Designing, evaluating and exploring Web-based tools for collaborative annotation of documents

Henry Rodríguez

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Stockholm 2003
Royal Institute of Technology
Department of Numerical Analysis and Computer Science
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ABSTRACT

This thesis explores the use of the World Wide Web as infrastructure for collaboration among small or middle sized groups. A collection of Web-based tools has been developed, whose main characteristic is that they allow users to make annotations to shared documents. These Web annotations form a dialogue that is persistent and immediately accessible to the users. Special interest has been devoted to observing how collaborators make use of a common space where Web-documents as well as Web-annotations are organized and stored. This common space has been called a domain.

We have also tried a novel method for the design of collaborative Web-based systems, called “designing from inside”. It is based on communication between the users and the designer in the form of a dialogue, which is generated and presented “inside” the system that is being developed. In this way, users can make comments about their experience using the tool while in the appropriate context. Comments by the users as well as the designer’s replies are shared with other users. In this way the users become involved unobtrusively in the design process of the tool.

One of the tools, DHS, has been used in longitudinal studies within courses where students also met regularly in the classroom. In one context the students used the DHS as a discussion or annotation tool for documents that they had written. Within this framework, we also explored how second language students collaboratively made use of the tool to accomplish a task that is normally done individually (reading comprehension).

Col·lecció is the latest version of the DHS. The most important change in this tool is that users can add the Web-documents to the domain themselves. This gives a new perspective to the tools because it can work as a collective bookmark system. This system has been used in three case studies in which a distributed and co-located group discussed a collection of Web-documents.

Another system in the family is Col·laboració, which is oriented to supporting collaborative writing tasks. It focuses primarily on the communication needs co-authors might have around a shared document that is being produced. The system also allows for on-line revision and for generating versions of the document. This system has been used in 8 case studies, where we have observed the users’ interaction and explored the possibilities that the Web offers to collaborative writing. For example, co-authors can use the commenting space as a “window to the Web”, as the Web provides a huge amount of information that can be relevant during the writing process.

One of the characteristics of all these tools is that they present the comments in chronological order. No threading mechanism is used, although several users have requested a threaded presentation of the comments. This design choice is based on the belief that with threading of comments, the focus of the discussion could drastically divert from its original topic, the document. In our observations, a dual discourse context is often found in the comments referring both to a previous comment and to the shared document. To facilitate orientation in the discussions, we have also developed a visualization tool called Domain Interactivity Diagram (DID), designed to work together with the other systems.

The studies show that the Web offers a suitable infrastructure for text-based discussions in which the document can be given a prime role. It also emerged that the integration of email was appreciated by users mainly because it was considered as a reminder of the task. In educational settings, students valued the possibility to go through many examples written by other students in comparison with the traditional way. Also the dialogue formed by the comments was a straightforward way to promote collaboration among students.

Keywords: WWW, discussion, annotation, design, writing, collaborative work, asynchronous communication, text-based communication.
ACKNOWLEDGEMENTS

Al fin! That is the first thing I want to say. Translation into English at the end.

In all these years that I have been working and studying to present this thesis Kerstin Severinson Eklundh has always been on my side. I am sure that without her help and all the effort that she has put in, especially in the last weeks, this would have not been possible. I have learned a lot of things from her and I am grateful that she could lead me and made me focus on the interesting research area of collaborative writing. Thanks a lot and I will never forget all these years of collaboration with you.

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“Al fin” means finally but I have to say it in Spanish because I really mean that (I almost forgot to translate it, you know mañana)
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1 INTRODUCTION

1.1 Background

A huge amount of information is stored in the Internet, and using mechanisms such as the Gopher system, File Transfer Protocol (FTP), and the World-Wide Web (WWW) all this information can be accessed. The most successful of these mechanisms is the WWW, also called the Web. The Web appears to the user as an enormous hyperdocument that users can browse through an HTTP gateway controlled by a Web-browser program. The early purpose of the Web was to encourage physicists to share information using wide-area networks (Berners-Lee, Cailliau, Groff, & Pollermann, 1992). However, today it is extensively used by almost any kind of organization and for a boundless diversity of purposes. Web software provides a means for organizing servers into a structure that allows easy hypertext navigating and browsing through the vast store of existing remote data on the Internet. During the first years, while rapidly expanding, the Web was mainly used to retrieve information. As users gained experience, the Web was used not only as a retrieval mechanism but also as both a shared space and a communication channel.

Web-browser programs now include various features that help the users share, communicate, and coordinate their efforts in order to accomplish a common task. Web-based applications are increasingly developed through which users can collaborate, taking advantages of the Internet and its ubiquitous character. People involved in a product creation process need support in their collaborative activities to define, design, transform, and maintain a product. The members of such a team often work independently, even asynchronously, but need access to shared data in a controlled way and a medium for communication so that they can coordinate their work tasks.

One of the most common units of information that we find on the Web is a document, usually a hypertext document. As we rely more and more on the Web, our documents are subjected to the requirements of this global networked environment. Writing for publication on the Web is becoming increasingly frequent, and tools that facilitate the production of Web documents are now very common. In fact, most word processors include the feature “Save for the Web”, which generates a document in a format that a Web-browser can read, e.g. HTML or XML. In general, Web-documents can be indispensable for teamwork, both as sources of information and as the result of a collaborative effort.

The Web continues to expand to all the fields in which a computer can be used. Collaboration using the Web is becoming more and more frequent, used not only by people that have a technical background or long experience using the Web but also by non-technical and novice Web users. In particular the use of the Web within educational contexts, where documents are important entities, has grown tremendously. These premises make it important to study how collaborative work is performed around Web documents and using Web-based applications. It is equally important to study the design and implementation of these Web-applications for collaborative purposes.
1.2 The focus of this thesis

The studies presented in this thesis are concerned with the possibility for groups to cooperate around documents via the Internet. The groups studied here have used a set of Web applications that we have developed from scratch. These applications offer the possibility to share documents and to communicate around them through comments that are presented in a common space, forming a dialogue. The aim of the dialogue is to discuss different aspects of the shared document and in some of the cases to improve or revise them. In a part of the studies, the author of a document was a member of the group, which meant that he/she had a particular interest in the comments that were made on his/her document.

The thesis deals with the following issues:

- How do small and middle size groups collaboratively discuss, annotate and communicate around Web documents?
- How is asynchronous text-based communication used in a shared space by teams?
- What impact does the use of a Web-based collaboration tool have on a traditional classroom in a university setting?
- Finally, this thesis deals with the design of Web-based collaborative tools in the light of these issues.

In general terms, the process of writing a document can be seen as three intertwined subprocesses (for details see the next chapter).

1. Prewriting in which, for example, co-authors have to plan and negotiate the activity, and discuss the content of the text and strategies to follow.
2. Translating the ideas into text.
3. Reviewing the text in which, for example, co-authors read the text in order to find problems or errors, and make annotations about it.

During collaborative writing, these processes must be co-ordinated in the writing group, which can follow several different models. Many of the case studies in this thesis deal only with the first and last sub-processes of the writing process. We set up our studies in such a way that the users:

- were exclusively involved in the discussion of the content of a document, or
- were exclusively involved in the annotation of a Web document, or
- had to interact with each other to produce a Web document

Breaking down these processes, we were able to collect data about the use of the Web as infrastructure for collaborative activities.

This work is related to several research areas. A central area is computer supported collaborative work which gives a conceptual background for this thesis. Another logical starting point is the Web and its possibility to be used as infrastructure for collaboration is
another logical starting point. Finally, a third relevant research area is collaborative writing.

At the time when this research started (1996), the Web was a “hot” technology. We decided to develop our Web-based tools so that we could shape them according to our research intentions. As a result, we have developed four systems. The first system, the DHS (Domain Help System)\(^1\) was used to support the process of discussion and annotation of Web documents. From the basic ideas of DHS we developed two more systems. Col·lecció\(^2\) is a system that, apart from the discussion and annotation feature of DHS, offers a collaborative bookmark functionality. The third system, Col·laboració\(^3\) was used to support collaborative writing processes in which co-authors discuss, negotiate, and co-ordinate their work. The process of designing these tools has been characterized by an iterative and longitudinal process, where each iteration was defined by a case study. The design process used a method that emerged from our first experience in which the users were involved actively while interacting with the tools. The approach is called “Designing from inside”, see chapter 9 for details.

“Designing from inside” is based on a continuous persistent dialogue in which the system designer answers the users’ questions related to the system. An advantage of this approach is that the user can cope with problems concerning the system because of the quick response from the system designer. The approach is also a way to detect problems that may occur only under particular Web settings used by the users; such problems would otherwise be very difficult to detect. It should be emphasized, however, that the system designer has not normally taken part in the discussion of the content of the documents. Instead his role has been exclusively that of a system administrator. Exceptions to this are some of the case studies of Col·laboració in which the system designer was one of the co-authors.

There are some phenomena and observations related to the case studies that have deserved a separate discussion. One of them deals with the structure of a text-based asynchronous dialogue. We have studied the implications of presenting the dialogue ordered in a chronological sequence, where the users themselves created strategies for ensuring the coherence of the discussion. We have also designed and implemented a visualization tool called Domain Interactivity Diagram (DID), with the main purpose of presenting the relationships among the entities of users, documents, and comments. Such a tool has the potential to help the user understand and navigate in a text-based discussion, whether he/she is an author, a reader or a researcher.

Another issue that we have studied is the users’ need for awareness of what has happened since the last time the system was visited, and to be informed about the contributions by other participants without being flooded with information. Finally, we also discuss the publicity and privacy aspects of the use of our prototypes. To fulfil the awareness

\(^1\) At the very beginning this project aimed to design a help system. For administrative reasons the name is kept.
\(^2\) Col·lecció is the Catalan word for collection
\(^3\) Col·laboració is the Catalan word for collaboration
requirements of some users means that others have to share information. The benefits that
the group gets by supporting awareness could be a problem for some users by threatening
integrity and privacy.

DHS, DID, Col·lecció, and Col·laboració are still prototypes and we do not claim that they
are a perfect solution for Web-based collaborative work around documents. Many
enhancements have been suggested by users and designers. These enhancements have
been taken into account when new releases of the prototype were made. One important
factor throughout this work has been that, as the designer, I could observe the use of the
systems directly. This gave me the opportunity to follow the interaction with the users
closely, giving a better understanding of the data collected.

There are some limitations in this approach. The prototypes have been developed
iteratively which means that their possibilities and goals were slightly different from case
study to case study. Further, the evaluation of the system focused primarily on the use of
the system's features. Therefore, it has not been possible to make a detailed analysis of the
collaboration activity in which the members have participated. Rather, the approach that
we have taken in this thesis focuses on the participation in collaborative work by a group
supported by Web-based systems, and the possibilities and problems it presents.

1.3 Web development issues

In order to run some Web applications, the user needs to install or add functionality to the
Web-browser, such as plug-in modules. Another group are those Web applications in
which users do not have to install additional software; instead the only requirement is that
the user has to enable the script language that is a default choice in the Web-browser
settings. In this thesis we focus on Web applications that fall into the last-mentioned
group. This choice was made since, when we started this research, users in general were
not familiar with installing, or downloading Web software. In this way we could reach
more users and it was also simpler to manage, as we did not have to deal with new
software installations in the users' environment.

One of the most important features introduced in a Web-browser, in this respect, was a
client-side scripting language, i.e. JavaScript. With this, it was possible that the user, from
the Web-browsers, could interact with a system, e.g. validate some entries. With JavaScript
and CGI the basis for the development of Web-based collaborative applications are given.
I have developed all the code of the software DHS, Col·lecció, and Col·laboració, using
CGI, Perl, and JavaScript. The DID system was implemented in Java and was developed
within a Master's project that I supervised.

1.4 Summary of case studies

DHS and Col·lecció are easy to learn, and they could be used to fulfil a diverse set of tasks
in which text-based communication is used. Therefore it was possible to try them in
different contexts as support for real collaboration within a group of people. The idea was
that depending on the context, the users interaction would provide valuable data for the future design of more complex systems that would support that context. In addition, we had the opportunity to evaluate the new approach “Designing from inside” with different kinds of users. In this way a more reliable evaluation of the method could be made. In the case of Col·laboració, the tool was oriented to supporting the activities of co-authors while writing a document. In the case studies, Col·laboració was used to produce different genres of documents, for example a technical report, and a short conference paper. Table 1 shows an overview of the case studies that we have carried out and reported in this thesis.

Table 1. Case studies presented in this thesis

<table>
<thead>
<tr>
<th>Tool</th>
<th>Context</th>
<th>Task</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHS</td>
<td>A tool for discussion of Web documents in a CSCW course</td>
<td>Students wrote documents and discussed their content</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>An annotation tool in an Academic Writing course</td>
<td>Students in a class wrote fragments of a scientific paper and made annotations in order to change the form of the text</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>A discussion tool in a second language course (Spanish)</td>
<td>Students read a book and then discussed the content of the book on line. The book and the discussion were in Spanish.</td>
<td>2</td>
</tr>
<tr>
<td>Col·lecció</td>
<td>A discussion tool and a collective bookmark in a CSCW course</td>
<td>Students collected articles from digital Web versions of newspapers and journals. Then they discussed their content</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>A discussion tool used by a distributed team. The team had no professional commitments</td>
<td>A team collected Web sites in order to discuss a particular topic</td>
<td>2</td>
</tr>
<tr>
<td>Col·laboració</td>
<td>Collaborative writing with professional commitments</td>
<td>Co-authors had to write a document</td>
<td>9</td>
</tr>
</tbody>
</table>

The texts in some of the chapters have been presented in several international conferences and have also been accepted as a chapter of a book that will be published in the near future. The papers that have been presented in the conferences have been written in collaboration with, Sandra Brunsberg, the teacher of the writing course that used DHS; Arango-Alegría David, the teacher of the a second language course that used DHS; Sylvie Noël, who was one of the users in one case study in which Col·lecció was used, Teresa Cerratto-Pargman, a co-worker in our research department, and Kerstin Severinson Eklundh who is my supervisor.

