no tutor who intervenes during the activity. Only the questions about the use of the communication software were answered. In addition, the evaluation is applied to the group as a whole, not to participants individually (evaluation notions of Group Investigation method).

8.2.3 RESULTS

The test was developed with some technical problems given the erroneous displays of graphs in certain structures of interactions. Nevertheless, this test helped us to obtain a first glance and a basic idea of the development at that time. Thus, we could obtain only the most important issues regarding the new interface and functionalities. Figure 8.3 shows a conversation that took place during the first test. Here four people took part and three threads were created, one of them (the thread generated by Lis) has been further developed and its child threads develop through the contributions of other participants.

The main issues found are the following:

Regarding the proposed interface, we found some interface usability problems associated with the graph-like visualization (it is not a standard text-based interface). Users take some time to get used to this new visualization. Also,

some participants incorrectly interpreted the meaning of certain graphical cues, especially the decomposition of a message into topics because of the ambiguity between message and topic visualization.

When there are long threads, it is difficult to browse the content of messages and their inspection in the workspace. Mailgroup allows users get messages by clicking on them, but the system displays all child messages of threads, this fact confuses users that find a long list of messages in the workspace.

Also, the first results show that the proposed visualization produced, when students defined several topics in a message, a larger topic segmentation, which contributed to the dispersion of the conversation into small units. This situation can increase the fragmentation problem of traditional threaded conversations (Hewitt 2001).

8.2.4 SOLUTIONS

Regarding the ambiguity of topics and messages, we implement a visualization strategy in the interface to clearly distinguish these two elements. On the one hand, a message is a circle that can have links with other messages belonging to other columns. On the other hand, topics are linked by a vertical line between them in the same column. This solution allows users to visually differentiate the fact that topics

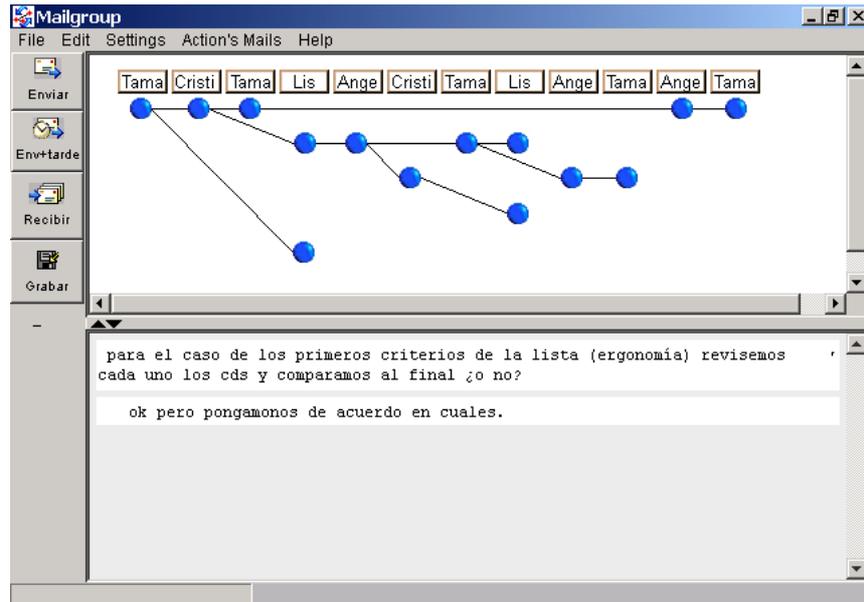


Figure 8.3. A conversation that took place in Mailgroup during the first test.

represent a “segmentation of messages” without graphically burdening the interface. Figure 8.4 illustrates a message as it is displayed in the browserspace and a one possible segmentation of it.

In relation to the child message display problem, we restricted the number of child levels that can be displayed in the workspace when

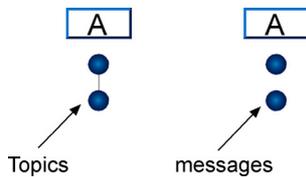


Figure 8.4 Topics and messages

a user clicks on a message. This way, users never obtain a long list of messages that could confuse them.

Moreover, we note that in the interface used in this text, users can visualize in a glimpse the link structure of approximately 20 messages in the browserspace (in a 800 x 600 display), whereas in the traditional forums users can visualize approximately 30 messages (with less space used in the interface). Consequently, our system prevents the users from viewing the messages globally, thus forcing them to look at only a part of the structure. We have reduced the size between message representations (circles)

and the diameter of each message in order to obtain a wider vision of messages.

8.3 *Second test with Mailgroup*

8.3.1 CONTEXT OF EXPERIENCE

The second test was a part of Jean Luc Passin (2003) DEA's (Diplôme d'Études Approfondis) training course activities in the spring of 2003. 15 participants were recruited. All of them were teachers, who for a month and a half carried out a distance collaborative activity as part of a training course on information and communication technologies (ICT). During this study, the tool was used just as the medium of communication and discussion, not as a point of concern in itself. We did not want students to discuss the tool, nor think about it. We were interested in evaluating just how they could "work it out". The participants' activity objective was, to carry out a collaborative analysis of integration and the use ICTs in the educational milieu. The monitor's role of the training course was to guide conversations towards the subjects of interest for this course.

Nevertheless, the general context of this activity is wider than the exchange of opinions in

Mailgroup. The activity included two principal stages: First, an activity that focused on the exchange of opinions about a set of subjects related to the usage problems of computers in the educational milieu:

- The copyright concerning the use of resources or applications in the educational environment
- The protection of people, in particular of minors, in communication situations via Internet.
- The *instrumentalization* process of computing tools by students in a class.
- The certification of students' competences and the systems used through the experience.

The second activity focused on the creation of a database of specific discipline references. This activity demanded participants to explore resources on the Internet, to share and organize them, to propose and defend their point of view, to envisage a template layout, and to justify and negotiate it. This activity was planned for four disciplinary groups (mathematical, technology, orientation, and humanities-history).

In this general context, Mailgroup acts only in the first stage of activities. In the second stage SPIP¹⁰ is used as the technological medium to communicate and organize them.

In this context, an empirical study was designed in order to collect feedback on the actual

¹⁰ SPIP (système de publication pour l'Internet) (<http://www.spip.net/>) is a web publishing freeware system.

characteristics of our prototype, from the user's perspective. That is why we propose a usability study by empirically using Mailgroup. Basically, this study consists of (a) analyzing interactions that take place in Mailgroup through an analysis of some conversations. These conversations were studied in order to examine the impact of the new thread visualization model on threaded conversations in a learning context and (b) Obtaining initial feedback on the interface usability and its organization of messages through a survey that collects the students' impressions related to the use and value of this tool and its potential for learning enhancement.

8.3.2 USABILITY ISSUES

The tutor of this test analyzed usability issues on Mailgroup before participants used it as a part of a collaborative training activity created by him.

This analysis is based on the expert judgment method. This consists of giving the interface to experts who give their opinion.

In this context, the tutor put together this study and located some difficulties of potential uses according to a systematic study of the functionalities of Mailgroup.

The overall conclusion of this analysis was:

“The user who discovers Mailgroup for the first time quickly assimilates the functionalities of the two zones of this application. The principles of navigation, the modes of readings of the

exchanges of the forum seem to be adapted to competences of my public and favorable to back the activities which I wish to implement” (Passin 2003).

Moreover, this analysis contains some suggestions for improving the characteristics of Mailgroup.

8.3.2.1 SUGGESTIONS AND IMPROVEMENTS ON MAILGROUP

Several improvements were suggested from the study carried out by the tutor.

8.3.2.1.1 Making the date of messages explicit

The tutor found that it is important to have the date of messages, in order to get the temporal limits of a conversation which indicate the duration of discussions.

This suggestion was accepted and the date now appears in the column heading of each session (where the name of the sender appears) when the users pass the mouse over these headings.

8.3.2.1.2 Creation of multiple Conversation spaces.

Is not possible in only one browserspace to handle the number of activities envisaged and the diversity of the discussion subjects. We realize that it is necessary to have as many spaces of communication as number of subjects of discussion. In this test the tutor planned to develop ten



Figure 8.5. Bar of conversations

topics or conversations. Now, Mailgroup integrates a functionality that allows users to create and manage up to 18 spaces of conversation. Figure 8.5 shows a part of Mailgroup interface where conversations are placed. If users want to browse another conversation, they must click on

the conversation bar.

We also created a second possibility for reaching conversations. They became accessible thanks to the submenu “to select a conversation” inserted in the menu “actions”, that open a dialog box (figure 8.6) in which all conversations are displayed.

8.3.3 PRELIMINARY RESULTS

In this test 11 conversations took place in Mailgroup for a month and a half. In total, when regrouping the messages, the discussion constituted a document of almost 25 pages (12,000 words), which suggests a very rich exchange among participants.

First, we detail three conversations that took

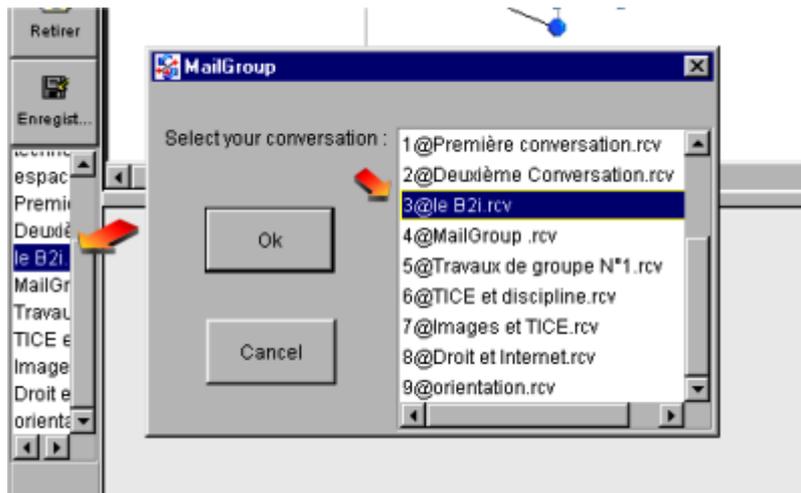


Figure 8.6. Dialog box to select conversations

place in Mailgroup. Next, we present some results of the survey. Finally we present some suggested improvements that emerged from the use of Mailgroup.

The first conversation is “disciplines”. Here seven people took a part and four threads were created by four different members (figure 8.7). The initial number of threads of this discussion (4) can be considered initially as low. But the exchanges are very rich. They include recommendations, advice, and examples proposed to others. There are also interrogations and incentives to offer an opinion. Moreover the thread depth (i.e., the number of responses within a particular thread) goes up to five levels. Consequently, the group does not stay in a situation of question and answer. In total, when regrouping the messages, this conversation constituted a

document of almost 3 pages.

In figure 8.8 we can observe the second conversation, “workgroups”, where the convergence functionality is used. The participants were asked to come to a conclusion about the two days of training. They were asked to give their own opinions, and then the group created a synthesis. We can observe some exchanges among participants. After these exchanges, participant A (the moderator of this experience) creates a convergent interaction (a synthesis in this case) taking into account the contributions of participants “A”, “B”, “E”, and “F”. This synthesis could have also been a longer spiral style synthesis discussion, that is, in successive turns to continue the debate on more specific agreed upon topics. However, the objective of this conversation was to have a fast consensus,

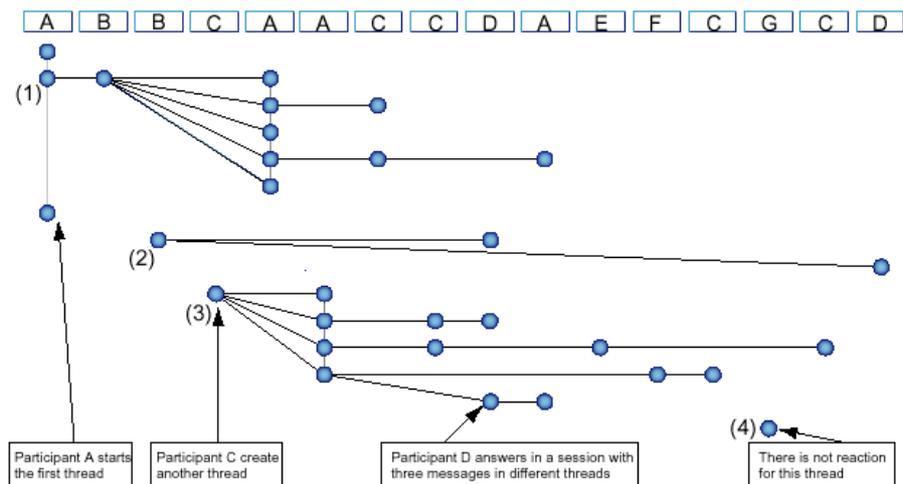


Figure 8.7. “TIC and disciplines” conversation in Mailgroup

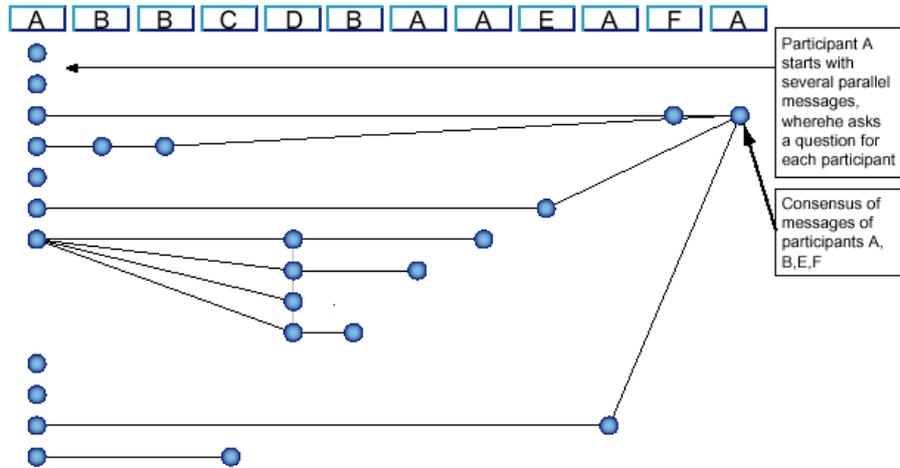


Figure 8.8. Creation of a convergent interaction in Mailgroup in “workgroups” conversation.

an initial idea of the training activity to help to structure the other activities.

In figure 8.9 we observe a part of the conversation “technology”. Here we can observe the WYAIWYL criterion and session functionality in use. The message of “C” was divided into topics (third column), two of them were answered by “B” in the same session. Next, participant “C” reacts to the two messages sent by “B” in only one session. Therefore, these threads can grow in a parallel way representing congruently the interactions that take place in Mailgroup. Figure 8.10 shows the content and the links of these interactions.

Regarding the indicators, they are integrated in the “Mailgroup” forum tool. In this environment, users see the values of the indicators per-

manently in a bar graph. They also can access these indicators through a menu item.

The indicators implemented in this tool were cohesion, complexity of interactions and status of participants. At the first stage of experimentation, indicators are shown only to the monitor of this activity in order to test out the validity of SNA models used in these indicators.

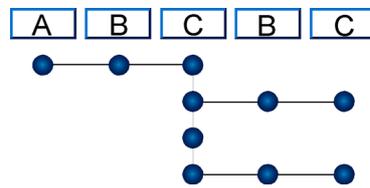


Figure 8.9. A part of conversation “technology”

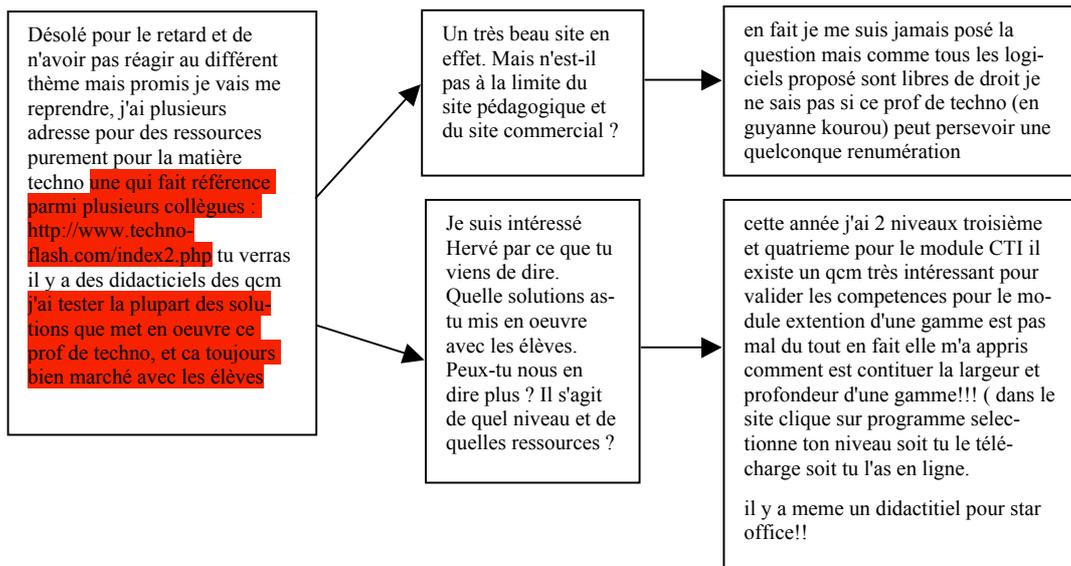


Figure 8.10. The content of interaction structure of figure 8.9

Table 8.1 shows values of complexity, cohesion and status obtained in some conversations that took place in the test carried out in Mailgroup FTT. Each conversation is displayed as independent graphs and the user can select

the desired conversation through a pop-up menu.

We present some possible interpretations of these indicators. In particular, we focus on a part of conversation number 3 (ICTs and disciplines)

Conversations	Cohesion (%)	Complexity (%)	Status
Prise en main de logiciel	9	61	(2, 1, 13, 9, 1, 11, 14, 1)
Travaux de groupe	21	43	(1, 21, 28, 1)
Tice et disciplines	13	55	(5, 11, 1, 4, 4, 17, 8)
Image et TICE	100	71	(10, 10, 5, 13)
Droit et Internet	18	47	(1, 2, 1.2, 1.4)
Education à l'orientation	75	67	(1, 18, 1, 1.2, 1.4)
Humanité	56	73	(17, 12, 6, 3, 8)
Technologie	25	77	(1, 14, 6, 10, 18, 15)

Table 8.1. Values of cohesion, complexity and status of some conversations.

that is shown in figure 8.7. From analyzing the indicators of this conversation, the low value of the cohesion indicator stands out. Analyzing the status of participants we can deduce that there is an imbalanced in participation since two users carry out almost the whole conversation. Their participation and central position (high status value) indicate that they lead the conversation. A potential absence of these participants can imply the ending of this conversation or a radical change of interaction structures. Thus, both indicators indicate to the users (or to a tutor) that it is necessary to change their current social structure.