1.5 Outline of the thesis

Chapter 2 presents a review of related research in areas connected to the thesis. This includes computer-supported cooperative work, the writing process in general, how the medium influences the writing process and some research on the use of annotations. Research on collaborative writing and existing software to support it are also presented.
Chapter 3 describes the methods employed in these studies. This includes the selection of participants in the field studies, the tools that were used for data collection and the motivation for using these tools. We also present the advantages and problems of the methods used.

Chapter 4 presents the DHS system. A pilot study is presented as well as two sets of case studies in which the DHS was used, involving discussion and annotation of Web documents, respectively. Also, a case study is presented in which the DHS was used as a discussion tool in a second language course.

Chapter 5 introduces the visualization tool that we have developed (DID). It also gives a previous research background for this tool and presents some graphs and how they could be used.

Chapter 6 presents the system Col·lecció and the case studies that were performed using this tool.

In Chapter 7 we report on the results of the survey in which participants of DHS and Col·lecció took part. The survey was related to the public aspects of sharing and working on the Web.

Chapter 8 presents the Col·laboració system, supporting the writing process. The chapter also summarizes the case studies in which Col·laboració has been used. The last case study is discussed in detail.

Chapter 9 describes experiences from the design process of the Web-based tools developed, in particular how the users contributed to the design of the systems.

Chapter 10 presents conclusions drawn from the empirical studies using DHS, Col·lecció and Col·laboració, and some design implications for collaborative tools. Limitations of this work are also discussed, and issues for future work are outlined.
2 RELATED RESEARCH

This chapter presents research related to this thesis. We focus mainly on collaborative writing, with special attention to the communication needs co-authors might have during a collaborative writing task. To broaden our perspective of the problems involved, we go briefly through general issues such as computer-supported cooperative work, the writing process, the influence of the medium on this process, the use of annotations, collaborative writing theories and systems, and the Web as infrastructure for the writing process.

2.1 Computer supported cooperative work

The research in the area of computer supported cooperative work (CSCW) is vast. Here, we will just mention some basic concepts that are important for the understanding of this thesis. A common framework for cooperative work distinguishes between three aspects of working together: communication, coordination, and collaboration, which are emphasized to a varying degree in a particular task and context. This also has implications for the tools to be used. Computers have been used to mediate teamwork through what is known as groupware. A well-known definition of groupware is “a computer based system that supports groups of people engaged in a common task (or goal) and that provides an interface to a shared environment” (Ellis, Gibbs, and Rein, 1991). When designing groupware it is not enough to perform a task analysis prior to design, but the complexity of the social context has to be taken into account. A well-known taxonomy for groupware is based on the place where the activity occurs in relation to participants’ locations (separating between distributed and co-located work) and the time when this activity is performed (separating between synchronous and asynchronous work) (Ellis et al. 1991).

2.1.1 Text-based communication

An important and crucial use of computers in cooperative work is to mediate communication among members of a group. The field of Computer-Mediated Communication (CMC) in general refers to the communication among human beings via the computer. This communication can be graphic, auditory, tactile or text-based. In text-based communication, the sender composes a message at a computer and then it is presented on the screen of a receiver. Text-based CMC can be synchronous, if the message is processed “immediately” by the receiver (e.g. in chat programs), or asynchronous, if the message is processed at a later point in time (e.g. in electronic bulletin boards). In asynchronous groupware the most common way of direct communication is text-based. This medium is often interactive and conversational in character, but is has various limitations compared to speech.

Using text-based communication, extra-linguistic cues such as identity, gender, personal information (e.g. age), or mood of participants are partially or completely lost (Hiltz and Turoff, 1978). Therefore, text-based communication has been considered by many as impersonal and distancing, useful for the transfer of information but unsuitable for personal relationships (see Herring, 1996). As anonymity is easier to achieve than in other
media, it becomes an issue that those using text-based communication have to deal with. This has been put forward as the reason why inhibition may decrease, leading to self-disclosure on the one hand, and increased tendency for hostility on the other hand (Kiesler, Siegel and McGuire, 1984). The lack of personal cues in text-based communication is also claimed to be the ideal ground for freedom and democracy: “one is judged on what one says and not on who one is” (Herring, 1996, p 4)

Email is an example of text-based communication, considered as the most important application on the Internet (Katz and Aspend 1997). Email generally supports collaborative work because of its high speed, asynchronoyness, and computer processability (Palme, 1995). An important characteristic is also that it is possible to send any digital file via email. Recent research about the use of email in organisations has shown that email is used for a variety of purposes, and that heavy use of email is associated with problems of information overflow for many users (Bälter, 1998, Bälter and Lantz, 1995; Bälter and Sidner, 2002). This means that strategies for handling email are important, but also that the problem of when to expect a response is increasing.

Severinson Eklundh (1986) in an early study made on private email messages in a conferencing system, observed when a message was received, the receiver replied to it promptly. Forty-nine percent of the replies were sent within two minutes from reception of the message, and 95% within one hour. In this early study, participants communicated mainly locally as there was yet no direct access to the Internet.

It has been suggested by Galegher and Kraut (1994) that groups communicating by means of a computer spent more total time working, as well as more time communicating with each other. They explained this by saying that when opportunities for interactive and expressive communication are constrained, to shift between these activities becomes more difficult. The author also claimed that when using CMC it is difficult to establish social relationships among participants, as it is more difficult to get to know each other and therefore collaborate. Groups working with a computer reported that it was difficult to coordinate their work even when a lot of time was invested to accomplish the task. They also observed in their study that the document produced by the group using CMC was similar in quality to the one produced by those who meet face-to-face. This indicates that the groups were uniformly effective but the group using CMC were less efficient. However, it is important to point out that coordinating face-to-face meetings can be also problematic and time consuming.

2.1.2 Grounding

Participants interacting in a group have different backgrounds and bring different knowledge to the task. During the collaboration process they seek to achieve common ground, i.e. a shared understanding of the task at hand. The process of achieving common ground is called grounding (Clark and Schaefer, 1989). The grounding process depends on the type of medium that participants use (e.g. face-to-face, audio, video, text-based communication), so that some media are associated with particular difficulties (“costs”, cf. Clark & Brennan, 1991) of grounding.
Clark and Brennan (1991) describe properties of different media in these terms. For example, in asynchronous text-based communication, participants can compose at the same time (simultaneity) but they lack cotemporality, i.e. the possibility to be aware that another participant is also composing. Even if the message is shown as it is produced, it will not be read in real time. Usually a message is delivered when it is complete, and when posted, it could still be delayed by a slow communications network. The sequence in which text-based messages are presented may also be a problem compared to spoken conversation. Structural units of discourse such as adjacency pairs (e.g. a question and an answer) are often separated due to the occurrence of parallel conversational threads. This also affects turn-taking; to decide who will take the floor, and when, is not easy in text-based communication. These problems get more severe as the number of participants increases.

### 2.1.3 Context and awareness

Context is very important in any communication process. Messages have meaning with respect to external context; the state of the world, and internal context; the state of the conversation (Dix, Finlay, Abowd, and Beale, 1998). In asynchronous-distributed communication the external context is hard to make use of because each participants might work in different external contexts sometimes unrelated. To keep the internal discourse context is difficult also but can be alleviated by presenting the same view to all participants, that is the same internal context. A common requirement is that it is important to keep a WYSIWIS (“what you see is what I see”) mechanism. A simple way to apply this principle is to keep a shared workspace in which participants can work on an object and collaborate in its transformation until the goal is reached.

In CMC when keeping the internal context two common problems may occur; interleaving or overlapping of messages. Interleaving is mainly a consequence of the order in which the messages are received. Two related messages could be separated by several messages received before by the system. The users may have to spend significant efforts to establish coherence (e.g. by scrolling through messages). Even worse, the user may be forced to omit the interleaving messages and treat them as noise in the communication process. Overlapping refers to partially omitting information in favour of presenting more information. For example, instead of showing the whole message only a fragment of it is shown. For an easy perception of the internal context it might be needed to present the whole relevant information.

In her study of email, Severinson Eklundh (1986) observed that email messages are seen as part of a dialogue and that many users often reviewed previous messages to grasp the discourse context. The subject in email can be used to help track the context of a dialogue and also to organize the messages. Quoting a previous message is another way to preserve the context through an email dialogue, which is used widely both in email and group discussions (Severinson Eklundh, 1998).

A central concept in the analysis of groupware is awareness. Dourish and Bellotti (1992) discuss the importance of passive awareness, an understanding of the activities of others, which provides a context for your own activity. Individual contributions may be improved
by the understanding of the activities of the whole group. In a distributed-asynchronous context the concept of awareness becomes even more essential because social cues are missing. It is important that members of the group can see the changes and the work progress so that they could understand and in this way regulate their own actions. The topic of awareness is closely related to privacy. Awareness can only be achieved by letting others know about our actions. This requires that the level of privacy be regulated so that the mechanism of awareness could work.

It is more and more common that co-workers in a virtual group interact without ever meeting in person (Sproull and Kiesler, 1991). In spite of the problems this might bring to collaboration, an aspect that can be seen as positive is that the work group size could grow, and yet it does not necessarily mean that actual participation of other group members will decrease, as may happen in face-to-face meetings.

By definition, collaboration within a group has to deal with a shared goal or a shared object to transform, and it presumes the participation of more than one individual working, at the same time or not, on that shared object or to achieve that goal. A problem is, however, that individual goals very often do not match the group goal. This is even more difficult when the relationship object-owner is not a one-to-one relation but a one-to-many relation. So the classical Saint Thomas Aquinas’ citation that manifests that the best person who can take care of something is its owner is unclear. Olson (1965), cited by Kollock and Smith (1996), 37 years ago expressed the same problem in other terms: “if the members of some group have a common interest or objective, and if they all be better off if that objective were achieved, it [does not necessarily follow] that the individuals in that group would act to achieve that objective.” So the problem of collaboration is not only determined by technology, or the media that members of the group use to collaborate, but also by both social and individual factors.

Grudin (1988) pointed out that the biggest problem that groupware has to face is the disparity between who does the work and who gets the benefits. In many cases the users cannot understand the benefits they will get from the collaboration and therefore might not be willing to collaborate. It is also important that the point of critical mass can be reached, as for groupware the cost of use will be less than the benefits only when a number of users can be reached. However, this does not necessarily mean that the user population must be large. Instead it means that groupware systems should be designed so that they have benefits even when the user population is small (Dix et al. 1998).

The Web-based tools that will be discussed in this thesis were designed to cover distributed, asynchronous work by small or middle-sized groups. In all but two of the case studies that we present here, users met regularly in real life before and while using the systems. The communication via the systems took place via text-based messages in the form of comments presented in a shared space.
2.2 The writing process

Writing is a complex process. It is a learned craft that requires a lot of practice, and no formula can guarantee a good document. Writing is also a form of communication; it is used for the transfer of information, ideas and concepts from one individual to another, or within a group.

There have been many attempts to explain what writing is. Rohman (1965) divided writing into three stages: prewriting, drafting, and revision in which the product was the core of writing (plan-write-edit). Janet Emig in 1971 was one of the first who saw writing as a process, focusing on how writers compose rather than what they compose. According to Emig, research on writing before 1968 was not based on any theories. Murray (1980) argues that the writer is constantly learning from writing. Murray placed emphasis on the importance of a series of drafts in the writing process as “he writer gradually discovered through writing what it was that he/she wanted to say.”

Hayes and Flower (1980) developed a model of writing as a cognitive process of problem-solving. Their model (see figure 1) has three basic processes: 1) planning, which includes generating ideas, organizing, and goal setting; 2) translation of plans into text; 3) reviewing, which includes reading and editing. Processes in this model do not appear in a linear way but instead a subprocess could start at any time and even be part of any other subprocess. The writer could shift from one subprocess to another in any phase of writing. This model allows for studying how these three processes are co-ordinated in the writing process and how they affect the final product. The research presented in this thesis focuses mainly on reviewing processes.

![Figure 1: A simplified version of Hayes and Flower’s three-phase model of the writing process (taken from Sharples et al. p 191)](image)

Focusing on problem solving, the writing process was seen from a new perspective in this model. A set of methods for probing these processes emerged, in particular verbal protocol analysis. Moreover, empirical findings from studies on problem solving were used to shed light on a number of issues in writing theory. In their studies of writing as problem-solving, Flower and Hayes focused their attention on writers’ strategies. They discovered that expert writers, in comparison with novice writers, constantly redefine their audience and assignment while composing. Expert writers also consider in their goals how they...
wish to affect the audience. That is, expert writers develop more elaborate plans, and continue to develop and modify them throughout the whole writing process. As a result, expert writers modify the content more during the writing and the revision processes. Flower and Hayes' findings have outlined various techniques that good writers use to alleviate the problem of composing.

Although very influential in the last decades, the model by Hayes and Flower has been criticised for focusing exclusively on the individual writer. Nystrand (1989) argues that writing is a social interactive process occurring between readers and writers. In other words, a dialogue between the writer and the reader is developed, with the aim to converge in a meaning of the text. According to this theory, the writer is trying to make the reader understand his/her intentions in order to reach mutual understanding in a social context, while the text itself plays a secondary role.

### 2.3 The influence of the medium on the writing process

“The medium is the message”, perhaps Marshall McLuhan’s most often quoted phrase, is relevant today because technology has been extensively used to create new and diverse media of communication. Technology has affected writing tremendously; including e.g. paper, moveable type, the typewriter, Linotype machine, and the computer. From the 1980’s, a great interest was focused on how the use of a computer would affect writing processes and products.