In relation to the complexity indicator, its mid-range value indicates a conversation with a medium overlapping degree among messages and an average of parallel threads. This value indicates to the users that is not necessary to change their interaction structures (e.g., the

number of parallel threads or the overlapping degree of messages).

8.3.4 SURVEY

In order to obtain the students' impressions of the use of Mailgroup as a communication tool, we elaborated a survey. The survey takes into account all aspects of the training course activities. Nevertheless, we focus on the questions concerning Mailgroup. This survey was handed out to participants the last day of the training course.

In general, a high percentage of participants (75%) considers that the proposed visualization and organization of messages allow for a better follow up of the ongoing development of conversations.

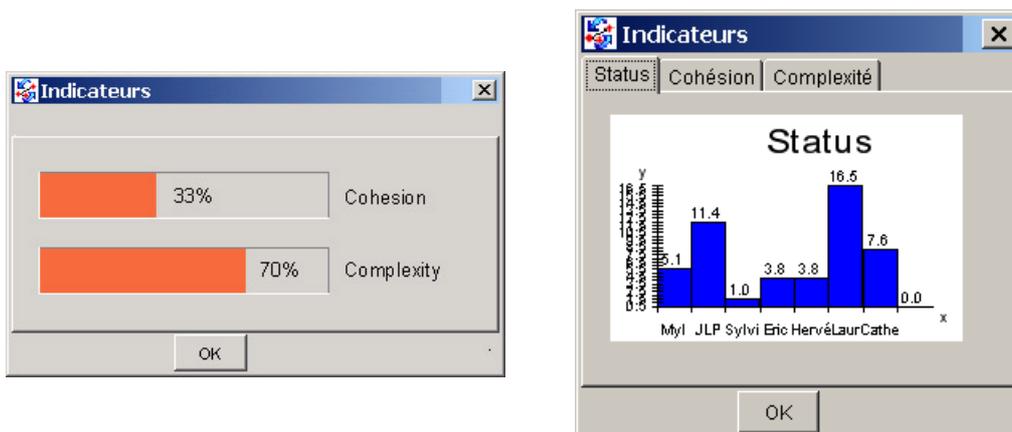


Figure 8.11. Indicators in Mailgroup.

Moreover, a high percentage of participants (75%) considers that Mailgroup permits an effective visualization of the participant's exchanges. Only a small percentage (13 %) had difficulties following up threads in the proposed visualization.

Also, the experience has shown that the introduction of the new session element in VLC does not generate a significant change in terms of the temporal behavior of participants. Using this session element, only between 20% - 30% of the messages can be categorized as consecutive messages. This is approximately the same percentage that was obtained by analyzing this work pattern in selected newsgroups (see section 5.2.3.2). Nevertheless, more than 50 % of these consecutive messages were bound together through sessions that contain two or more messages.

Participants used the WYAIWYL principle. Since students could choose more granular and "findable" topics in the easily navigable thread view, they could organize and collaborate better. Also, the most significant benefits of using this criterion identified by users were: (a) an easier identification of the active threads and (b) it better allowed for the organization of answering, related to current FTTs.

Consequently, the survey, though limited, seems to strongly show the benefits of using this visualization for threaded conversations.

8.3.5 IMPROVEMENTS FROM THE USE

Several improvements were collected from the use of Mailgroup. Some of them were implemented and used by the participants. The titles change of conversations, ephemeral messages, and the creation of conversation spaces were developed and are detailed in sections 7.2.2.5-7. The other requests not yet developed are detailed in the follow sections.

8.3.5.1 PRIVATE MESSAGES

We identified the need to implement the possibility of sending private messages. Sometimes participants wanted to ask the tutor or another student a question but they did not want other students to acknowledge this communication. By using the private message feature a student would be able to contact another participant directly. We identified the absence of this functionality as a new breakdown in conversation, given users had to exit from the Mailgroup environment to use external e-mail applications to communicate (generally, technical discussions) in a more private way. This functionality is not yet implemented.

8.3.5.2 THREAD'S PRINT

Users wished to have conversations printed. Unfortunately conversations have a tree-like structure, they are not always linear, and that requires a specific method for its impression. We think that it is a very important functionality to print threaded conversations.

8.3.5.3 OTHER REQUESTS

Other requests to improve Mailgroup were made during the test period. Users wished to change the name of their alias or the anonymity of certain messages. Another proposition was the possibility to freeze conversations to prevent more interventions in a particular conversation

8.4 Discussion

The results of this study are preliminary, mainly due to the relatively small size of the sample. Nevertheless, the results have allowed us to obtain good feedback about the usability of the proposed system. These results indicate that the proposed system and the concepts underlying the construction of Mailgroup are significant. The results, and the experience gained, encourage us to further develop, refine, and expand

future implementations of the Mailgroup system.

Our principal findings are summarized below:

- The experience carried out with Mailgroup confirms that WYAIWYL principle is a useful mechanism for structuring FTT threaded conversations.
- The use of this tool enables a change of practice: students organize the structure of messages into paragraphs. Indeed, they affirm that creating messages in this way will make it easier for other participants to locate and respond to parts of a message (topic), facilitating topic salience and definition.
- Another observation is the salience of no-answer topics. The proposed visualization facilitates the tracking of no-answer topics that take place during the conversation. These topics are visualized and highlighted in the interface as circles without links to or from other messages.
- The graph visualization must be improved (a) using algorithms that allow fewer lines to be crossed between messages, because these lines make the visualization of references between messages difficult. (b) Optimizing the space that is now poorly exploited (in the current visualization there are many zones without messages, which makes the navigation between the messages difficult).

- Indicators can be an element used to analyze the group in order to obtain a structural awareness of their interactions, although more studies concerning this must be made.

IV

CONCLUSIONS

9 Conclusions



9.1 Summary

This work principally aimed to create new technologies of communication for VLCs, emphasizing the process of creating these new technologies through the adoption of a particular methodology approach of design, which stresses the establishment of a scientific background as the element that guides this research.

Regarding the methodology, we conjecture that specifying the scientific background (Part I) allows us to develop a sensitivity that helps us reveal anomalies in our context of interest. The scientific background involves three components that have been developed in this thesis: the research issue, the scientific context, and theoretical considerations.

The research issue (chapter 2) of this thesis concerns the analysis of learning conversations that take place in VLCs, in order to provide mechanisms to support and facilitate the emergence of these types of interactions among the users of CMC tools. This research issue concerns a wide range of different areas of research.

The scientific context of this thesis (chapter 3) basically corresponds to the Computer Supported Collaborative Learning domain. In this broad domain we focused on a specific field of study, which specifies the target group, and its

characteristics, studied in this research. In our case this field of study is the VLCs in FTTs (section 3.3).

Through the theoretical considerations taken in this thesis (chapter 4), we propose a structural perspective of conversations. We do not interpret conversations as semantic chains of participants' contributions, but we interpret the interactions in a purely relational way. That is, we consider interactions in FTTs just as links or connections among messages, not as semantic content providers.

Once the scientific background was established, our work consists of revealing anomalies in VLCs taking place in FTTs (chapter 5).

We have used different methods for analyzing data to reveal anomalies (observation analysis and quantitative analysis of selected newsgroups and bibliographic analysis). Each of these methods allows us to interpret different anomalies from the analyzed groups. In spite of their intrinsic difference, we notice that all these methods are based on experimental and practical issues. In this context, our thesis can be seen as a work of conceptualization of the issues found and an instrumentation of these conceptualizations, in order to give users new tools that facilitate their mediated, and written, conversations.

Particularly, we found four anomalies (from a structural perspective) that we call "structural incongruencies" (section 5.2). First, the fact that the current FTTs have an "interactional incongruence" derived from the granularity difference

between the message unit that users can handle and the one they can reference. This incongruence causes information losses and reference confusions. Second, current forum-type systems bring up what we call “turn-taking incongruence” caused by the disruption between (a) the temporal and the thread order of messages and (b) the management of parallel threads. Third, current FTTs bring up what we call “convergence incongruence” triggered by the lack of a mechanism to manage the convergent interactions taking place in FTTs, as consensus, connecting ideas or synthesis. Fourth, current FTTs bring up what we call “group perception incongruence” caused by the lack of perceptions of the structural regularities of interactions taking place in a group.

In order to overcome these incongruencies, we propose a peer-to-peer support approach that we call the structural awareness support. This approach has been implemented on a FTT called Mailgroup. Structural awareness deals with the knowledge about structural features or activities of a group. Its emphasis is on revealing the group structure to their participants from both a static and a dynamic viewpoint. The aim of creating structural awareness for the participants of a FTT is to make salient some structural properties of the group, in order to promote collaborative interactions.

In particular, structural awareness will be reified through (a) different strategies that aim to enable participants to perceive their interactions in what we suggest is a more congruent and

concise way than current FTT, by being able to see the structure of their exchanges in an ordered visual manner overcoming the interactional, convergence, and turn-taking incongruence already mentioned. Thus, we show the participants the group’s structure of interactions, enabling them to perceive their interactions through a graph-like visualization, providing particular mechanisms for maintaining a higher coherence between their interactions and the visualization; (b) A set of persistent indicators of certain characteristics of the group, which allows users to get summarized information related to some group structural properties and even some structural attributes of individuals, that are not salient in VLCs. We have implemented an observation level of the communicational activity based on these quantitative indicators, namely the complexity of a group, cohesion of a group, and individual status indicators. Each of these strategies has been implemented on a FTT called Mailgroup.

Regarding the tests of this prototype implementation, it has been tested twice in different contexts, obtaining initial feedback of its pertinence according to our objectives. The results indicate that the work is properly oriented, but also that it is necessary to do further research.

9.2 *Contribution*

The tool presented in this thesis focuses on the notion of enhancing coherence in threaded conversation systems. It is aimed at facilitating the emergence and development of learning conversations. This was done overcoming some incongruencies we have identified as undermining the emergence and development of better communication, without resorting speech act or sentence opener techniques, nor through costly agents' utilization. It was made through a simple reconceptualization of communication in threaded conversation tools and the specification of high-level indicators, which catch some structural properties of the group interactions.

Even though this tool can be used in other contexts than learning communities, we argue that the best benefits for this new structure can be drawn from these communities, considering that in this context the creation of a common ground is a very important issue that helps virtual or distant learning conversations emerge and progress.

The next sections detail different concepts and notions introduced in this thesis.

9.2.1 METHODOLOGY

This thesis used a design methodology that facilitates the development of scientific exploration in computer science. In this context, we think that the establishment of the scientific background, as a principal axis of the methodology, guides the study towards revealing anomalies, offering a new way of looking at design and the researcher's role. We suggest that this approach is adapted in a better way to technological innovation research, given that it focuses on the process of creating new technological tools. Nevertheless, we must consider this methodology as the first step of research ("framing stage"). That is, the new technologies created must be analyzed subsequently by deductive research, in order to validate the solutions proposed.

9.2.2 STRUCTURAL AWARENESS NOTION

We propose the structural awareness support. This support aims at users being aware of their activity through their communication structure.

This notion is based on two ideas: (1) structural perspective, which considers the interactions among participants in FTTs just as links between messages and (2) Peer-to-peer support, where one does not seek to make a system that

intervenes on the actors, but a system that gives them the means of intervening by themselves.

All strategies implemented in this thesis rely on the need to inform actors, enabling them to structurally perceive their group activity. The tenet of this support strategy is that making the structures of interaction more congruent with the communication patterns contributes to facilitating better communication in VLCs.

We think that our work follows a poorly explored line of research in the domain thus giving to researchers a new space of action to develop new tools for the asynchronous communication by finding new anomalies. Moreover, we conjecture that computer supported systems for collaborative learning other than FTTs can benefit from our perspective.

9.2.3 NEW CONCEPTS ON FTTS

9.2.3.1 THE “WHAT YOU ANSWER IS WHAT YOU LINK” PRINCIPLE

The proposed tool introduces an adjustment in the granularity of the interactions and new dynamics of answering based on the WYAIWYL principle (Reyes and Tchounikine 2003). This principle makes it possible to go from a thread-fixed structure to a more flexible and granular one that considers the aspects of interaction self-management through the user’s capability of defining new topics and their development.

By making use of this principle, an FTT that applies WYAIWYL changes the significance of the unit of communication, from a chain of messages containing topics, (generally misused) to a chain of topics, where its easier to follow and find the actual topics of discussion.

We note that this principle can be used not only in Mailgroup, but also can be implemented in other FTTs. Moreover, we present in this thesis only one strategy for implementing this principle: other FTTs or threaded conversation tools can design other ways of implementation.

9.2.3.2 SESSION CONSTRUCT

We propose in this thesis the introduction of a new element in the forum-type tools that makes certain work practices of participants in a VLC explicit.

The introduction of the session construct allows us to make salient a temporal behavior of participants of a VLC that current technology hides. We conjecture that stating these behaviors can be an element to improve the management of threaded learning conversations, because this structure gives a more congruent visualization of turn-taking. Moreover, the session can be conceptualized as a type of representational guidance (Suthers 2001) element for students or participants. That is, a representation (like graphs or pictures) that helps promote collaborative interactions of users through a direct perception of participant’s turns and their actual time management.

Our approach clearly differs from the research on turn-taking issues where the main focus is on the consequences of the delay in the communication tools like forums and chat's (e.g., Herring 1999; Pankoke-Babatz and Petersen 2000).

9.2.3.2.1 *Session as a turn-taking element*

The session structure can help to rearticulate the turn-taking in threaded conversations for better coordination, cooperation, and collaboration given that users can situate and contextualize the interventions of participants better. We state that the introduction of a session structure redefines the concept of turn-taking in threaded conversations. Using the session construct these conversations become linear alternating turns similar to those in face-to-face conversations.

Turn-taking in spoken conversations deals with alternating turns for communicating between participants. This process takes place in an orderly fashion. Nevertheless the application of the turn-taking concept in the FTT context is not clear, because the threaded structures produce a lack of linearity and message dispersions. Thus, we propose to interpret the turn-taking in threaded conversations at another level of granularity, and no longer think that each intervention (message) in a thread is a turn in the conversation, but the group of messages (each one answering a different thread) sent in an session is now the turn.

With the use of this session element, users obtain a clearer notion of turn-taking that takes place in threaded conversations. With this temporal structure the non-linearity of threaded conversations disappears and the turn-taking becomes alternating turns of sessions.

Also, this structure allows for the management and the parallel visualization of different threads in a multithreaded conversation, which are normally visualized in a dispersed way: the session structure "packages" the messages that are normally dispersed in different threads. Therefore, this structure overcomes an identified dissociation in threaded conversations between the temporal and the thread order of messages (Herring 1999; Davis and Rouzie 2002). This dissociation has important consequences on participants, which often fail to follow the development of a multithreaded debate (Davis and Rouzie 2002).

9.2.3.3 GRAPH VISUALIZATION (LINEAR DEBATE GROWTH)

FTT systems have a lack of awareness mechanisms for appreciating the evolution of the developing discussion. Tools that allow a visualization of this progression of a conversation are extremely important for improving the understanding of the group process by members. (Turoff, Hiltz et al. 1999). Mailgroup, our prototype implementation, allows participants to be aware of the ongoing progress of their threaded conversations, given its conversation visualiza-

tion tracking features, which allows a linear debate growth.

9.2.3.4 STRUCTURAL INDICATORS

At this time, three awareness indicators have also been implemented: group cohesion, its complexity, and the relative status of the participants in the group. These indicators revolve around structural properties, the “social relationships” in a group. Future studies revolve around the use and benefits of these indicators as peer-to-peer support elements for participants in VLCs. In this way, these indicators are not developed in order to understand interactions or groups in a sociological approach or for decision making by “authorities” or administrators, but for all participants of the group in order to obtain a structural awareness of their interactions. This perspective of work is close to the social profiles notion introduced by Hummel and Lechner (2002).

9.3 Current state of research and future developments

We present some of the difficulties and gross decisions we are facing now, regarding mainly

our prototype tool implementation, but also some limitations we have found regarding our methodology and tests.

9.3.1 MAILGROUP

The tool has been improved at different moments and by different methods. This way, the tool, which was first conceived only by looking at the practices of potential users, has evolved into an iterative and participative process.

Regarding the next steps for Mailgroup, one of the main tasks ahead is to open it to a broader audience. We envision a free downloadable distribution that anybody could use a few months later.

The main challenge is to rearchitect it so that it can be used as a newsgroups reader. Actually, Mailgroup works as an e-mail client application, according to the initial design, in order to make it usable without requiring a permanent online connection to Internet. Moreover, users mentioned this feature: “The possibility of being able to consult and to enrich the discussions offline, is a very good point for the people involved in the test (who do not have ADSL). Therefore, the participants can, without feeling pressured, try to understand how this application is organized, develop the ideas more easily, and to seek the contributions of others. One does not react obligatorily in the moment” (Passin 2003).

Nowadays, given the new ubiquitous nature of the Internet, we have decided to make the system geared towards the “always on” nature of today's and tomorrow's Internet users.

Making Mailgroup a tool which any traditional newsgroups can use to browse and work in these VLCs would foster in our view a wider community. Technically, it means mainly adapting it as a web application and making it compatible with NNTP protocol, through adding specific headers, which will carry specific information about the selected topics of messages. Therefore, users should access newsgroups through a web interface that includes all of the functions of Mailgroup. Both activities are currently under way.

Also, working on message visualization is required to guarantee its scalability, in order to provide proper performance under high volume of messages. Particularly, (1) diminish the crossing lines among messages; (2) diminish the complexity of reading the graphs when these attain a big number of messages.

The other milestone refers to augmenting the ubiquity of virtual conversations by printing them. This will allow users to read the conversation using another format. Moreover, printing threaded conversations can produce the compilations of conversations in a book format.

In the context of our research project, printing exchanges can be a relevant way to study and analyze the interactions of threaded conversations and augmenting the ubiquity of online conversations. Moreover, in the pedagogical en-

vironments, printing exchanges can be an important pedagogical element for readers, given that relevant conversations can benefit from the portability and flexibility of the paper medium.

9.3.2 METHODOLOGY

The main problem of the exploratory methodology used in this work is the uncertainty regarding the results that can be obtained. Stating the scientific context helps develop a sensitivity for revealing anomalies, but it does not assure that anomalies will be found.

On the contrary, the deductive methodology, like the classical two-step paradigm of (1) defining hypotheses, and (2) testing them through experimentation, ensures us that results will be obtained (through the validation of hypothesis). Due to the fact that results are not guaranteed produces a certain restlessness during research development for an academic context such as a PhD thesis. Furthermore, this type of methodology makes developing a plan of action difficult.

It is necessary to continue the research, but using deductive methodologies. The new elements of FTTs, notions, and support elements need to be validated scientifically: research not only consists of exploration, but also work within “laboratory” in where we must validate the findings from scientific and experimental protocols.