Christina Haas (1989a) made an experimental study to assess writing products with: 1) personal computer, 2) workstation, and 3) pen-and-paper. The workstation had a bigger screen compared to the personal computer and different word processors were used in these conditions. Results from these studies indicate that writers wrote at the same rate in all three conditions but they wrote for a more extended time on the workstation than with pen-and-paper and, therefore, produced longer texts. The quality of the text was significantly better on the workstation and with pen-and-paper than on the personal computer. A second study by Haas (1989b) assessed the writing process. The outcome of the experiment showed that more total planning and more initial planning was observed in the pen-and-paper condition. In the personal computer condition, users were attending more to the medium, rereading more and paying more conscious attention when revising. In general, Haas found that “the pen-and-paper condition was consistently different than the computer conditions” (p. 163).

Writers using only word processors engaged in significantly less initial planning, conceptual planning, and total planning than when they used pen and paper. This phenomenon was related to the difficulty experienced writers reported in getting “a sense of the text” of their texts and recalling them when using word processors (Haas, 1989a). Severinson Eklundh (1992) relates this phenomenon to writers’ lack of overview of the text. The limited view of the text on the screen has also been related to the fact that during revision on computer, more attention is paid to local problems and low-level errors (e.g. misspelling, wording) in texts (Severinson Eklundh, 1990).
Van Waes and Schellens (2002) studied the writing process of experienced writers using a word processor, or pen and paper. They found that the writing profile was influenced by the writing mode, and that the difference between the profiles adopted among the writers who used different modes concerned mainly three areas. The first was the level at which revisions are made: the percent of revision made on word level when using pen and paper was at least 1.5 times than when using computers while computer users tended to revise more at a level of the letter. The second area was the way the revisions are distributed throughout the writing process; pen and paper writers had a tendency to reread and revise the text systematically, working from the beginning to end. Computer writers revised in smaller units. The third area was the degree of fragmentation of the writing process; computer writers' planning, formulation, and revision were strongly focused on relatively small units of text and also showed a high degree of recursion. For pen and paper writers the writing process took place in longer episodes and was less locally oriented and also the degree of recursion was low.

The digital medium in contrast to the paper medium presents many differences. Nielsen (1990) recognizes a homogeneity problem in on-line documents, which is based on the fact that on-line text always looks the same. This would make more difficult for co-authors to discuss the text as there are few cues to use to make reference to problems in the text. In contrast, paper presentation is more flexible in its presentation and invites to personal use and adaptation. Paper print-outs also offers a way to obtain an overview of texts that is crucial when composing long texts (Severinson Eklundh, 1990).

Kellogg (1994) claims that word processors address only the typewriter aspect of the writing process and that idea processors should address the thinking aspect of the writing. Kellogg suggests that “idea processors may succeed in amplifying writing performance” (p. 184) He argues that outlining before translation of the ideas into text leads to higher quality texts compared to those who plan during the writing of the text itself. Kellogg (1989) points out that tools such as idea organisers may reduce the cognitive load of the user by focusing attention on the planning process while temporarily ignoring the translating and reviewing processes.

### 2.4 The use of annotations

During the writing process, from its genesis to the final product, annotations are almost certain to be made. Annotations can be created to fulfil different functions (e.g. planning, revising) and be directed to particular audiences (e.g. the next reader, a co-author, oneself). They also have distinct uses (e.g. to serve as a reminder, to request a change). Annotations can be used as an external store for knowledge or ideas that the writer has not yet given a coherent linear structure. For example, during the planning stage, the writer will probably make a note of some books, articles, or situations he or she would like to refer to in the text. Annotations, in a collaborative writing task for example, could be used to advise on reading material, or schedule a meeting with the author. Also annotations could be done while reading; writers could record their own reactions, and their interpretation of the text. In fact, annotating is one of the most common activities when reviewing.
Neuwirth, Kaufer, Chimera, and Gillespie (1987) presented the Notes program that keeps a link between each note and the specific region in the source text that the note refers to. They claimed that computer-based note cards “would free the writers (1) to paraphrase because they would be able to recover the quotation and (2) to record their own elaboration, reactions, inferences, etc., because they could easily recover the context for them”. Computer-based note cards would also help writers create alternative organisational frameworks more easily. Moreover, the computer can hold and display a great amount of information which is significantly limited on paper.

Ovsiannikov, Arbib, and McNeill (1999) pointed out that digital annotation systems are in an underdeveloped stage and suggested an annotation technology that covers the architectural, functional, and user-interface aspects of annotation systems. They presented an empirical study of annotation on paper and demonstrated that using electronic annotations, users could perform hypertext-oriented action such as linking pages. Annotations can be synchronised in real time, serve as the basis for conversations, searched, and have capabilities specific to the media type such as a soundclip.

The most common types of annotation interfaces are the split-screen, interlinear, and aligned interface. See figure 2

In the split-screen interface the user’s screen is divided into two horizontal adjacent windows and in the aligned interface the screen is divided into two vertical adjacent windows. The original text is shown in one of the windows (usually the upper or the left one respectively) and the annotated text in the other. In the interlinear interface, annotations are differentiated from the original text by using format features (bold-face, italics, parenthesis, capitalisation, etc.). However, there are other possibilities, for example pop-up windows for the annotation.

Wojahn, Neuwirth, & Bullock (1998) found that the production of annotations made by reviewers is affected by the annotation interface. They compared the three above mentioned annotation interfaces. It was shown that the time of the task (reviewing a document written by someone else) was not affected by the annotation interface. However, those reviewers who used the aligned, and interlinear conditions communicated significantly more problems than those who used the split-screen condition.

Neuwirth, Kaufer, Chandhok, and Morris (1990) proposed a set of requirements for annotation interfaces during a co-authoring task:

- There is a minimum of motion required to make an annotation
• The primary text is easily distinguishable from the annotation text
• The annotations are visible “at a glance” while reading the primary text
• The relationship between the primary text and the annotation is easy to see
• Different annotators are readily distinguishable

Marshall's (1997) study focused on the form and function of annotations made on textbooks by students and discussed some issues and implications for the design of annotation tools for a digital library setting. She found that the annotations could be found in the text (also called in-situ), or in the margin (also called off-side). Annotations can be telegraphic, namely, using a personal opaque coding, or they can be explicit; usually textual. Finally, annotations can be removable or not. It was found that “annotation form arises in part from the characteristics of the material themselves, the imprints and the implements used to write them” (p. 134). For example, it turned out that students who use highlighters write fewer marginal notes than students who use pens. Finally, Marshall suggested principles for the design of support for digital annotations: 1) in situ annotation, distinguishable from the source (e.g. interlinear annotation) (cf. Neuwirth et al. 1990), 2) non-interpretative marking (e.g. underline, highlight of text) as they are very much used, 3) fluidity of form because annotations on paper were very rich in form, 4) informal coding; several annotators a developed personal system of annotation in which symbols and pen colour meant something to the reader, 5) public and private annotations, and 6) annotation should interrupt reading as little as possible.

It has also been found (Neuwirth, Chandh, Charney, Wojahn and Kim, 1994) that voice annotations for reviewing documents have benefits compared to text-based annotations in the reviewing process of a document. Kraut et al. (1992) found that those who used voice annotations were more likely to comment on global problems of expression and structure of the text than those who were communicating via text. Moreover, voice annotations compared to text-based annotations were judged to be more useful; especially for structural and semantic problems, where they were found to be more complete, justified and socially oriented. This implies that it is important to have different kind of modalities for annotations. However, Kraut et al. note that voice annotation can be tedious to listen to and difficult to process.

Cadiz, Gupta and Grudin (2000) presented a case study of annotation created using the system Microsoft office 2000. The system is one of the first commercial products to support web annotations. They observed that most annotations for a document occurred near the time of the first annotation, however, many documents continued to be annotated for several months.

In this section we have see that annotations play an important role in the writing process and that a lot of research has been done around the. Web annotation, as the Web, have not been used since a long time ago and therefore it merits investigation on this area.
2.5 Collaborative writing systems and theories

Collaborative writing is a very old and often-performed practice. Already in the 70’s the first attempts to create collaborative writing groupware tools appeared: for example, LS/AUGMENT provided split-screen and voice conferencing features as part of a “knowledge workstation” and aimed at individual or collaborative on-line creation, manipulation and retrieval of text and graphic (Engelbart, 1975). In the late 80’s the research community became interested in studying the process of collaborative writing. One of the first was Mackler (1987) who performed a study of collaborative course work writing among 49 undergraduates. It was found that the respondents thought that a document produced by a group's effort was better than one produced individually. Hartley and Branthwaite (1989) performed a survey of 88 academic psychologists who were judged to be productive writers. The results showed that many respondents wrote alone, and when they had to write in group they usually wrote the different sections of the document in parallel, and then these sections were put together to form the final document.

Ede and Lundsford (1990) surveyed about 700 respondents from different professions (e.g. engineers, chemists, technical writers) and found that people wrote collaboratively to a much greater extent than had been claimed so far. They used a broad definition of collaborative writing that was in line with Rimmershaw’s (1992, p. 16) definition which reads as follows:

“… any piece of writing, published or unpublished, ascribed or anonymous, to which more than one person has contributed, whether or not they grasped a pen, tapped a keyboard, or shuffled a mouse. “

A total of 58% of the respondents in the Ede and Lundsford study thought that collaborative writing was more productive. The respondents valued the fact that collaborative writing could capture different perspectives, different kinds of expertise are involved, errors are reduced and the text becomes more accurate. However, they also mentioned that integrating everyone's writing into a single style was a big problem and that it also took more time than it would usually have taken for individual writing. The fact that the task had to be divided and the diffusion of responsibility were also seen as problematic.

Couture and Rymer (1991) distinguished between collaborative writing (people writing together) and interactive writing (people get only feedback from others). Based on their survey of over 400 professional writers, they claimed that writers on the job practise interactive writing more often than collaborative writing, especially when document quality is a chief consideration. They explore the types of interactions that writers on the job have with their supervisors, noting curious differences in the perceptions of writers and supervisors. For example, writers considered it to be a democratic and informative process when the supervisor edited their writing, as this serves to clarify the writing assignment. On the other hand, supervisors considered this editing as a directive and corrective process that teaches the writer what to do or avoid doing whenever needed in a future assignment. Writers and supervisors focused their interaction on the writer's
provisional draft, with little or no collaborative planning prior to drafting. Interestingly, a
great number of writers, 81%, had revised their text based on another person's responses.

When co-authors decide to accomplish a collaborative writing task, they must not only
express their ideas and attitudes in relation to the document to other members of the group.
They also have to share and discuss their thoughts so that the group can establish a
common ground, a shared understanding of the task on which they can build new ideas to
eventually come up with a solution to the given problem (Sharples, Goodlet, Beck, Wood,
Easterbrook, and Plowman, 1993). Sharples et al. describe four areas that should be
studied to give a deeper understanding of collaborative writing to consolidate and enforce
the basis for the design of CSCW systems for collaborative writing. These areas are:

- **Task issues**: Includes strategies used by writers for partitioning and coordinating the
  work, and the interleaving of tasks: a) sequential - one co-author passes the document
to another co-author after he/she has worked on the document; b) reciprocal - all co-
authors work together to create the document; c) parallel - the writing is divided into
sub-tasks and each co-author is responsible for one of these, for example all co-authors
work in parallel on different sections of the document.

- **Group issues**: Definition of roles, substitutability and interdependence in the group: a)
  Substitutability and interdependence between group members; b) roles; c) management
  of conflicts; d) sub-groups.

- **Communication issues**: Describes the context in which communication takes place and
  the effects of media on communication and its structure: a) identifying the purpose of a
  communicated representation; b) communication in context; c) deindividualization and
  media effects; d) structured communication.

- **External representation issues**: Include types of representation used by writers,
  constraints and effects of media representation and management: a) what to represent;
  b) constraints; c) communication of representation; d) effects of media on
  representation; e) version management.

Neuwirth et al. (1990) point out that members who are writing in collaboration should
“understand plans, changes, and comments made by others”; namely, the communication
process should be well supported. They also claim that definition of social roles and
communication among the members about plans, constraints, and comments is crucial.

According to Kraut, Galegher, Fish, and Chalfonte (1992) in a study of speech versus text
as a medium for reviewing documents found that co-authors are likely to choose, if
possible, a rich communication medium (e.g. voice, face-to-face) when they are planning
and revising. Face-to-face communication has been found to be very helpful for
coordination of planning and construction of long documents. However, co-authors
avoided face-to-face communication while they were drafting the manuscript.

Galegher and Kraut (1992) compared groups of co-authors who used either computer-
mediated or face-to-face communications and found that the groups that communicated by
computer had more difficulties doing their work, but performed as well as those who met
face-to-face. They also found that if the group had the means to work together easily, a
substantial portion of the work was done jointly and a lot of time was given to communication so that members of the group could coordinate their ideas. On the other hand, groups lacking the means to work integratively worked more independently and invested less time in communicating about the task. Neuwirth et al. (1994) state that participants in collaboration can improve their chance of success by managing with whom, when, what, and how they communicate. Also, knowing what not to communicate can be just as important as communicating. They claim that “to provide computer support for interaction among collaborative writers requires understanding their patterns of social interaction.”

One idea that many studies support (e.g. Cole and Nast-Cole (1992) Neuwirth et al. (1990), Leland et al. (1988), and Rimmershaw (1992)), is that of role-support. Roles clearly exist within any groups and writing groups are not an exception. They may be general social roles (e.g. mover, opposer, follower, and bystander (Cole and Nast-Cole (1992) or more task-related ones, such as author, reviewer, and annotator in a co-writing context. According to Sharples et al. (1993) role-mechanisms should be applied with care. Role inertia imposed by the system is likely to interfere with experienced writers' excursions into other roles, because these may be better suited to the task at hand. For example, if the role of the annotator is strictly defined then this member might not be able to negotiate his/her position with the author.

Miles, McCarthy, Dix, Harrison, and Monk, (1993) propose some sort of locking mechanism that collaborative writing systems should take into account to prevent others from (partly) destroying the results of one co-author's effort (accidentally or not). That is, that the system should both guard the interest of the group and protect the individual's work.