9.3.3 TESTS

In order to perform the tests, we took a structured approach of collaboration (section 3.1.1.2). Even if our interest is to give these new tools to emerging learning communities, which do not present a structure of interaction a priori, the emergent nature of auto-organized learning communities makes the study of the use of Mailgroup in these communities random and not easily systematized. Moreover, this situation, i.e., the difficulty of setting up an emergent collaborative activity in an institutional educational milieu, remains as an unsolved problem, which will not be tackled in our work. Furthermore, there are few possibilities of guiding an existing VLC to adopt an experimental tool, which is in its experimental stages, given its character of autonomy. For this reason we want to build the web implementation of Mailgroup, with compatibility to newsgroups, so that the tool can become openly available to potential users.

Consequently, the fact of having a semi-controlled context (structured approach of collaboration) facilitates the attainment of the test objectives within a PhD thesis context. We conjecture that this change does not reduce the validity of our test because the interactions taking place on the groups also take place in learning communities. Nevertheless, we are conscious of the differences between our public test and the real target public, and we conjecture that

the results can be applied to learning communities.

9.4 *Final words*

This thesis is considered part of a project, and a work in progress that aims to design new technologies for everyday life. We consider this design as a way of enquiring about our everyday lives.

This study operated, principally, at three interwoven levels:

1. The theoretical level, in which we explored the potential for new methodologies for designing technologies. Particularly, in this thesis we worked on a design methodology that sees the design as revealing anomalies, and it tries to augment the sensitivity for revealing these anomalies in a particular context through the establishment of a scientific background (i.e., part I of this thesis).
2. The conceptual level, in which we worked as explorers and designers of new interactive tools. At this level, our work has been to detect a set of anomalies and design new tools for overcoming these anomalies (i.e., part II of this thesis).

3. The experimental level, in which we put in practice the proposed design. Here, the role of this level is not the scientific validation of the design, but

to obtain early feedback on the behavior of users towards the new design (i.e., part III of this thesis).

10 References



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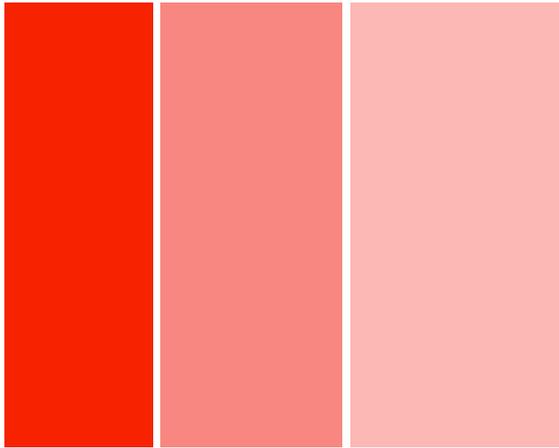
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Appendix I





Análisis en forma cooperativa y virtual de la calidad de un programa educativo

En esta página se encuentra toda la documentación y programas necesarios para realizar la actividad diseñada para el curso **Libro Virtual**, modalidad virtual.

Para el desarrollo de esta actividad se han creado grupos que deberán trabajar en forma conjunta sobre el tema propuesto.

Para comunicarse, los alumnos utilizarán un programa de discusión que podrán bajarlo desde este mismo sitio.

- [Definición de la actividad.](#)
- [Grupos de Trabajo](#)
- [Lista de Programas educativos](#)
- Software a utilizar

Grupos de trabajo

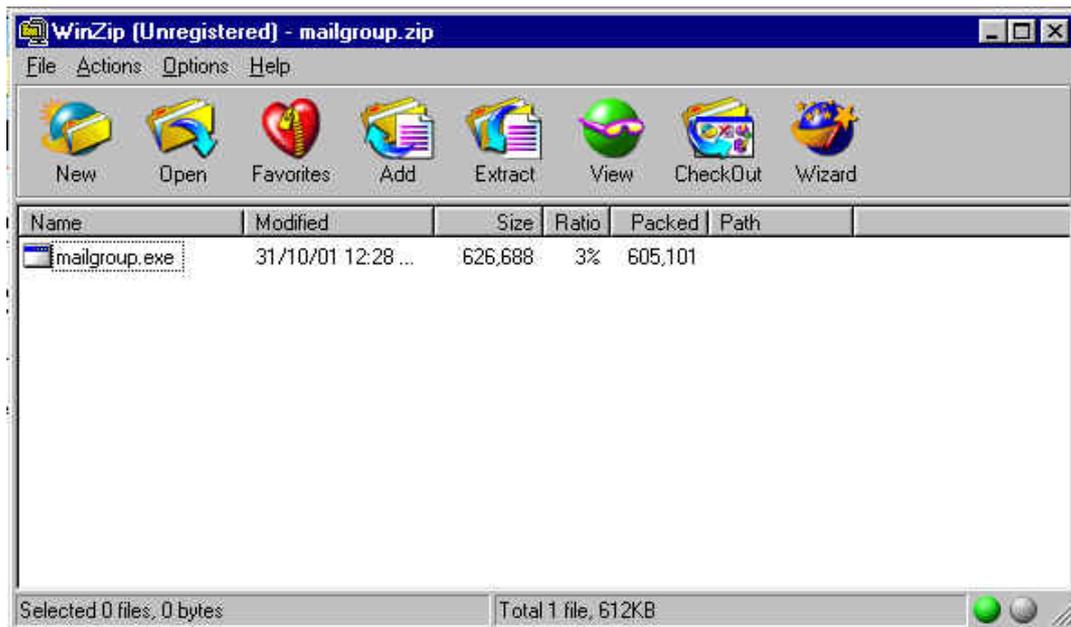
En esta página encontrará la conformación de cada grupo y el programa de comunicación *mailgroup* ya personalizado para cada usuario - esta personalización consiste en que ya se encuentran realizados todas las configuraciones iniciales para cada usuario.

Solamente, es necesario realizar un doble click sobre la carpeta que corresponde a cada alumno y seguir las instrucciones que siguen a continuación.

Grupo 1	Grupo 2	Grupo 3	Grupo 4
Alumnos Grupo 1	Alumnos Grupo 2	Alumnos Grupo 3	Alumnos Grupo 4
Grupo 5	Grupo 6	Grupo 7	Grupo 8
Alumnos Grupo 5	Alumnos Grupo 6	Alumnos Grupo 7	Alumnos Grupo 8
Grupo 9			
Alumnos Grupo 9			

Instrucciones de Instalación de Mailgroup

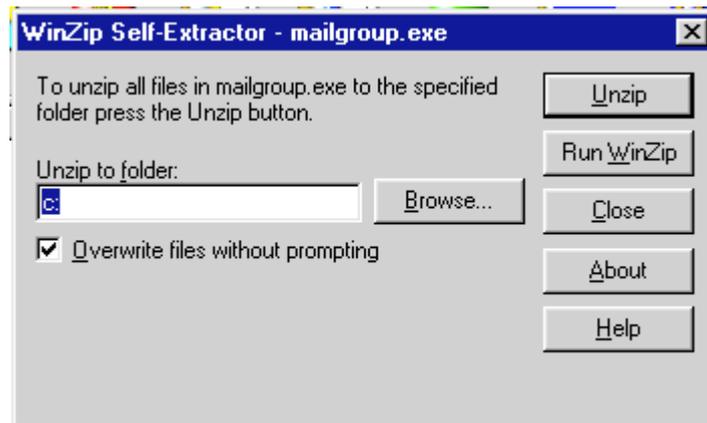
1. Descargar [Mailgroup.zip](#) desde este sitio WEB -Recuerda donde vas a dejar este archivo al momento de descargarlo en tu computador-.
2. Ejecutar (doble clic) el archivo descargado (mailgroup.zip) . Al ejecutar este programa debería aparecer el siguiente cuadro de diálogo



Si el computador no reconoce el archivo significa que tu computador no posee el programa Winzip, y por lo tanto debes instalarlo. Este programa se descarga desde la siguiente dirección :
<http://www.winzip.com/download.htm>.

Después de descargado e instalado el programa winzip puedes pasar al volver a ejecutar el archivo mailgroup.zip

3. Ejecutar (doble click) el archivo mailgroup.exe que aparece como el único archivo dentro de la ventana de WINZIP. Al ejecutar este programa aparece el siguiente cuadro de diálogo :



4. Presionar botón "Unzip". Al presionar este botón el programa se instala **automáticamente** en la carpeta mailgroup.

5. Para ejecutar Mailgroup debes dirigirte siempre a la carpeta mailgroup - c:\mailgroup- y ejecutar -doble clic- el archivo "**ejecutar.bat**"



**Actividad grupal a distancia:
Análisis en forma
cooperativa y virtual de un
programa educativo.**

El objetivo de esta experiencia es realizar una evaluación de diferentes programas educativos, a partir de los criterios que se señalan y detallan en la sección siguiente. Esta experiencia se debe realizar utilizando el programa de comunicación que les será proporcionado.

El objetivo pedagógico de esta experiencia, es entregarles a los participantes una “visión” basada en diferentes criterios, con la cual poder analizar y evaluar distintos programas informáticos dedicados a la educación.

La experiencia termina cuando existe un consenso en la aplicación de los criterios entre los participantes en los distintos programas que estarán disponibles. Al finalizar la actividad se debe entregar un ranking de los programas analizados.

La actividad es intrínsecamente grupal, para ello se deben conformar grupos de 3 ó 4 personas. A cada grupo tendrá asignado igual número de CD's o sitios educativos, que podrán ser seleccionados entre una lista que les será proporcionada.

Estructura de la actividad.

La actividad debería estar dividida en varias etapas que se detallan a continuación :

- **Etapa de información**
comprensión de los criterios entregados (Incluye comprensión personal e interacción entre los distintos participantes, por medio del programa que les será proporcionado).

- **Etapa de exploración y análisis de los CD's y sitios proporcionados.**
Cada alumno debe explorar y analizar los CD's o sitios proporcionados.

- **Etapa de interacción**
publicación de cada evaluación en el sistema proporcionado.
Confrontación, discusión e intercambio de opiniones.
Consenso

- **Etapa de entrega de resultados**
Cada grupo debe entregar en un texto que incluya los resultados del análisis, y argumentos que justifiquen todas las conclusiones del grupo.

- **Etapa de evaluación**
La evaluación de esta experiencia pone el acento en dos puntos : el proceso de cooperación y el resultado entregado.
El primero dice relación a diversos aspectos que se relacionan con los integrantes de un trabajo en cooperación, como es la participación, el grado de compromiso, la responsabilidad, capacidad del grupo para resolver conflictos, etc.. (el cómo organizarse a partir de la estructura de la actividad dada, tiene tanta importancia como el resultado que entreguen.)
El segundo elemento de evaluación –evaluación del resultado- comprende una evaluación de la aplicación de los criterios sobre los programas.



Criterios de calidad para programas de interés educativo

La evaluación de programas de interés educativo debe partir de la aceptación de unos criterios de calidad que se tomen como marco de referencia para realizar su valoración.

Los buenos programas educativos son **eficaces, facilitan el logro de sus objetivos**, y ello es debido, supuesto una buena utilización por parte de sus usuarios, a una serie de características que atienden a diversos aspectos funcionales, técnicos, estéticos psicológicos y pedagógicos, los cuales se comentan a continuación:

Hemos definido tres áreas de evaluación de la calidad de los programas de interés educativo.

1. Ergonomía : Esta área concierne los aspectos del programa que se relacionan con su facilidad de uso, adaptabilidad, calidad del entorno visual.
2. Manejo de la interacción y comunicación : Esta área dice relación con la capacidad que presenta el programa para interactuar con él.
3. Espacio de aprendizaje y enseñanza. Esta área incluye los aspectos pedagógicos que posee un programa de uso educativo.

Cada una de estas áreas posee diferentes indicadores que sirven, dentro del contexto de cada área, como criterios de evaluación de la calidad de un programa educativo. Estos indicadores se detallan a continuación.

Facilidad de uso. Deben ser fáciles de usar y autoexplicativos, de manera que los usuarios puedan utilizarlos sin dificultad y ver realizados sus propósitos de **localizar información, obtener materiales**, encontrar enlaces, **consultar materiales didácticos**, realizar aprendizajes...

En cada momento el usuario debería conocer el lugar en el programa donde se encuentra y tener la **posibilidad de moverse según sus preferencias**: retroceder, avanzar.

Un **sistema de ayuda** on-line puede solucionar las dudas que puedan surgir.

Calidad del entorno audiovisual. El atractivo de un programa educativo depende en gran manera de su entorno comunicativo. Algunos de los aspectos que, en este sentido, deben cuidarse más son los siguientes:

- **Diseño general claro y atractivo de las pantallas**, sin exceso de texto y que resalte a simple vista los hechos notables..
- **Calidad técnica y estética en sus elementos:**
 - Títulos, menús de opciones, *frames*, ventanas, iconos, botones, espacios de texto-imagen, formularios, barras de navegación, barras de estado, elementos hipertextuales, fondo...
 - Elementos multimedia: gráficos, fotografías, animaciones, vídeos, voz, música...
 - Estilo y lenguaje, tipografía, color, composición, metáforas del entorno...
- **Adecuada integración de medias**, al servicio del aprendizaje, sin sobrecargar la pantalla, bien distribuidas, con armonía. Hay que tener

en cuenta que los recursos audiovisuales ralentizarán la carga de las páginas, por lo tanto no se debe abusar de ellos.



Sistema de navegación e interacción. Los sistemas de navegación y la forma de gestionar las interacciones con los usuarios determinarán en gran medida su facilidad de uso y amigabilidad. Conviene tener en cuenta los siguientes aspectos:

- **Mapa de navegación.** Buena estructuración del programa que permite acceder bien a los contenidos, secciones, actividades y prestaciones en general.

- **Sistema de navegación.** Entorno transparente que permite que el usuario tenga el control. Eficaz pero sin llamar la atención sobre sí mismo. Puede ser: lineal, ramificado, jerárquico, poligonal, libre... En cualquier caso debe permitir, si el usuario lo desea, la navegación libre.

- **El uso del teclado.** Los caracteres escritos se ven en la pantalla y pueden corregirse errores.

- **El análisis de respuestas.** Que sea avanzado y, por ejemplo, ignore diferencias no significativas (espacios superfluos...) entre lo tecleado por el usuario y las respuestas esperadas.

- **La gestión de preguntas, respuestas y acciones...**

- **Ejecución del programa.**

- La ejecución del programa es fiable, no tiene errores de funcionamiento y detecta la ausencia de los periféricos necesarios.

- Tiene los links actualizados, de manera que los hipertextos funcionan bien.

- La velocidad entre el usuario y el programa (animaciones, lectura de datos...) resulta adecuada.

Bidireccionalidad. Es conveniente que los usuarios sean no sólo receptores de la información sino que también puedan ser emisores, de manera que sea posible una comunicación bidireccional. En el caso de paquetes educativos en CD esta interacción puede estar reflejada en la capacidad de realizar ejercicios y tests.

Uso de tecnología avanzada. Resulta también deseable que los programas educativos presenten entornos originales, y que utilicen las crecientes potencialidades del ordenador y de las tecnologías multimedia e hipertexto.



Capacidad de motivación. Los programas educativos deben resultar atractivos para sus usuarios, y especialmente los que sean de tipo "material didáctico" deben resultar motivadores para los estudiantes a fin de potenciar los aprendizajes. En este sentido las pantallas y las actividades deben despertar y mantener la curiosidad y el interés de los usuarios hacia la temática de su contenido.

Adecuación a los usuarios. Los buenos programas tienen en cuenta las **características** de los usuarios a los que van dirigidos (desarrollo cognitivo, capacidades, intereses, necesidades...) y sus **circunstancias**. Esta adecuación se manifestará en tres ámbitos principales:

- **Contenidos:** extensión, estructura y profundidad, vocabulario, estructuras gramaticales, ejemplos, simulaciones y gráficos...

- **Actividades y secciones** : tipo de interacción, duración, elementos motivacionales, mensajes...

- **Entorno de comunicación:** pantallas, sistema de navegación, mapa de navegación...

- **Uso.** Posible uso on-line y off-line

La calidad en los contenidos. Al margen de otras consideraciones pedagógicas sobre la selección y estructuración de los contenidos según las características de los usuarios, hay que tener en cuenta las siguientes cuestiones:

- **La información que se presenta es correcta y actual,** se presenta bien estructurada diferenciando adecuadamente: datos objetivos, opiniones y elementos fantásticos.

- **Los textos no tienen faltas** de ortografía y la construcción de las frases es correcta

- **No hay discriminaciones.** Los contenidos y los mensajes no son negativos ni tendenciosos y no hacen discriminaciones por razón de sexo, clase social, raza, religión y creencias...

Potencialidad de los recursos didácticos. Los buenos programas utilizan potentes recursos didácticos para facilitar a sus usuarios el acceso a la información y la realización de buenos aprendizajes. Entre estos recursos se pueden destacar:

- Proponer diversos tipos de actividades e itinerarios que permitan diversas formas de utilización y de acercamiento al conocimiento.

- Utilizar organizadores previos al introducir los temas, síntesis, resúmenes y esquemas.

- Emplear diversos códigos comunicativos: usar códigos verbales (su construcción es convencional y requieren un gran esfuerzo de abstracción) y códigos icónicos (que muestran representaciones más intuitivas y cercanas a la realidad)

- Incluir preguntas para orientar y consolidar la relación de los nuevos conocimientos con los conocimientos anteriores de los estudiantes.

- Tutoriar las acciones de los estudiantes, orientando su actividad, prestando ayuda cuando lo necesitan y suministrando refuerzos

Fomento de la iniciativa y el autoaprendizaje. Se valorará que la interacción en los programas educativos potencien el desarrollo de la iniciativa y el aprendizaje autónomo de los usuarios, proporcionando herramientas cognitivas para que los estudiantes hagan el máximo uso de su potencial de aprendizaje, puedan decidir las tareas a realizar, la forma de llevarlas a cabo, el nivel de profundidad de los temas y el nivel de autocontrol de su trabajo.

En este sentido, facilitarán el **aprendizaje a partir de los errores** (empleo de estrategias de ensayo-error) tutoriando las acciones de los estudiantes, explicando (y no sólo mostrando) los errores que van cometiendo (o los resultados de sus acciones) y proporcionando las oportunas ayudas y refuerzos.

Además estimularán el desarrollo de **habilidades metacognitivas** y estrategias de aprendizaje en los usuarios, que les permitirán planificar, regular y evaluar su propia actividad intelectual, provocando la reflexión sobre su conocimiento y sobre los métodos que utilizan al pensar.

Ergonomía				
	EXCELENTE	ALTA	CORRECTA	BAJA
Eficacia (entorno que facilite el logro de los objetivos que pretende)				
Facilidad de uso (entorno amable, no te pierdes)				
Calidad del entorno audiovisual (pantallas, sonido)				
Manejo de la interacción y comunicación				
	EXCELENTE	ALTA	CORRECTA	BAJA

Sistema de navegación e interacción (claridad, estructuración, velocidad, formas de comunicación...) Bidireccionalidad (los usuarios pueden ser receptores y emisores de mensajes y/o información) Uso de tecnología avanzada				
Espacio de aprendizaje y enseñanza				
	EXCELENTE	ALTA	CORRECTA	BAJA
Calidad en los contenidos (textuales, audiovisuales...				
Capacidad de motivación (atractivo, adicción)				
Adecuación a los usuarios (a sus características y circunstancias)				
Potencialidad de sus recursos didácticos (explicaciones, ejemplos, resúmenes, preguntas...)				