It is not easy for collaborators who are using computer-based tools to carry out their activities due to the incompatibility among programs and the computing environments. For example, co-authors might be using different word processor programs (e.g. Microsoft Word, and FrameMaker) that use different formats to save the files. As a result, one co-author might not be able to process the file produced by another co-author. In other words, sharing of the object to be transformed fails. Often, in a computer-supported collaborative writing task almost the whole responsibility of formatting text, for instance, is dropped upon one of the collaborators. As a result, the person who is responsible for the formatting takes total control of the manuscript. So the collaboration assumes a hierarchical-centralised structure which, could make the outcome represent the preferences of the one who was in charge, more than those of the group as a whole.

Noël and Robert (in press) in a recent study investigated which technology was used by collaborative writers and which tools they used to communicate. It turned out that only 3 out of 41 respondents mentioned using some type of groupware. The technology most often mentioned was Microsoft Word (83% used it). Though no special software was used for accomplishing their collaborating writing task, most people (85%) thought that the software they used supported this activity well. The most valuable function of the software they used was “tracking changes” (to see the changes that another co-author has done).
Version control, adding comments and being able to identify the contributor were other appreciated functions.

## 2.6 Software that supports collaborative writing

When discussing software that supported collaborative writing, we have to mention the stand-alone word processor software that was introduced in the 70’s. The simple fact that a file could be transferred from one computer to another by a diskette, or that two users could use the same machine, makes a simple word processor a piece of collaborative software. Today, several writing systems have been explicitly designed to support collaborative efforts. However, no single tool can as yet satisfy the majority of a group’s needs.

### 2.6.1 Local area network collaborative systems

When local area networks (LAN) became common, the computer was already more used for writing than for calculations, and the first dedicated collaborative writing tools appeared. There were two basic ideas in common for almost all of these systems. The first one was to make the document to be produced a shared object. The second was to support communication among co-authors. However, different approaches have been taken in these systems in relation to the document, the participants in the writing group and the communication among them. Some of the systems present novel functions that are of interest. In the following section, some characteristics of collaborative systems that run in a LAN will be briefly summarized.

#### 2.6.1.1 Document structure

One of the very first tools that appeared was Quilt (Fish, Kraut, and Leland, 1988). An idea that Quilt used was to treat the document not as an indivisible unit, but as a set of sections on which co-authors could work asynchronously. In NoteCards (Halasz, Moran & Trigg, 1987) the document is seen as a “semantic network” of electronic note cards interconnected by typed links. These notes could be opened and read at the same time by several users. In GROVE (Ellis, Gibbs, and Rein, 1991) the document is divided into private, shared, and public sections. A document in PREP (Neuwirth, Kaufer, Chandhok and Morris, 1990) is defined as one or more columns. These columns can be used for the main text, for document plans, and comments. In SEPIA (Haake & Wilson, 1992), a document is created by interacting in four activity space browsers: 1) content generation space, 2) planning space, 3) argumentation space, 4) rhetorical space.

#### 2.6.1.2 The participants in the system

Some systems explicitly define the role that a particular user will have during the collaborative task. Quilt, for example, identifies users as either co-authors or commenters. Only certain privileged users, i.e. the co-authors, can modify the document. NoteCards did not use any role definition, but it locked the note to avoid concurrent updating. In
GROVE there is neither locking function for editing nor any turn-taking mechanism. Instead, users themselves establish a social protocol for negotiating access to the document.

2.6.1.3 The communication among co-authors

Quilt allows annotations, computer conferencing, and notification facilities to support communication and information-sharing among collaborators on a document. PREP offers annotation functionality and a chat box for communication. This system has the feature that annotations are presented aligned across columns of text, which allows users to link an annotation spatially to a particular chunk of text, and facilitates overview.

2.6.1.4 Special features

NoteCards provides tools to organise, manage, and display the structure of the document. In GROVE when users enter (or re-enter) the system, they receive an up-to-date document unless they choose to retrieve a previously-stored version and uses voice annotations. PREP was designed focusing on providing a usable, visual representation of the information. It pinpoint the differences between different versions of the document, and provides coupling among users. In the NLS project (Engelbart and Lethman, 1988) two terminal screens are linked for real time conferencing. In SEPIA, co-authors can work in synchronous or asynchronous mode. In the independent mode (that is while working asynchronously) users may work on their own tasks without interfering with each other. In the loosely-coupled mode (working synchronously) users may share certain public information while working on their own tasks. In the tightly-coupled mode (working synchronously) users share the same view of the object. Each co-author sees the same browser in terms of size and content. Also, SEPIA has a telepointer device that is used for pointing to items visible in the shared view. A locking facility that applies to the objects in the shared space is provided.

2.6.2 Systems that use the Web as infrastructure for collaborative writing

In the last decade, a few systems have been developed to support collaborative writing through the infrastructure of the Web. As the Web is extensively used in organizations it is natural to use the same environment for the common practice of collaborative writing. Furthermore, the possibility to access the Web from different places makes Web-based collaborative systems important. An additional point is that Web formats for documents like HTML and XML are widely used and supported which facilitates the exchange of information among co-authors. The communication needs that co-authors might have could also be mediated by the Web. Furthermore, the Web is a vast information space that co-authors might use to help reach their goals in writing.
2.6.2.1 Document structure

One of the first applications using the web infrastructure to support collaboration work was the BSCW (Basic Support for Collaborative Work) system (Appelt & Busbach, 1996). For this system the document is indeed a shared file to which co-authors had access. Alliance (Romero & Decouchant, 1997) exploits special knowledge about the internal hierarchical structure of its documents to provide concurrence control on document subtrees. EquiText presents the document as a table in which each row is a paragraph. Each column gives information about the content of the paragraph, who included it, when and the possibility to add an annotation. It does not show the structure of the document as a whole.

2.6.2.2 The participants in the system

Access rights in BSCW can be set on a per-object basis to control the operations available to different users. Alliance defines roles that are related to the document parts (also called fragments in the system).

2.6.2.3 The communication among co-authors

Ceilidh (Hughes, Jake and Okelberry, 1998) use threaded messages for communication. The content of each comment is presented one by one and a navigation bar through the comments is available. The Anchored Conversations system presented by Churchill et al. (2000) provides a synchronous text chat window that can be anchored to a specific point within a document, moved around like a post it note, and searched via a database. EquiText presents the comments for each paragraph, as the core of communication but for each paragraph there is only one annotation so a dialogue is not possible.

2.6.2.4 Special features

Alliance can handle temporary disconnection from the network without disrupting the cooperative editing. Ceilidh automatically converts text, including carriage returns, URLs and email addresses in the body of the message into HTML. It also has the ability to include graphics and even multimedia outcomes. Microsoft Office 2000 uses email for notification of new annotations. The system anchors annotations by computing a unique signature for each paragraph. For this reason the annotation system can fail to match an annotation to the correct location when the text is edited. When this happens, the annotation is “orphaned”. EquiText allows users to view the document from two perspectives: one as a table in which each paragraph is a row and the other in linear form. It gives the possibility to place a paragraph according the position the author considers is needed.
Designing, evaluating and exploring Web-based tools for collaborative annotation of documents
3 METHODOLOGY

The research presented in this thesis is the result of almost seven years of work. In 1996 the Web was not the same as it is today; it has continued to expand and evolve in the intervening years, which has affected the research process significantly. For example, the number of computer users in Sweden with network access from home has increased dramatically in the past few years, from 3% in 1995 to 60% in 2002 (Nordicom, 2002). In the beginning of this research, few Web-based applications had been developed and programming on the Web was in its first years. During the course of the studies, the Web browsers in which our prototypes were to run were often changing and presented new features, which offered new possibilities. A particular problem was that in many aspects the various Web browsers we used were responding in different ways to the same conditions, which made the programming a “headache”. Furthermore, the different platforms on which users were running the system and their individual settings and preferences affected their use of the prototypes, partly in unpredictable ways. Despite these difficulties, many of the problems were solved and the current versions of our systems are comparatively stable. I can state this because the use of the current versions has been characterised by a very small number of error reports. Also, in the case studies users have gradually showed more interest in their task than in the system.

A central aspect in my research is the use of text-based CMC, a form of communication that was less wide-spread in the beginning of this research. As time passed, users have become more familiar with this medium, which has probably affected their interaction in our case studies as well as their attitudes to our tools. However, this is also a positive factor, making it easier for users to understand the tools and learn to use them for their own purposes.

The collaborative work discussed in this thesis is performed by a small or middle size group who are interested in sharing a document to all the members and exchanging comments around them. The results, however, cannot be generalized for teamwork, even when many of the observations are of broad character.

3.1 About the iterative design

A common factor in all the case studies presented in this thesis is that the Web-based tools being utilised were developed iteratively. That is, after each case study, the tool was changed, in order to solve problems with the interface or to include new features. Changing the web-based tool for every case study, of course, makes it more difficult to generalise from the results; however, these changes were motivated by the users’ interaction with the system. We have been exploring how people interact and communicate in order to accomplish a collaborative writing task using the Web as infrastructure. We have gathered information that helped shed light on a number of issues:

1. How people discuss the content of a document this was done using DHS and Col·lecció in the discussion context.
2. How people make digital annotations on an on-line document using an interface that allows only plain text input -this was done using the DHS in the annotation context.


We have considered it as essential to observe real situations in which members collaborate mediated by computers. Grudin (1988) observes that “it is difficult or impossible to create a group in the lab that will reflect the social, motivational, economic, and political factors that are central to group performance” (p. 87). The case studies have overall been performed in an educational environment in which discussion and/or production of documents plays a central role. Most of the studies deal with situations where the students met in real life, and the use of computers to mediate the homework has been part of the course's goals. However, we have also case studies in which members have worked in distributed mode sometimes placed in Asia, America and Europe.

When the tools were used in educational settings, the students had to prepare real homework with one of our tools. Similarly, in the case studies in which Col·laboració was used, participants engaged in a real writing task. This has provided an interesting context for the evaluation of our prototypes. Also, this gives validity to the objective data collected in these cases.

3.2 The participants

A total of 212 participants has been part in the studies that we present here. These people have worked in groups. All the groups that participated in our studies were already formed when they used our tools, e.g. members of a class in graduate, post-graduate education, and co-workers in a research department. All participants had access to the Internet and almost all had used the Web for at least two years when the study was done. Participants were from both sexes. None of the participants has been rewarded for using taking part in the studies. However, a social hierarchy influence has been used in some of the cases. For example, the teacher of the course or the head of the department asked participants to use the tools. In other cases, participants were interested in Web-design and the Web as infrastructure for collaborative writing.

3.2.1 Participants who used DHS or Col·lecció

All co-workers in a research department were asked to participate. The main reason why this department was selected was because many were interested in the Web, and the head of the department was interested in testing a Web-based application in the unit. Another important reason was that I was part of that department, therefore it was easier to get in touch with participants during and after the study.

The other groups were students from three different courses. One course was from the computer department, the other two were from the language department. The teachers of the courses were in agreement with using the tools in their classes and also willing to
participate in the study. In these courses, the need to share documents and comment on them was part of the syllabus. One of the courses was given three times during the same semester by the same teacher. The teacher of the course selected the class that was going to use our tool and be part of the study. The selection was based on how many students were registered in the class (no more than 15). Also, it might be easier for a physicist to comment on a document in his/her field than on a document on, say, economics. Therefore, she considered those courses for participation in the study in which the similarity between students’ background knowledge was higher.

3.2.2 Participants who used Col·laboració

The studies of the use of Col·laboració were mainly done in our research department. Participants were highly motivated in using the tool as it was part of a project in which several of us were involved. However, there was one study that was done outside our department, where the participants were graduate students that had met in a summer school and that were located in different countries (in Europe and America). During the summer school they agreed to use Col·laboració to mediate the work with the final report, which was due one month after the end of summer school.

3.3 How the data was collected

In the studies presented in this thesis, two main types of data have been collected. The first type includes observations from the interaction between users (objective data). These data include the documents that the users produced or included in our system, the comments that they produced, and the log files that our system kept. The other main type of data I have collected is subjective, resulting from interviews and surveys I have carried out with our users.

3.3.1 Objective data

I was interested in observing the way people collaborated, particularly when they were using Web-annotations as the medium of communication. These Web-annotations were linked to a particular Web-document. All these Web-documents were saved. However, we were not interested in the content of the document. For example, we have not evaluated the quality of these documents nor how the users themselves evaluated the documents in question. Instead we have focused on the communication process which took place between them using the Web-annotations.

These comments posted by the users have been the core of this research. It was an advantage to have total control over the data that users were posting so that we could structure it according to our research goals. For every comment, relevant information was kept (e.g. date, author), and a program was developed to perform basic statistical analysis on the collected data.
The use of Web-annotations posed ethical dilemmas. For example, all but 9 of the comments were inscribed by the users. Consequently I decided to change the real names of the participants. However, to give the reader the context in which the interaction took place, I present data that might reveal the identity of my users.

A great amount of comments were read and analysed by me, especially in the case studies of Col·laboració and in the case studies where DHS was used as an annotation tool. In these case studies, I was interested in the nature of the cooperation and the way the Web annotations were used by the participants. Two case studies where DHS was used as a discussion tool were analysed. First, all documents and comments included in the domain were printed out and read. The aim of this was to identify the linguistic reference links among the comments in the discussion and the documents in the domains. This work is not yet finished and has only been used marginally in this thesis, with the purpose of providing real data for the examples presented of the DID visualization.

The comments were also parsed to find different patterns that were relevant to collaboration (e.g. “I think” might represent an idea that the participant wants to negotiate). The text of the comments produced in the second language course was used to create a list of vocabulary. This list was given to the teacher of that course as a supplementary aid that the system could give. This work was done by a computer program.