Fomento de la iniciativa y autoaprendizaje (estrategias de localización y valoración de información...)

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FUENTES :
EVALUACIÓN DE RECURSOS EDUCATIVOS, PLAN MAESTRO CAPACITACIÓN,
ENLACES.

CRITERIOS PARA LA CLASIFICACIÓN Y EVALUACIÓN DE ESPACIOS WEB DE INTERÉS EDUCATIVO Dr. Pere Marquès Graells-99, UAB.

CD's sugeridos

Los alumnos son libres de escoger cualquiera de los CD's o sitios que se proporcionan. Si algún participante desee utilizar otro CD o sitio puede utilizarlo igualmente.

Los siguientes CD's se encuentran disponibles en el CDM y pueden ser elegidos libremente por los participantes de la actividad.

- Leonardo el inventor
- Veo veo
- En busca de positrón
- Miguel Angel, vida y obra
- Museo d'Orsay
- Historia de Chile 1.1
- Anatomía
- Nuestra tierra, Geografía escolar interactiva
- El cuerpo humano 2.0
- Ilusiones [cuando el ojo engaña a la mente]
- El origen de nuestra civilización
 - Colección Vergara
 - La vida
 - Genética y evolución
 - Vertebrados
 - Aritmética
 - Mecánica
 - Geometría
 - Álgebra
 - Movimiento vibratorio
- Enfocando
- Los grandes inventores.

Sitios WEB:

- <http://www.edc-ven.com/03e/index.html>
- <http://www.contenidos.com/entretenimientos/animales/index.htm>
- <http://www.codelco.cl/educa/index.html>
- http://www.educarchile.cl/funchile/Autoaprendizaje/inicio_flash.htm

- http://www.educarchile.cl/modulos/contenidos/uc/buscador_front.asp?tipo=sitio&esc=docente
- http://www.contenidos.com/arte/instru_autoctonos/index.html
- http://www.educarchile.cl/funchile/sitios_educativos/musica/index.html
- http://www.educarchile.cl/funchile/sitios_educativos/patrimonio/index.html

Manual de uso de MailGroup

Introducción

MailGroup es un sistema de mensajería que tiene por objetivo entregar a los participantes de un grupo de aprendizaje, herramientas para manejar de mejor manera el flujo de correos electrónicos que se envían.

Para lograr este objetivo se han propuesto dos mecanismos:

- La creación de una zona de navegación, donde los usuarios pueden ver gráficamente como los mensajes se van enlazando y donde también pueden seleccionar los mensajes de su interés.
- La creación de la capacidad de no sólo responder a un mensaje en su totalidad, sino también a una parte de éste, bajo la premisa de : **“respondes lo que seleccionas”**.

Esta última característica es única dentro de los sistemas de mensajería y del trabajo en grupo a distancia.

Este software se inserta en el marco de la creación de nuevas tecnologías de la comunicación.

Requerimientos

Los requerimientos mínimos de Hardware para la utilización de este programa son los siguientes :

1. PC, mínimo 350 Mhz,
2. Mínimo 32 RAM,
3. Conexión a Internet.

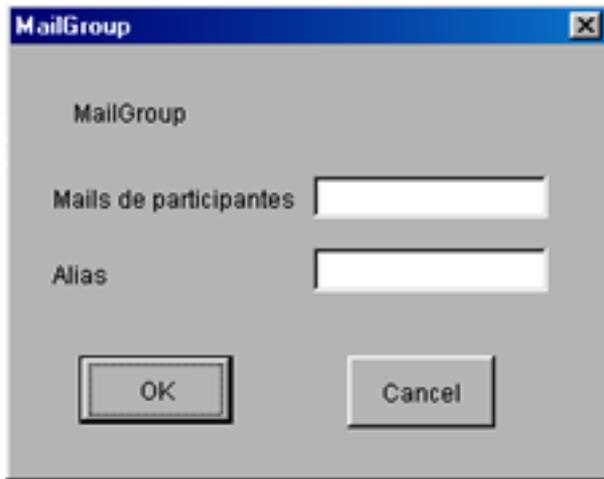
Instalación

- 1.- Instalar Java Runtime. Para esto ejecute (doble click) el archivo "j2re-1_3_1-win.exe" que se encuentra en el CD.
2. Instalar MailGroup. Para esto ejecute el archivo MailGroup.exe, que se encuentra en el CD de instalación. En el cuadro de diálogo que aparece, presione el botón "UnZip".
4. Luego de reiniciar el computador podrá ejecutar el programa haciendo doble click sobre el archivo "EJECUTAR.BAT" que se encuentra en la carpeta c:\Mailgroup

Configuración inicial

NOTA : EL PROGRAMA YA HA SIDO CONFIGURADO PARA CADA PARTICIPANTE, LO ÚNICO QUE ESTE DEBE HACER ES **COMPLETAR** EN EL ITEM LEARNGROUP DEL MENÚ "SETTINGS" EL ALIAS, QUE VA CORRESPONDER AL NOMBRE CON EL SUAL SE IDENTIFICARÁ A CADA PARTICIPANTE.

El alias corresponde al nombre con que los otros participantes lo reconocerán. Este nombre no debe contar con más de 5 caracteres.



Detalle de la interfaz del programa

Al ejecutar (doble click) sobre el archivo "ejecutar.bat" se da inicio al programa que posee la siguiente interfaz:



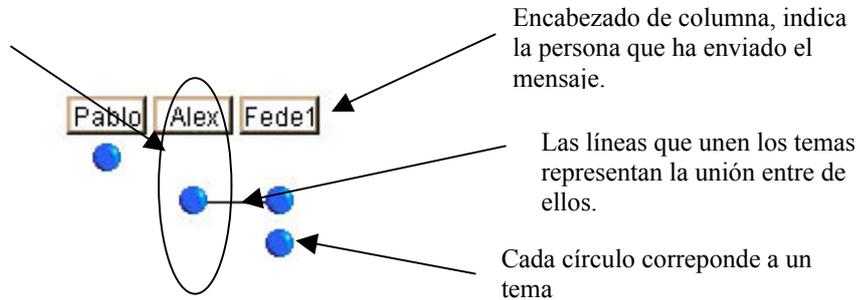
La interfaz posee dos áreas :

Zona de navegación

En esta área el usuario tiene la posibilidad de navegar a través de todos los temas de la conversación –presionando sobre los círculos, para ver un tema en particular, o sobre el encabezado de columna, para visualizar todos los temas del mensaje -. Además esta zona

permite visualizar una representación de las interacciones del grupo, a través de la relación que se crea entre los mensajes que se envían y reciben.
 La figura siguiente muestra un detalle de la zona de navegación:

Cada columna representa un mensaje enviado.



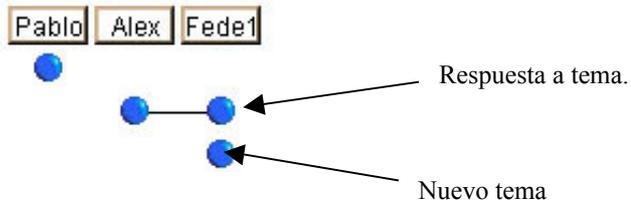
Cada columna corresponde a un mensaje (un mensaje –o sesión- está compuesto por varios temas). Cada vez que algún participante envía una nueva sesión, se agrega una nueva columna, indicando el nombre del participante que la envió en el encabezado de columna.

A partir de tres ejemplos recorreremos de manera general el funcionamiento de la zona de navegación.

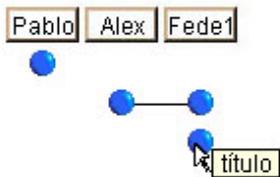
Ejemplo 1 : la siguiente figura muestra dos sesiones enviadas, primero “Pablo” que en su mensaje ha enviado un tema y posteriormente “Alex” que ha enviado otro tema.



Ejemplo 2 : La siguiente figura representa la continuación de la situación representada en la figura anterior. Aquí el participante “Fede1” ha agregado un mensaje, este mensaje consiste en dos temas, el primero de ellos es una respuesta al tema de “Alex”, y el segundo corresponde a un nuevo tema.

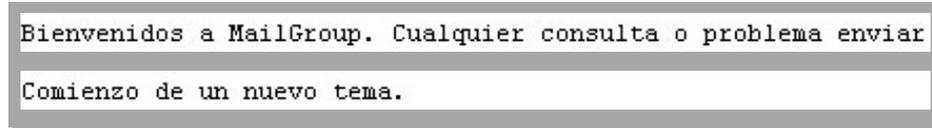


Ejemplo 3 : Si yo deseo ver el contenido de cada tema debo hacer clic sobre él y el contenido aparecerá en la zona de trabajo. Por otro lado, si deseo ver el título del mensaje es necesario sólo posicionarse sobre el tema y aparecerá el título (subject) que corresponde al tema indicado, como se ilustra en la siguiente figura :



Si deseo ver la totalidad de los temas que contiene un mensaje se debe hacer click sobre el encabezado de la columna de interés (donde se encuentra el nombre del remitente).

La zona de trabajo es el área donde se visualiza el contenido de los mensajes- Ver figura siguiente-, además es aquí donde se pueden crear y responder los mensajes.



```
Bienvenidos a MailGroup. Cualquier consulta o problema enviar  
Comienzo de un nuevo tema.
```

Cada tema está inserto dentro de un rectángulo blanco. En la figura anterior podemos observar el texto de dos temas.

Casi la totalidad de las funciones que posee este sistema pueden ser realizadas en esta zona presionando el botón derecho del *mouse*, donde aparecerá un menú indicando las funciones disponibles, como son por ejemplo, responder, crear nuevo tema y/o crear un acuerdo.

Relación entre la zona de navegación y la zona de trabajo.

Todos los mensajes y temas que son creados o respondidos en el sistema son creados en la zona de trabajo. La zona de navegación va representar de manera gráfica esos mensajes.

Si el usuario pasa el *mouse* sobre algún tema que se encuentra en la zona de trabajo, producirá un cambio de color en el tema que lo corresponde en la zona de visualización. Asimismo, al pasar sobre algún tema de la zona de navegación –círculos- se destacará el tema correspondiente en la zona de trabajo.

Funciones básicas

Las funciones de este programa de mensajería son básicamente las siguientes :

- Crear un nuevo tema.
- Responder a un tema anterior **o a una parte de éste.**
- Unir mensajes.
- Adjuntar archivo.
- Abrir archivo adjunto.
- Enviar mensajes.
- Recibir mensajes.
- Deshacer cambios.

Crear un nuevo mensaje

Esta función se utiliza cuando un participante desea introducir a la conversación un nuevo tema.

Para crear un mensaje se debe posicionar el *mouse* en la zona de trabajo y presionar el botón **derecho** de éste, luego de lo cual, aparecerá un menú en donde se debe seleccionar el ítem “crear nuevo tema”, a partir de lo cual, se creará un nuevo tema solicitándose el título de este tema. Este nuevo tema es creado tanto en la zona de trabajo como en la zona de visualización.

Responder a un tema anterior o a una parte de éste.

Esta función se utiliza cuando un participante desea responder o continuar un “hilo” de conversación.

Para responder a un tema completo –todo el contenido de un “círculo”- se debe seleccionar todo el texto en cuestión y presionar el botón **derecho** del *mouse* sobre el texto seleccionado y seleccionar en el menú que aparece el ítem “Responder”. De manera alternativa, si el usuario desea responder la totalidad del tema no es necesario seleccionar el texto, sino sólo posicionar el *mouse* sobre el tema a responder y presionar el botón derecho del mouse para luego seleccionar el ítem “Responder”.

Si se desea responder a una parte del tema –alguna parte del contenido de un círculo- se debe seleccionar el texto que se desea responder y luego, sobre el texto seleccionado, se debe presionar el botón derecho del mouse y seleccionar el ítem “responder” del menú que aparece en pantalla. Se creará un tema en la zona de trabajo donde se puede ingresar la respuesta. En la zona de navegación se visualizan los temas involucrados encadenados por una línea.

NOTA : Una característica diferenciadora de este programa con otros sistemas de mensajería es que el usuario puede seleccionar una parte de un tema y responder solamente lo que uno desea. Por ejemplo, si el participante “A” ha enviado el siguiente mensaje :

Hola,
Yo quisiera insistir en la idea de evaluación formativa , creo que no tenemos una idea clara sobre el concepto , es mas, creo que ni siquiera nos hemos preocupado por este tipo de evaluación.

también me gustaria que comenzaramos a trabajar la revisión de los CD con la grilla de trabajo dada.

chao.
pAb10!

El cual consiste básicamente en dos ideas; una con respecto al concepto de evaluación formativa, y la otra en relación al trabajo que deben desarrollar. Si, por ejemplo, el participante "B" desea responder a "A", pero en relación al trabajo que deben desarrollar el debería seleccionar el texto de su interés y responderlo :

Hola,
Yo quisiera insistir en la idea de evaluación formativa , creo que no tenemos una idea clara sobre el concepto , es mas, creo que ni siquiera nos hemos preocupado por este tipo de evaluación.

también me gustaria que comenzaramos a trabajar la revisión de los CD con la grilla de trabajo dada.

chao.
pAb10!

Responder
Integrar acuerdo
Establecer acuerdo
Crear nuevo tema

Con este sistema se logra que los hilos de conversación traten realmente una materia, y se obtiene asimismo un mejor seguimiento del tema.

Unir mensajes

La capacidad de unir mensajes es una característica propia de este programa, ésta consiste en la posibilidad de seleccionar diferentes temas de diferentes mensajes y entregar una respuesta de acuerdo común entre varios temas.

Para esto es necesario realizar las siguientes acciones :

1. Agregar los temas que se deseen acordar.

Posicionar el *mouse* sobre el tema que será parte de un acuerdo y presionar botón derecho del mouse. Luego seleccionar el ítem “agregar a acuerdo” . Realizar esta operación con todos los temas que integrarán al acuerdo.

2. Establecer acuerdo.

Para la creación del acuerdo se debe presionar el botón del mouse en cualquier parte de la zona de trabajo y seleccionar el ítem “Establecer acuerdo” , luego de lo cual se crea un nuevo tema que está encadenado con todos los mensajes integrantes del acuerdo.

Adjuntar archivo

A los nuevos temas es posible adjuntar archivos (por ejemplo, un documento word o una foto) Si yo deseo adjuntar un archivo es necesario posicionar el mouse sobre el mensaje y presionar botón derecho, luego se selecciona el ítem “adjuntar archivo” y aparecerá un diálogo para seleccionar el archivo en cuestión. Al enviar el mensaje, este se enviará junto al archivo.

NOTA : Sólo se pueden adjuntar archivos sobre los temas del mensaje que se está creando. Si el ítem “adjuntar archivo” no aparece es debido a que está tratando de adjuntar un archivo sobre un tema que no es el que está Usted creando.

Abrir archivo.

Los mensajes que poseen archivos adjuntos tienen en el encabezado de columna el dibujo de un clip, al presionar el botón derecho sobre el encabezado aparece un listado de los documentos adjuntos. Para abrirlos basta con seleccionarlos.

Enviar mensajes

Para enviar mensajes es necesario presionar el botón “Enviar”. Si Usted no desea enviar inmediatamente los mensajes debe presionar el botón “Enviar más tarde”.

Nota : Si Usted se conecta a la Internet a través de un módem se debe conectar antes de presionar el botón “Enviar”.

Recibir mensajes

Para recibir mensajes es necesario conectarse a Internet (si Usted se conecta a través de un módem) y luego, una vez conectado, presionar el botón “Recibir”. Los nuevos mensajes se agregarán como nuevas columnas a la derecha de los mensajes que existían. Los nuevos mensajes se distinguen porque el encabezado de columna (donde aparece el

nombre del remitente) está en rojo. Nota : Si Usted se conecta a la Internet a través de un módem se debe conectar antes de presionar el botón “Enviar”.

Deshacer

Si ha creado una respuesta, un nuevo tema o un acuerdo y se ha equivocado al hacerlo, el programa entrega la posibilidad de deshacer los cambios para esto debe dirigirse al menú “edit” y seleccionar deshacer.

NOTA : deshacer es acumulativo por lo que si se ejecuta varias veces va deshaciendo secuencialmente todas las operaciones realizadas.

Problemas conocidos

- Al realizar alguna de las operaciones básicas, la zona de navegación (donde se ve el gráfico) desaparece, para volver a verla se debe mover la barra que separa las dos zonas.
- Al existir un problema de conexión a Internet, se deben revisar los parámetros, si éstos son cambiados o no, se debe salir SIEMPRE del programa y volver nuevamente. En cualquier caso los datos son siempre guardados.

Cuadro resumen de operaciones básicas

Operación	Acciones
Crear un nuevo tema.	<ul style="list-style-type: none">- En zona de trabajo presionar botón derecho.- Seleccionar ítem “Crear nuevo tema”.
Responder a un tema anterior o a una parte de éste.	<ul style="list-style-type: none">- Seleccionar el contenido del tema que se desea responder.- Presionar botón derecho sobre el contenido seleccionado.- Seleccionar ítem “Responder” <p>NOTA : Si desea responder todo el contenido de un tema sólo debe realizar las dos últimas acciones, sin necesidad de seleccionar la totalidad del tema.</p>
Unir mensajes.	<ul style="list-style-type: none">- Presionar botón derecho sobre un tema que se desea integrar a un acuerdo.- Seleccionar ítem “Integrar acuerdo”.- Realizar las acciones anteriores con

	<p>cuántos temas se deseen integrar a un acuerdo.</p> <ul style="list-style-type: none"> - Sobre la zona de trabajo presionar botón derecho. - Seleccionar ítem “establecer acuerdo”
Adjuntar archivo.	<ul style="list-style-type: none"> - Presionar el botón derecho sobre el tema que ha creado. - Seleccionar el ítem “adjuntar archivo”
Abrir archivo adjunto.	<ul style="list-style-type: none"> - Presionar botón derecho sobre encabezados de columna. (donde aparece el nombre del participante que ha enviado el mensaje). - -Seleccionar el documento que se desea abrir .
Enviar mensajes.	<ul style="list-style-type: none"> - Presionar el botón “Enviar” <p>NOTA : si desea enviar los mensajes posteriormente presionar botón “Env más tarde”.</p>
Recibir mensajes.	<ul style="list-style-type: none"> - Presionar el botón “Recibir”
Deshacer cambios.	<ul style="list-style-type: none"> - Seleccionar el menú “Edit”. - Seleccionar el ítem “Deshacer”.

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