The third kind of objective data was collected from the log files, which were maintained by the system that we had developed. Indeed, all Internet servers keep a log file of every interaction they have with their users, where we can find the same information we recorded in our own log files. The main reason I wanted to keep our own log files was to develop the programs according to our own research needs and, if needed, change the structure of the log files. Also, we realized from the beginning that the log files could be important in providing awareness of the group activity. Although a great amount of data has been accumulated in the log files, it has only been used marginally. However, the last version of Col·lecció used this information to support users in their work.

### 3.3.2 Subjective data

The subjective data was collected just after the group had accomplished the collaborative task. The tools we used to collect subjective data were interview and survey. Participants who supplied subjective data were either interviewed or completed a survey. In the case studies where Col·laboració was used only subjective data was collected for two of case studies. Moreover, one of the survey was filled by those participants who were not involved in the project. In the other survey, only one of the four participants for that writing task was involved in this project and completed a survey. The reason we were reluctant to gather more subjective data for these case studies was simple: most of the participants in the case studies were involved in the development of Col·laboració and this could create biased answers. One reason why we took part in many of the case studies in which Col·laboració was used was because experiencing the tool in a real task allowed us to understand its impact on the collaborative writing process and to identify both the
system’s shortcomings and benefits. Most of the data collected for the study of Col·laboració was therefore objective.

One of the methods that I used to collect subjective data was a Web-survey. It is a Web-form with questions that can be submitted and recorded on the server. I decided to use a Web-survey because it gave me the possibility to reach most of my users easily. I had personally met all the participants who, in some cases, had been my students. I also had access to their email addresses. Since all the survey responses were in digital form they could be processed by computer.

The questions in the Web-survey were oriented to evaluating several aspects. The first questions were to determine personal information and the respondent’s experience using the Web. Another group of questions were oriented to evaluating the functionalities of the system and to what extent the system supported the task it mediated.

We also asked about how the users perceived the use of the Web-space that they shared and about security issues in context in which the users were working. Finally, we asked also about their opinion of using web-based tools in the traditional classroom.

The Web survey consisted of multiple-choice questions whose answers could be single or multiple options given to the subjects. These questions were used to assess data whose answer could group be grouped in different choices for example whether the participant had used the Web at least for a certain period of time. There were also questions ranked using Likert scales. These question were oriented to evaluating the extent to which the participant ranked a specific task. For example how easy/difficult was to use a certain future of the system. These questions generally were followed by an open-ended questions in which they were asked to motivate their choice. Getting responses in some cases was not a problem because in some of the case studies it was mandatory to complete the survey so that the students could fulfil the requirements of the course. In those cases where the survey was not mandatory the number of respondents was, of course, less. When the deadline for the survey had passed, I sent an email to everyone who had not replied to the survey. The email was personalized by using their names. After the reminder, 4 to 6 more responses were received. The Web-survey was different for every case study. The main reason is that every case study used a slightly different version of the system used by the previous cases study and we were interested in evaluating the new features. Also there were some questions that were specific to the task. In the appendix, we present those questions that were somehow the base of the Web-survey as they were used in all the cases in which the survey was used to collect subjective data.

To avoid bias in the analysis of the survey, I decided to browse the results in such a way that I could not identify who was the respondent, a sort of blind-analysis approach. This form of presentation had the advantage that I could be more objective while reading their replies. The approach I selected was to group their replies by questions in the form of a list and I developed a program to support this. This program also grouped the multiple-choice questions and counted the frequency of a particular choice. However, sometimes the respondent wrote as a reply to a question “see answer to question n”. To know what the respondent referred to, it was necessary to read his/her responses individually. The
program I developed supported this function as well but it was used only in those particular cases. A similar problem is that the contact between the respondent and the researcher is minimized. Five respondents wrote something like “I do not understand the question” in response to a particular question. I had included contact information (mail, phone) at the beginning of the Web survey but I was never contacted by any of the respondent in relation to the content of the survey.

There are other possible problems. One is that respondents could be cheating. People could be completing the survey more than once, or they might not be part of the target group. The last situation is really difficult to control because no mechanism ensures that this problem do not occur unless each respondent gets a unique code to be used for identification. To alleviate this problem we asked the students to write their names at the beginning of the survey. As a consequence, respondents might not have been so open, especially when commenting on our tools (though we did say that the tools were only prototypes which they may have been more ready to criticize). However, the use of open-ended questions mainly to motivate their choices can be a way to dig deeper in this respect. Open-ended questions, usually more personal and requiring more time, were also a way to minimize the possibility that one person responded for another or responded twice. Indeed the real problem for us would be to get response of someone who had not used the systems for obvious reasons. I consider that, in the responses to the Web-survey, the problem of cheating was not apparent. I would therefore say that the blind-analysis approach also gave extra support against cheating. Since all the answers to the same question were read and processed at the same moment, it is easier to recall an abnormal situation (e.g. identical responses to a open-ended question).

As in other cases, Web-forms can behave differently depending on the platform, Web-browser version, user’s preferences, etc. Some of the respondents (4), from the two very first cases on which the Web-survey was used, had some technical problems that were solved by running the Web-survey on another platform. One of the respondents printed out the survey when she noted that the submission of the survey was not possible and turned it in. This response was appended to the other responses in digital form. Those who had problems submitting their responses, mentioned that it was frustrating to find that all their effort was lost. After this incident, the Web-survey consisted of two parts: a welcome page and the page for the questions. The welcome page provided contact information, the purpose of the survey, and how to complete it. This page was also used to verify that the Web-browser was supporting the Web-survey. From this page the server was asked for the question page of the survey. If this question page was presented then the Web-browser used by the respondent was compatible with the Web-survey. They were informed of this situation and were asked to contact me if the question page could not be seen. Also, a log file for the Web-survey was kept. When a respondent requested the question page, pertinent data to identify him/her were registered. This was used to determine if a particular user had indeed received the question page. Only one respondent did not complete the Web survey and the log files showed that this person did not obtain the question page, so this respondent was asked to do the survey again. Finally, as any digital data, the information in the Web-survey could be deleted by accident. I lost four responses to one of the studies. However, three of them could be recovered from the backup.
A technical limitation also found was that the amount of information which can be submitted in a Web-form is limited. Yet, compared to a paper survey there is much more space to answer an open-ended question. Although the responses were collected asynchronously, it should always be kept in mind that concurrent submission can occur and the program that handles the Web-survey should take care of this situation. On the other side, only text-based comments can be used and the respondent might like to use other forms (e.g. line drawings).

The other method I used to collect data was interviews. Interviews were conducted with selected users after the use of one of our tools. No transcriptions of the interviews were done. There were three formats that I used to carry out an interview. The first was to a group of 16 respondents who responded to a structured interview. The duration of these interviews were 15-25 minutes. Respondents were interviewed one by one. These interviews were recorded. To collect the results, I wrote down the questions in a notebook and for every respondent I summarized his/her response.

The second type of interview was with the teachers of the course. This had a free format, though the goals had been established previously. One teacher was interviewed four times in a period of three years after using one of our tools in the class that the teacher conducted. This interview was recorded. During the time of the interview I made notes. Later, I replayed the interview and expanded the previous notes, and also added new ones.

The final format I used was to conduct an interview with the whole class at once. This was used with the Spanish students course, carried out in Spanish with the idea of motivating the students to participate in the interview. The students were at the end of an advanced level so they could express themselves well enough. These interviews were not recorded. While the conversation was going on I took notes that I expanded just after the interview. The students were asked to fill the Web-survey one week before the interviews. At the moment of the interviews some responses had arrived and I had read them. I did this to prepare the questions of the interviews. The aim was to clarify some of the responses and to dig deeper in some of the topics related to the study (e.g. what problems the student face while using the system).

However, a technical problem was presented when distributing the Web surveys to one of the group that used Col·laboració. This group was asked to complete the survey two weeks after the end of the collaborative task, because of technical problems. The only respondent who was interviewed more than once was the teacher of the writing course in which the DHS was used as an annotation tool.
4 THE DOMAIN HELP SYSTEM: WEB ANNOTATION AND DISCUSSION AROUND DOCUMENTS

4.1 Introduction

The Domain Help System (DHS) project started in 1996. The original idea was to develop a new help system that could present information according to an iceberg model of information. The idea of this approach was that initially only a minimum of information is presented, namely that information which an experienced user could request for, and consecutively more information is available on demand. Like an iceberg the system shows only tips of information, but there is an entire mountain of information to be accessed as we descend deeper. An important requirement for this project was that a user should be able to easily add knowledge items to the system while he/she was interacting with it. We therefore decided to have a simple representation of knowledge items in the form of written comments or annotations.

However, the DHS is not at present a help system. The process of designing a new system, aiming to support a specific task, might be full of unexpected results. The original goals can easily swerve, and in this process the task is also redefined. Furthermore, the artifact (in this case the system) adapts itself to the requirements that the new task imposes and creates new possibilities that, in turn, may modify the task. Carroll, Kellogg, and Rosson (1991) defined this process as the task-artifact cycle. The design of the DHS bears witness of the task-artifact cycle through iterations of user participation.

The result of that project was a Web-based tool that, generally speaking, lets users select a Web document from a list and attach a comment to it. These comments are available immediately to all the users. The comments are presented in chronological order, which allows for the development of a dialogue. Joining a) the possibility to make an annotation or comment on a Web document, and b) the possibility to create a dialogue among those using the tool, we decided to use the DHS as a discussion or forum tool and simultaneously as an annotation tool for document production.

This chapter presents the current user interface of the DHS and the case studies in which it has been used. The DHS has been modified after each user study we carried out in terms of the interface and usability, and these changes will be reported on here. For the analysis of the case studies I used the comments submitted by the users while using the system, and also, I performed interviews and surveys. Additionally some of the case studies included log files that will be used in the analysis.

The use of the DHS can be separated into three contexts. The first context was in a research department and it was a pilot study (it will be called R-group case study). The purpose was to investigate how the DHS could be used and how users interacted with it. The R-group case study disclosed the potential of the system. The second and third context were in an educational framework.
In the second context the DHS was used as a forum tool but in two different scenarios. The first one in a CSCW course in which participants had to discuss the content of documents. This will be called the D-sample case studies and involved five versions of the course over a period of five years (see page 37). The documents were written by the participants and dealt with a topic given as an assignment to them by the teacher. This scenario led us to draw conclusions about how the users discuss a set of documents individually and as a whole and to determine the needs that the user might have during such a discussion. The second scenario was in a second language advance course of Spanish. The students had to show that they had read and understood the content of a book in Spanish by having a discussion of the book using the DHS. In this scenario we were exploring the possibilities that the use of the system offered to the user during a collaborative learning process. In this context, the DHS was used to support asynchronous discussion for a middle size group (10-15) around a document. In the second language course situation, the documents presented the questions that the students had to discuss.

In the third context, the DHS was used in a writing course given to PhD. students at KTH. Students were supposed to review or correct the documents that other classroom mates wrote to fulfil an assignment. This will be called the A-sample case studies and involved data collected in four versions of the course over a period of four years. This case study led us to draw conclusions about the communication process between the writer and the reviewer about changes in the text. In contrast to the D-sample case studies, the comments made were related to the form of the document rather than their content.

Below some general aspects of the DHS are described. Later, we will describe the case studies and their results, followed by discussion.

### 4.2 Main characteristics of the DHS

The DHS is a Web-based system that lets users share Web documents and make comments on them. The comments are also shared by the users. A domain, in the DHS project, is a site on the Web that divides the Web browser into four frames which display: 1) a hypertext link list, 2) the content of the most recently activated link in the form of a document, 3) the comments users have made so far on that document, and 4) a button that pop-ups a comment-input window. The documents held by the system are included in the domain by the domain’s editor (in all the studies, I was the editor). Comments could be related to the content, the formatting, the design of the document, or even be a response to a previous comment. A domain is said to be closed-from-inside because once a document or comment is “inside” the domain, users cannot delete or modify it. Users can just retrieve or add new comments. Only the domain’s editor can update the files in the domain. In Rodríguez (1999) the creation of a Domain Help System it is motivated and the most important parts of its development are described pointing out the versions or prototype's characteristic and how a version of the DHS differs from the previous one.
4.2.1 Layout of DHS

When the user enters the system, the Web browser window is divided into four frames as follows (see figure 3):

- The left frame displays the hypertext link list (index frame).
- The right frame (information-frame) is divided into three frames.
  - The top-right frame displays the content of the most recently selected link (content-frame).
  - The middle-right frame displays the comments made so far to the document that is presented in the content frame (comment-frame).
  - The bottom-right frame displays a button that pops-up a window from which a new comment could be written and submitted (command-frame).

![FIGURE 3. The layout of the DHS in a Web browser’s window](image)

4.2.2 How the DHS works

The domain’s editor creates a domain and members of the group are asked to send their contributions in the form of documents. The domain’s editor receives these documents, makes an HTML version of them if needed, and places them in the domain. The DHS automatically creates a hypertext link list including all the HTML files in the domain. Additionally, the domain’s editor includes one document that explains how to use the system and how to deal with known problems of the system. This document is associated with a link in the index frame of the domain with the text “About this prototype”. In the following, this document will be referred to as the ATP document. To provide users with an easy and quick access to the ATP document the system reserves the first place in the index-frame to its link. The communication consisting of comments under the ATP document is discussed thoroughly in chapter 9.
In detail, this is what happens when the user enters a domain.

- In the index-frame the hypertext link list of the documents that the domain contents is displayed.
- In the content-frame the ATP document is displayed.
- In the comment-frame the comments made so far on the ATP document are displayed. Comments in the domain are generally presented in a chronological order and a simple navigation bar is presented for each comment “First-Next-Previous-Latest”. The system automatically shows the last comment added to the document.

After entering the system, users can select any document from the index-frame. When the user selects a document (clicking on its link), the content-frame and the comment-frame are updated immediately. The content-frame displays the content of the just selected document and the comment-frame displays the comments made so far on it.

In the first versions of the DHS, to add a comment on the current document, (the one that is displayed in the content-frame) the user has to click on the “Add comment” button. This will open a separate window (see figure 4) in which users can write their name or nickname and the text of their comment. This window identifies the document to which it is related by adding the same hypertext link text as a heading in it.

Figure 4 shows the Add Comment Window for the ATP document. When the comment is submitted the Add Comment Window is closed automatically, and the comment is appended immediately to the comment-frame; the just added comment is presented at first. After this, all members of the group have access to the comment whenever they select the corresponding link. If a document has no comments, a message saying so is presented to the user.

4.2.3 The DHS as a discussion/annotation tool

The DHS interface has been changed iteratively in response to the observations of the users’, the interviews, and survey. One point worth noting here is that the changes made to the Add comment window have been significant for the system as a whole. The first significant change was to make this window bigger and divide it into two frames, where the left frame contains the same document that was in the content-frame when the add
The domain help system: Web annotation and discussion around documents

4.2.4 Awareness of new comments

One of the main problems that the first versions of DHS confronted was the lack of group awareness about changes. Consider this situation: user A is the author of document-A, say, user B makes a comment on document-A and on document-C. The only way for user A to know about this was to enter the system and select document-A and document-C. If user A enters the system it is very likely that he will select document-A and will, hopefully, notice that there is a new comment. It might not be the same for document-C, as user A is not its author. It might be frustrating for a user to spend his/her time visiting the domain several times and after browsing all the documents in it, find that everything was the same,
especially in relation to the documents that he/she is particularly interested in. As a result of this frustration, the user might not come back to check the domain any more. To alleviate this problem two features were implemented. First: Email messages are sent automatically to the author(s) of the document when a comment is made on it. The comment is attached to the email and it is labelled in such a way that the receiver could recognise that the message is sent by the DHS system.

The second solution was to write a comment counter tag beside the links in the index-frames to indicate how many comments had been made when the session started, for example: Document-A (3 comments). Users might recognise that the comment counter tag of a document has changed. It also helps explorative browsing of the domains, since users will at a glance know whether a document in the domain has got comments and how many comments there are so far. The user might be interested to “see” the most (in number of comments) commented document’s content and its comment, or, conversely, see why a document has not been commented on at all.

4.2.5 Logging function

The DHS has a logging function in order to provide information about the users’ actions in the system, which documents they visited, how long time they spent on each document, how long time it took for a comment to be written, how long time the user spent in one session, etc. Basically, every time the user enters the system, selects a link from the index-frame, or when a comment is added, a record is appended in the log file as an action. In general an action is defined as when the client-side makes a connection with the server. That is, mouse movements, scrolling, text selection, keystroke are not considered actions. However, to what extent this reveals their real actions is unclear, as users could click on a document and at the same time receive a phone call, for example. This situation is not trailed by any logging function. Furthermore, this could also depends on the Web-browser program used, for example Netscape make a server connection when the user resize the window while Microsoft IE for the same action does not. Despite this uncertainty, I considered that this data might be valuable for some aspects of my studies. The log file registers the time of the action, the user’s IP number, which document was selected and the addition of a comment.

4.3 General topics in the DHS case studies

There are some common aspects of the three contexts (in the research department, in the discussion context, and in the annotation context) in which the DHS was used. Which comments were considered relevant in order to be included in the analysis, the privacy policy we took into account for the domains, and which users were those whom we labelled as participants are the topics described in this section.

Additionally, there are some common characteristics for all the domains:

• Participants had to work in collaboration in real cases.
Table 2. Case studies in which the DHS was used

<table>
<thead>
<tr>
<th>Case study</th>
<th>Pilot Study</th>
<th>D-Sample</th>
<th>A-Sample</th>
<th>Totala</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participants</td>
<td>16</td>
<td>26</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>Number of Contributions</td>
<td>17</td>
<td>21</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>Contribution with comments</td>
<td>12</td>
<td>21</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Duration (days)</td>
<td>97</td>
<td>78</td>
<td>15</td>
<td>38</td>
</tr>
<tr>
<td>Number of comments</td>
<td>77</td>
<td>130</td>
<td>33</td>
<td>61</td>
</tr>
<tr>
<td>Number of words in comments</td>
<td>3789</td>
<td>12532</td>
<td>3751</td>
<td>4869</td>
</tr>
<tr>
<td>Number of comments on ATP</td>
<td>48</td>
<td>25</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Number of words in ATP</td>
<td>2981</td>
<td>1916</td>
<td>57</td>
<td>189</td>
</tr>
<tr>
<td>Use mandatory</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Log file</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Email awareness</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Comment counter tag</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Combined layout</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>paste-text function</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

a. Total = R-group + D-sample total + A-sample total
Participants had an initial face-to-face meeting and there was a common physical location where they met regularly (daily, once a week, or once a fortnight).

The groups of participants were not especially created to use the prototype, but were formed for other reasons, i.e. they were members of a class course, or they were in the same project, or they were working in the same department.

Group members had access to different ways of communicating with each other, for example, using email, phone, face-to-face.

The only way to include a document into the domain was through the domain’s editor. Group members sent via email the document they wanted to include in the domain and the domain’s editor made an HTML version of the document if it was needed.

4.3.1 What is considered a relevant comment

In all the domains we found 29 comments that we considered as not relevant comments: e.g. “54t6yrethr”, or, “this is a test”. These comments were not taken into account in the analysis. We, thus, consider “relevant comments” those that made sense in their context and expressed an opinion or gave new information: a question, a suggestion, or a reply to a previous comment.

4.3.2 Members of the groups and participants in the domains

Members of the group in these case studies were defined as follows: a) in the R-group consisted of all those who were part of the research department; b) in the D-samples members were the students who were taking the course and the teacher; c) in the A-samples members were the students who were taking the course, the teacher and external reviewers.

There were some members of the groups that entered no comments. For the analysis of the communication in the domains, we consider as participants only those who entered at least one relevant comment.

4.4 Case studies

This section presents the studies in which the DHS was used. The pilot study was made in a research department. After the pilot study, we decided that the DHS could work well for distributed, asynchronous discussions around a Web document. In the educational field, students work often around a document. For example they have to read and comment on other students’ writing. Therefore, we decided to use the DHS in a traditional classroom context. Thus, the first series of studies was made to investigate how the DHS supports discussion about the content of a document (about one page long). The second series of studies was made in a course where students were supposed to learn to write in academic style. In this case, the aim was to investigate how the DHS supports annotations to a document. The third case study was made in a second language course in which students
had to discuss on-line the content of a book that was assigned, that is a reading comprehension exercise.

4.4.1 Pilot study: the R-group

This was the first study in which the DHS was used. This study had an explorative nature and aimed at disclosing the possible uses of the DHS.

4.4.1.1 Method

Participants

Members of an interdisciplinary research group (R-group) participated in the study. There were about 25 members in the R-group. All members of this domain had a Human Computer Interaction (HCI) background and were computer literate. No reward was given for participation.

Apparatus

The version of DHS used had the following characteristics: The Add comment window presented two input fields (for the user identification and for writing the comment) see figure 4. Participants had different Web browsers (Netscape, IE), versions (Netscape 3.1, Netscape Gold, etc.) and platforms (Mac, PC, Sun).

Procedure

R-group members were asked to make a draft project description of their research activity. These reports in a finished form were supposed to be published on R-group’s Web site later, and each member would get to know about other members’ projects. The R-group’s members were able to make comments on each other’s project descriptions during the drafting stage.

A domain for R-group’s topics was created. The index frame presented a list of the research topics going on at the R-group. The R-group’s members could read about other colleagues’ work and make comments on this description. This domain was on line for 97 days. This period is calculated taking into account the date of the first comment and the very last comment registered in the system.

After that the domain was closed, we had 15-20 minutes long interviews with the users about the DHS’s interface and about the different uses that could be given to this tool.

4.4.1.2 Results

A total of 15 project descriptions were presented in this domain. Despite the request made by the head of the group to use the system, very few contributions in the form of comments were made in the domain related to the topic that were submitted. Instead,
participants readily made comments on the interface of the prototype. No active
discussions about the topics were registered except for the one in the ATP document. The
ATP document got the major amount of comments, 48 of 77. Using the unit words-in-
comment, we found that almost 80% of the discussion made on this domain was related to
the ATP document, in other words, to the design or the use of the DHS.

Twenty-nine comments were found in the other documents that formed the R-group
domain. These comments were related to the content and style or layout of the document
but they were rather brief; 24 of them contained less than 40 words. Example 1 and 2 are
two comments that Soledad wrote in two different documents that she found in the R-
group domain. The examples are presented in the same format in which they were shown
in the DHS except for the italic font used in these examples. In the examples, the first line
labels a comment with a number, the date, and the time. The second line identifies the
author’s name. The other lines contain the comment itself. The name of the users has been
changed.

1)  Comment #1 97/04/07 14-32
   Soledad:
   This is a very nice text.

2) Comment #1 97/03/18 21:18
   Soledad:
   This text could be improved. There is too much about the author (this fits better on a home
   page), too much background and too little about the results of the project.

The interviews showed that all the users welcome the idea to get comments on their work
from their colleagues. However, some of them said that this situation might create
conflicts among them. Users also reported that it was hard to find the URL, which was sent
via email, for the domain. What kind of comments the users were supposed to make was
also an issue that was not clear according to the interviews.

Authors in most of the cases did not reply to the comments made on their project
descriptions. When replies were made, it usually took more than 8 days to respond.
Example 3a and 3b shows such a situation.

3a) Comment # 1 97/03/18 22:18
   Diana:
   I think it is best to remove all the “fortcoming” references. It is much nicer to include them
   when they get published!

   The next comment on the same document was made: 26 days 11h 28 min. later.

3b) Comment # 2 97/04/14 09:
   Oliver:
   I agree with Diana. It seems to me as if the text is an old version. Where should I put the cor-
   rected version?

The main concern for the participants was that they could not make a change by
themselves after reading a comment that suggested that change in the project description.
The system did not support users to revise the documents but they could ask the editor to
upload a new version of their document. However, it was in only two cases that users
requested the editor to do so.
4.4.1.3 Discussion and conclusion

In this case study, we found that the users had some problems to accomplish the task. It was not easy to find the entry to the system and also it was not clear what was expected from them. Users with a HCI background were, of course, willing to make comments on the interface of the system and most of the discussion was centred on this issue. Additionally, members of the group knew that we were developing a new system and it was common that they wanted to comment on it.

The name of the system “Domain Help System” also created confusion among the users. Most of the users asked during the interviews “but why do you call this a help system?” The name of the system was interfering with the accomplishment of the task because users were trying to compare the DHS what for them was a help system. One person said: “I do not even see the question mark button”, probably referring to other help systems known by the user. For administrative reasons, we decided to keep the name.

Before starting this case study, we did not perform any social study to determine whether the users were really willing to get comments on their work, especially in public. We were introducing a new tool. Did the users need this tool? Why is a new channel of information needed? Which are the new benefits, if any? The fact is that getting comments, specially if they are good and fruitful, is something most would wish. On the other hand, to which extent participants in this study were able to make a comment on others’ work was difficult to determine. Users claimed very enthusiastically that they thought it was a great idea to get comments from their colleagues on the ongoing work. However, the result of the interviews shows that commenting on others’ work could be very sensitive. “This might create a lot of problems” one of the users said. The reason given by this user was that it could publicly confront colleagues at work. Another user reported that it would be acceptable to get comments from those colleagues that knew about the subject area of their work but not from those who were ignorant in the subject. The main issue here is the public characteristic that a domain has in DHS- it is accessible to anybody, any time, anywhere who has access to the URL. In chapter 7 this topic is treated more extensively.

Another issue that arose was the lacking possibility for the author of the document to decide when and from whom the comments should be made. Yet, another problem the user confronted was very basic: where can I find the system? We sent the URL via email, so that the users could enter the system, but users reported that it was hard to find the URL in their email-boxes later on. Generally, I observed that communication via email might not be so effective for instruction. Users were somehow ignoring the requests the head of the group sent by email three times. Besides, members of the R-group were co-located and could meet daily. Probably, they did not find it natural to discuss the project description through the system when they had the chance to do it face-to-face.

One finding was that users were making comments on the interface instead of doing the task they were supposed to do. Almost 80% of the words that were registered in this domain were found under the ATP document. This might suggest that users found it difficult to make a comment about a document (e.g. its content or formatting) using electronic format and the Web. Probably, some people thought that the task was to make
comments on the system because they knew that we were developing a new system. However, since the very beginning of the domain creation there were some comments that could be used as model to make comments. The problem of awareness here is also evident. To know whether a document had got a comment, users had to click on its link, so that its comments appeared in the commenting space. The user had to click on every document’s link to explore the whole domain. This exploration might be unfruitful.

Furthermore, people who use a computer to write are used to their word processor. Asking them to move an activity as personal as writing from their word processor to the DHS is doubtful of success as long as the DHS does not contain most of the functionalities of their word processor. The DHS offers a very simple editing interface in which only plain text can be entered and it is only given for making comments. The editor of the domain received mainly documents in a ready-to-upload stage. Otherwise the editor produced the HTML version using other means as the “Save as HTML” feature of some word processors.

The discussion that evolved under the ATP document gives evidences that the DHS was appropriate for supporting asynchronous discussions.

From this pilot study we could draw the following conclusions:

- At first, R-group’s members welcomed the idea of using DHS to receive feedback from other colleagues about their work. However, during the interviews many expressed a negative attitude, mainly because of the public character of the system and the risk to get comments from people who were not qualified to do so. Some indicated that they wanted to have control of when and by whom their work would be read.

- The DHS worked well for the meta-discussion about the prototype itself. This suggests that this kind of tool might be used for asynchronous discussions within a group.

- An awareness system should be available for asynchronous discussions. Its lack might decrease users’ participation in the discussion and users could respond inopportune, that is, they could reply when the information is not needed anymore or too late. This could affect the collaboration unfavorably.

4.4.2 Case study series 1: the DHS as a discussion tool

The DHS was used during five periods (in 1998, 1999, 2000, 2001, and 2002) as a Web-based discussion tool in an educational setting, for a course in computer supported collaborative work. The experiences from this use will be presented below.

4.4.2.1 Method

Apparatus

Each instance of this case study used a slightly modified version of the DHS (see table 2). Instead of a list of topics in the index-frame as we had in the R-group domain, for this case we used the students’ names and under each name the title of his/her contribution. The
contribution’s title was really a hypertext link such that when activated, users could see its content as well as its comments.

Participants

The participants in this group were registered in the course CSCW given to graduate and undergraduate students. The use of the DHS was mandatory. There were 85 participants (including the teacher and the designer of the DHS) in these case studies distributed as follows: 26 participants in D1998, 11 in D1999, 18 in D2000, 13 in D2001, and 17 in D2002. Most of them had a technical background and most of them had completed at least one course in Human-Computer Interaction. All of them had at least two years of experience using the Web and were familiar with other Web-based discussion tools (e.g. USENET news, on-line forums in editions of digital newspaper, text-chat, etc.) However, very few (1) reported to have had experience with Web-based tools to discuss the content of a document on-line.

Procedure

One of the course assignments included using the DHS, which was introduced as a prototype designed to support discussion on Web documents. Students were first asked to write a text about one page long. They were supposed to tell their experiences while working in a team, focusing on issue of collaboration and technology. The D1998 class could submit their homework assignments in groups of two, but for the other case studies, the task was individual. They submitted their contributions to the domain’s editor who included them in the domain. It was required for partial fulfilment of this course that everyone must read all the documents in the domain and enters at least two constructive comments on others’ work. The students were supposed to discuss the content of the documents in the domain and not the form of the documents.

The lab was supposed to be done over a period of 15 days. However, the DHS was on-line for a longer period and some students continued to use it. The URL of the site was given in the homepage of the course and sent via email to the students. No password protocol to enter the domain was given. Participants could communicate with the domain’s editor via email, phone, or face-to-face if desired.

Students were told that they could make any comment on the DHS system under the ATP document. For every course the ATP was updated, indicating the new features that were included in the new version and all the previous comments attached to it were put aside. The ATP document indicated how to overcome some of the problems that were reported in a previous use of the DHS.

Participants of the D2000 (18), D2001 (13), and D2002 (17) had to fill out a Web-based survey at the end of the lab. This survey aimed to evaluate the functionality and the interface of the DHS system. The survey was basically the same for both groups but the latest one included questions about the new features that had been added to the version used by this group. All the students (38) in these courses filled out the survey. However, the responses of the D2002 were taken into account only for the discussion about privacy
and security that is developed in chapter 7. The data from this case study was also used for the example that are presented in the visualization tool in chapter 5.

4.4.2.2 Results from the interaction

Quantitative results

The 85 participants submitted 80 documents and produced 393 comments in these five case studies. All the documents but two in these domains received at least one comment. The average of comment per document was 4.5 (sd=1.86) excluding the ATP document. The 347 comments made on the documents included in the domain held 37,964 words. The 46 remaining comments, including 4,907 words, were made on the ATP document. Most of the comments made on the ATP document were an error or bug report on the system, a design suggestion, a new idea by the designers of the system, or a reply from the designer. One point worth noting here is that 54% (25) of the comments made on the ATP were made during the D1998 course. The reason for this, very likely, was that this was the first version used in these studies and it was normal to find bugs, errors, or better solutions for the interface. For details see table 2 in page 37.

I computed the time that passed between two chronologically adjacent comments in the same document \(^1\) for D1998, D1999, D2000, and D2001. Observe that the next comment is not necessarily a reply to the previous one. Notwithstanding, from this data we can

\[\text{FIGURE 6. Times passed between two adjacent comments for the use of DHS in the discussion context}\]

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1. I excluded the ATP from this analysis because I was taking part in that discussion and it was part of my job to monitor it.
appreciate the interactivity of the participants in this system. We cannot draw any conclusions, however, about how the email awareness feature influenced this result because the comment is sent only to the author of the document in question and not to the whole group. The only group that did not have access to the email awareness feature was the D1998. Figure 6 shows that in all these case studies, at least 20% of the comments submitted were made within 12 hours after the previous comment and at least 50% within two days. The graphic shows also that the results for the D1998, D2000, and D2001 are similar in relation to the time passed between two adjacent comments. However, in the sample D1998, 14% of the comments (9) were submitted at least one week after the previous comment. Comments sent after one week are practically absent in the other samples that had the email awareness feature (except for one comment in D2000 that falls in the category more than seven days). Yet, in the D1999 course all the comments were sent within two days time. There are many factors that could explain these differences, for example, the interest that the students had in the course might differ for every sample. I observed that all the comments sent in the D1999 course were submitted four days before the deadline of the lab, so it was normal that all the comments had been sent within two days. Also, the size of the group can be a factor to consider. In D1998, the number of participants was almost twice of that in the other samples and the interactivity may therefore be higher than for smaller groups.

Figure 7 shows the distribution of the comments in relation to the number of words they contain. I decided to group them in intervals of 50 words because in the pilot study most of the comments were not longer than 40 words. About 60% of the comments were not longer than 100 words in all of the samples but D1999 that has 44%. We can also see that comments in the interval 51-100 words were the most common ones.
Results from the survey

Twenty-nine students from the D2000 and D2001 filled out a Web-based survey. The questions concerned background information in relation to the use of the Web, issues about sharing their contributions and its advantages and disadvantages, security issues, problems in the system, quality of the awareness given by the DHS, the use of the DHS in the educational field, the use of some specific features of the system, and their attitude toward the DHS. The information collected from the D2002 was not taken into account in these results.

As for sharing their documents through the system, the most common advantage reported was the easy accessibility to the documents and its comments. Respondents valued the fact that all the information was in the same “place” and that they could read and comment whenever they got the time to do it. Several respondents compared DHS with email and pointed out that one advantage was that they did not have to look for the documents in their “inbox”, as one respondent said. In relation to email, they also said that it was very valuable to have an overview of the document and its comments at the same time without jumping from one window to another, something they cannot do with email. A few disadvantages were also mentioned. Internet connection requirement, sharing publicly the contribution and its comments without control of the document owner, were mentioned by the respondents as disadvantages.

Many of the respondents indicated that the main problem with the system was related to the structure in which the comments were presented. Some of them, 29%, found it difficult to associate a comment with the part of the document it referred to and 41% of them found it difficult to relate the comment to a previous comment if that was the case. Additionally, they reported that it was difficult to follow the conversation, especially when a reply to a previous comment was not adjacent to it. All those who pointed out this problem proposed threading as a potential solution (see example 4 in the next section).

Most described the experience of getting a comment on their documents as “fun”. Several also expressed that getting a comment made them feel that their contribution was interesting. One respondent wrote: “At first, when not receiving any comments, it felt a little as a failure. As if the contribution was of no interest to anyone.” All but two thought that sending the comments via email to the document owner was a good reminder. As one respondent wrote “That was good, because otherwise maybe I would have missed it”. They also said that in this way they could avoid to run the system just for reading a comment because they had got it in the email. Several expressed the need to alert not only the document owner but also those who previously made a comment on the document in question. However, they said that it could be annoying to receive lots of emails if the interactivity was high. A few of the respondents also reported that getting the comment via email sometimes did not make any sense (for example, when a comment was a reply to a previous comment that was not made by the document owner). In fact, the document owner is then getting a reply to something he/she has not said.

As for awareness, one question concerned how much users knew about the changes that the content of the system had gone through since the last time they used the system, both
for the system content as a whole and for those contributions in which they were particularly interested. More than 60% thought that the general awareness about what had happened to the whole content of the system was poor. Only one respondent thought it was good and the rest regarded it as enough. On the other hand, the awareness about the contributions in which they were particularly interested was rated as poor for 38% of the respondents. Only three respondents thought it was good and the rest regarded it as enough. In other words, the system provides a better support for awareness of those contributions in which users are particularly interested. The reason for this might be that users, very likely, are interested in their own contributions and every time a comment is made on it they receive an email message.

At the end of every comment the system provides a navigation bar “First-Previous-Next-Latest”. Only one respondent reported to use it often, 15% seldom, and more than 80% never made use of this navigation bar. Instead they just scrolled the comment frame. They were also asked if they felt the need to print a contribution or its comments and if they had printed it. Only 24% indicated that they had felt the need to print a contribution and about 7% had felt the need to print a comment. None of them printed the comments and only two respondents said they had (seldom) printed a contribution.

Most of the participants reported to have good but not excellent knowledge of HTML. Also, all of them reported to know that their word processor could automatically convert text into HTML format, though seven of them had never used this feature. However, only six participants used HTML tags in their comments and only 28 of the 327 comments included HTML tags. Furthermore, these HTML tags were used for simple formatting purposes such as presenting one word in italics or bold font. If users wanted to include an HTML tag in their comments, they had to do it in plain text. Another possibility to do this is to write their comment in a word processor, convert this formatted text into HTML format using the automatic converting function it provides and copy-paste its source into the DHS. Clearly, it is too troublesome to perform.

In D2001, the paste feature was provided in the Add comment window. None of the respondents in this group made use of this feature.

4.4.2.3 Discussion and conclusion

Only a few discussions, but not very interactive ones, turned out. Some participants indicated this situation; one respondent said “…But it never became any real discussions, just comments.” A discussion is an opportunity for everyone to defend, explain, and modify their viewpoints. It should be a way to negotiate positions. A comment could hold just a position that concedes defeat, probably the user above referred to this kind of comment. We also have to consider the nature of the task. The students submitted a story telling an experience they had while working in a team focusing on collaboration. They were just indicating the points in which the collaboration went wrong or right. Most of the comments were asking for more details of the story or were just telling another story similar to the one they commented. The most active discussion was around the ATP document in the case study D1998. One reason was because students were giving their
In the commenting dialogue of DHS, comments are chronologically ordered, and no subject line is used when creating a new comment. Users indicated several times that threading would be necessary in the comment space of the DHS. Users manifested this in the survey and also using the commenting function of the system on the ATP document. Example 4 is a comment made on the ATP document in the D1998 sample.

4) **Comment #23 98/02/20 14:21**

*Enrique:*

_I think threading of comments will be important as their number [of comments] grows._

Although this suggestion recurred several times, we decided that threading was not suitable for our goal with the system. Threading refers to arranging the sequence of contributions to a computer-mediated discussion according to their subject, by using the “reply-to” relationship as ordering principle. In newsgroup readers, for example, users can select to read a particular thread, and the threading of discussions is emphasised by graphical means such as indentation. Threading requires an initiating post with a subject or topic that users consider a representative one. In our case, the subject of the discussion was given by the Web-document. By creating another subject the discussion deviates from the original purpose. Another reason was that we were not expecting a large number of comments for each Web-document.

One possible solution would be to keep the linear structure but with the possibility to place a new comment adjacent to the comment it replies to. This, however, implies other problems, for example: when a new comment refers to two previous comments, should it be placed adjacent to the first comment it refers to or adjacent to the second?

Whittaker, Terveen, Hill & Cherny (1998) found in a quantitative study on Usenet newsgroups discussions, that messages on average referred to two previous messages, which indicates a lower amount of interactivity than might be expected (p. 262). This could mean that for a commenting space with a moderate number of comments, say ten, threading would not be necessary. In the DHS case studies, users were often using the identification number to make reference to a previous comment. We also observed that if a response to a comment was adjacent to it, the author, usually did not bother to make a reference to it, which increased the sense of a written dialogue.

An important aspect was that during the discussion, most of the time participants made an explicit and direct reference to the content of the document in discussion. For example, “what you wrote”, “the situation you describe”, “the people in the examples”, “I found your text to be interesting”. That means that the conversation was around the document presented in the content-frame, namely, the document was the centre of the ongoing discussion. In other Web-based forum tools, such as newsgroups, the original text that started the discussion is not easily reached by users and the discussion often gets far away from the original topic suggested in the first text. The tendency to lose the initial focus gets more pronounced when time passes. In DHS, we found that the central topic of the discussion, in this case, the content of the document, was always recalled in the comments. Even if the new comment was made a long time after the very first comment; the new
comment was, usually, touching the document that originated the discussion. This is, presumably, related to the fact that users can always view and read the original text while using DHS, and the discussions are not threaded. Also in our system, the document generally has a more important role than the start message of a newsgroup discussion.

Finally, in the DHS users may refer in the same comment to another comment and to the Web-document, which means that this is a dual context for the commenting dialogue. The reference to previous comment was usually made by its identification number. Example 5 shows such a situation. Paola makes reference to comment #1 and gives her opinion. Immediately after this, she mentions “the first example” but this time she refers to the Web-document around which the discussion is held. This would not be so easy to understand in a threading environment, which rather emphasises the coherence relationships of the dialogue of messages. Moreover, in a threaded discussion, participants cannot see at the same time the conversation as a whole and the message that originated the discussion. The lack of an overview of the replies and the original message might cause the next contributor to concentrate more on the last reply read than in the original message. As a result, the focus of the discussion may be lost.

5) Comment # 3 98/02/19 12-42

Paola:

Javier,

comment #1

You wrote about what you can “gain” from collaborating. You didn't mention how much does it “cost” to you!

In the first example, what kind of big effort could it be to say to the one who sits next to you “feet up, the cleaner is coming”?

4.4.3 Case study 2: the DHS in a second language course¹

The experience using the DHS as a tool in the traditional classroom; i.e. in a co-located classroom, in the courses of WSP and CSCW was stimulating. The series of case studies made in the WSP course will be presented in Section 4.4.4 on page 59. We found that the use of the DHS provided us with data that helped to appreciate and understand more the use of Web-based tools in the traditional classroom. The language unit that was responsible for the WSP course was willing to collaborate, so we decided to use one of their courses. We decided to explore what would be the impact if students of a second language course would use the DHS? How is text-based communication used in this context? Which advantages and disadvantages would this provide?

Reading is a necessary resource in the process of teaching and of learning a second language. There are publishing houses that publish books which are later adapted for easy reading making use of a simple grammatical construction and language. This is known as graded reading materials. Recently assigned graded reading material have been used with good results in second language courses. This gives the student the opportunity of seeing how language works in its natural environment or in a specific situation. At the same time

1. This section is an extended version of the paper Rodriguez, Arango-Alegria, & Cerratto-Pargman (2003)
this kind of reading introduces new aspects to a second language learning process that hardly could be integrated in any other way.

Moreover, we decided to look into a task that commonly was done under an individual format during the class (as a test taken by the student) giving it a collaborative format. Doing so we could also investigate more closely the alternative that a Web-based tool might represent in this context. The task selected was “Reading comprehension test”. Reading comprehension allows the teacher to check to which extent students understood the text they read and whether they read it or not. Reading comprehension is a common exercise in advanced or intermediate second language courses and it helps to increase the cognitive ability of the student, or simply to improve the student’s reading skills. The traditional instruments used for reading comprehension test are designed and applied according to the type of reading material and also to other aspects that the teacher might wish to measure and to control. In general, these exercises are done outside the classroom and can be evaluated in an individual or group form using oral or written media. The most common control for reading comprehension test is performed by using a written means (e.g. written exam, essay). For example, some questions that have two direct answers such as: true or false; completing sentences, description of different types of vocabularies, or synthesis of the readings. Students are often allowed to use the material that has been read while doing this kind of test. The student works individually. The advantage of this kind of control is that it is fast both for the student and for the teacher. To carry out a group control using the written communication is much more complex and is, therefore, not used very often. For example, it needs more coordination (the co-presence of the students), it needs in-class time instead of the out of class time that the student gives to the course. Also, in a co-located group control students can be encourage to use their mother tongue because the face-to-face interaction during the discussion.

Investigations done on reading comprehension have usually focused on the development of methods that could be used by the students to develop a vocabulary or their ability to understand a text (cf. Christen and Murphy, 1991; Alvarez, 1990; Smith, C. 1997; Beck, Perfetti, & McKeown, 1982; Nicholson, 1991; Gough, 1984). Pressley (2001) presents a detailed analysis of different methods for reading comprehension.

Social aspects in the development of complex cognitive operations, such as those implicated in the learning of a second language, are more evident every day (Lave & Wenger, 1991; Wenger, 1998). Cooperative learning (Johnson & Johnson 1985, Slavin 1987) is one of the most extended and investigated techniques that takes into account a social perspective regarding learning. These investigations, in synthesis, suggest that cooperative learning is more effective if 1) the teacher’s goals are clearly understood by the students and that these goals are group oriented and not individual oriented, 2) that the students are ready to teach and explain to others instead of simply answering to the questions, 3) that the activities of the group supplement the instructions given by the teacher. That is, the students do not have to follow step-by-step teacher’s instructions.

The possibility of using groupware in the classroom and specifically the Web has created enormous hopes in the educational media. There are already many Web-based applications that support cooperative learning. These systems basically use chat programs,
forums and email. However, The Web and its Web-based applications do not constitute an instrument nor has a didactic content in itself. They are merely alternative media, whose use is necessary to think about, test, explore and develop until they can be considered a common instrument for learning. The Web applications that have been developed for reading comprehension are metaphors of the common methods used in the classroom. This is the case, for example, for work-sheets that are used by the students to fill a questionnaire. In other words, the Web is used as a platform to evaluate the student individually. Very little is known about the use of the Web as a platform to evaluate the understanding of reading comprehension in a cooperative learning context using a written communication.

This case study helped us to explore the use of the DHS as a collaborative learning tool in the context of a second language course. In this opportunity the document to be discussed was not part of the domain. Instead the discussion was going to be about a document (a book in this case) that was not present in the system as in all the other previous studies. However, students could make use of the book while doing the homework. Also we could explore how asynchronous, text-based communication would be carried out by students of a foreign language. We expected the students to engage in a discussion that would let them develop their language skills in a social context as a written dialogue.

4.4.3.1 Methodology

This case study will be denoted as DL2-2001 in this thesis.

Participants.

A reading comprehension test was carried out by seventeen students of an intermediate level course of Spanish as a foreign language. They used the DHS to perform the task. The students were from different careers in a technical university in Sweden. The students had access to Internet from the university classrooms and all but one (a guest student) had also access from their homes. All of them had email accounts. The majority of them had been using the Web for at least two years. None of them had used a Web-based application to carry out an assignment in their course in group. They had only used email in previous courses, but basically this was done for announcement and coordination of activities or to exchange files with other students or the teacher. The students were not remunerated for using the system.

Apparatus

The assigned graded reading material was a book in Spanish, with a vocabulary of 2500 words, 54 pages. The story in the book was about a historical moment, habits, and culture of Mexico. It included a vocabulary that had explaining notes and illustrations in Spanish. The DHS system was used to establish communication among the subgroups and its members. A program that makes it possible to use statistics about the comments was also used (number of words, frequency with which the words appear, length of the comments in words, creation of lists of words used by the students). The output of this program was
used to generate the vocabulary list used by the students, for example. This material was not used during the reading comprehension test but at the end of the class each student got a copy of the vocabulary. This list indicated misspelling errors.

Procedure

The second language course was taught for 14 weeks. The reading of the book was assigned 30 days before the students started to use the DHS. Five groups were formed (with 3-4 members) trying to have an equitable distribution of knowledge and the ability of the language according to the teacher’s criteria. The leaders of the groups were also appointed by the teacher. Each group was denoted with a geographical name from the story. Using the group name, a Web page was created. It contained 1) the questions that the group would discuss internally and 2) the list of the participants with their email addresses. These Web pages were included in the DHS and the students were supposed to post their comments in the corresponding commenting space of the DHS. During this discussion, the students had to demonstrate that they had read and understood the book by answering the questions in the Web page corresponding to their group. A Web homepage for the homework was also created. It described the task and had a check box list with the name of the students and the teacher. From that Web homepage it was possible to enter the system. To enter the system the participants had to select the check box corresponding to his/her name and then press the enter button. No password to enter the system was needed.

This exercise was planned for a total of 6 weeks, being interrupted for two weeks of vacation. We decided to run the exercise even during the vacation time to observe if the students, making use of the ubiquity of the Web, would continue working. Before initiating the exercise the teacher presented the DHS to the students during one class. All the participants were able to follow the discussion that was generated by the other groups. The teacher received a copy via email of every comment that the students sent through the DHS. A system of filters and directories was adjusted in the electronic email program of the teacher with the purpose of facilitating the administration of the messages received. It was agreed that the teacher would not make any kind of correction of the texts and his intervention would be limited to motivating the students. Also, the progress of the exercise was not formally discussed in their classes. At the end of the exercise, the students were asked to fill in a questionnaire exploring the qualitative aspects of the experience. The survey was written in Spanish and was not mandatory. After some responses from the survey were received and briefly analysed, an interview with all the students and the teacher at the same time was carried out as a group discussion. This interview was also planned together with the teacher as a way to evaluate the pedagogical aspects of the exercise and the use of the DHS tool. During the interview, annotations were taken and later expanded. The comments written by the students were read and analysed.
4.4.3.2 Results

Quantitative aspects

The students sent 27 comments that contained more than 4600 words through DHS. Each group produced an average of 5.4 comments (sd=2.41). The number of words in a comment varied between 14 and 480 words, the average being 170 words (sd=121). The majority of the comments (68%) were not longer than 150 words. The register of different words used was about 1350 words and 93% of them were correctly spelled. The average number of words produced by the students was 288 words (sd=140.2). The activities log file indicates that the time it has taken a student to write and send a comment varies between 50 seconds and an hour, which is a considerable variation. Evidently this is in relation with the extent of the comment. According to the log file more than 50% of the comments were created in 12 minutes or more. The frequency with which a new comment appeared in the domain was low. Only 31% of the comments were made within 24 hours of the previous comment (the comment posted under the same discussion). The rest of the comments appeared after 2 days or more. This indicates a low interactivity in the discussion. In total, 14% (4) of the comments were produced during the vacation period. A total of 13 students of 17 answered the Web-survey.

Qualitative aspects

Observation from the interaction

The students used the commenting space not only for making comments about the book, that is the homework, but also to coordinate their work. The language used was informal. Parallel aspects such as organization, the planning of the work to be done and so forth were mentioned (example 1 6). In some cases this would not have been possible for different reasons, see example 6d in which one students indicate that is not available. Students used the commenting space even when they could meet in class.

6) a) Hi! I have just read the book and I think it is a very nice story.

b) ...I read the book a long time ago and I don’t remember the details very well. Besides I have forgotten to bring the book, so I only pretend to make a brief introduction.

c) I consider this question a little bit difficult. I hope you have more to add, now I have to continue studying for my exam on Monday.

d) I am on vacation in the Netherlands and I will not return until the first of May. I do not have easy access to computers and it will be important to hand in a contribution for the final report. Thank you, we’ll see you.

In example number 6b the student indicates his/her limitation and also shows the way he/she might work. We can assume that the student would like to refer to the book while making a comment. In example number 6c the student warns about his position regarding the homework, his availability, and his limitation.

1. The example are fragments taken from the students texts. They are translated from Spanish
In the previous examples we see that the students make comments beyond the homework and the collaborative aspect of the exercise. In example 7a, we see that one of the students had not read the book, which was indispensable for doing homework. However, he participates and takes part in the discussion based on his experience as he has lived in the same country of the story from the book. Another one mentions elements of daily life, such as could be referring to a movie he has seen (example 7b). The students’ participation reflected their personal experiences. Finally, a student as well as alerting the group on his activities, interpolates his reality with the story in the book. Having the possibility to use elements from everyday life the student might find the interaction of benefit. The extra textual information used by the students is evident and through this they experience new incentive for writing.

As expected, there were comments in which the student was fulfilling the requirement of the homework. The comments had the characteristic that they were not encouraging a discussion among the members. They were just answers to the questions that each group had to discuss. Instead of the discussion the students just answer them. Yet, in their comments they were structuring their reply using the number of the questions they had to answer. For example one student posted one comment for each question one after the other in an interval of 2h:45 min. In example 8 we can see this situation of numbering the answers but posted in a single comment.

8)  #1. The grandfather doesn’t like the church… The relation he had with Micaela looks like, as Carlos wrote, very nice …
    #2. I cannot add much to what Carlos has said in relation to this question…
    #3. I think that the situation was more or less the same. Religion was very important in Sweden also…

In example number 8 we can see that this student tries to complement what another member (Carlos in this case) has already commented. This corroborates that the student has read the comment Carlos has made. Also, addressing to a member by his/her name help the exercise to be placed in a social context.

Another aspect is that students considered that the possibility of seeing the progress of the other groups was a motivating factor and it awakened a spirit of competition. “The Popocatépetl\(^2\) group has many more comments than my group, this can’t be. So that is why I decided to make one more comment.” one of the participants indicated in the

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2. One of the names given to the groups
The domain help system: Web annotation and discussion around documents

interview. At the same time, it should be mentioned that the participants showed a positive attitude concerning the possibility of learning a language collectively.

The students’ perception of the exercise

We asked the students whether the exercise had increased their knowledge of the language. The responses were divided into two groups nearly of the same size. Some considered that by using the DHS they spent a great amount of time reading and thinking about what they were going to say. Thus, their knowledge of the language increased. The other group considered that the exercise had not increased their knowledge of the language. From the interview and the surveys it was inferred that the most probable reason for this opinion was that the students thought the book was not appropriate for the exercise. They said the vocabulary of the text was neither relevant nor actual. Besides, the use of local expressions in the book was considered as something negative as they were of no use in other contexts but the one in the story. The lack of feedback might have also influenced this opinion. Many of the students thought that the teacher of the course should correct their text and intervene in the discussion and motivate it. In the interview a commonly expressed view was that they were missing someone who, at the least, would indicate spelling errors.

The majority of the students appreciated the possibility of doing this exercise making use of the Web. It was seen as a new way of doing homework and the students were positive to the change. The most positive aspect mentioned by the students was the possibility of interacting with the system when they had the time to do so and without having their time or space restricted; both while making the comments and when reading others’ comments. In this way, the students could practice two activities that are very important in a second language course, namely reading and writing.

The survey reveals that the students made use of other resources like dictionaries while writing and/or reading. Several indicated that they used free resources from the Web (e.g. an electronic dictionary). On the other hand, there was one student who indicated that the use of the Web was not justified at all because attending class should cover all the needs. Two believed that it was negative that the homework was totally dependent on Web access. The student who did not have to the Web from home said that she felt in disadvantage in relation to the other students.

Students not only read the comments made within his/her group but also the comments made in the other groups. Many indicated that it was interesting and profitable to see what others wrote. This information is corroborated in the log file. Two fundamental reasons were given. The first was that they could see how the other students made use of the language (words, expressions, etc.) and the second that they could learn from the interpretation given to the book by others. A student compared the possibility of doing a reading comprehension control through the DHS, with making a synthesis1 of a book, which is another of the traditional methods for reading comprehension test. The student indicated that the synthesis does not give the possibility of “…knowing other people’s

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1. This activity commonly involves only the teacher and one student
thoughts. I feel it is important to listen to different opinions.” Three others said that it was more interesting than just writing a test for the same reason. Thus, to know other students’ opinion about the book was regarded as important.

The DHS does not allow editing of the comments that have been posted. One of the questions in the survey examines how this peculiarity of the system affected the students when making a comment. Many (70%) said that, when writing, they were more careful both about what they were going to say and about how they were going to present it. This suggests that the students were spending more time in the planning stage of the writing process. They also revised their comments before sending them. As one of the respondents wrote in the survey “It is more important to write well when you know that others will read it.” However, one of the students said that when he noticed that the comments, once submitted to the system, could not be edited, he stopped sending more comments.

All but two in the survey responded that they learned from the errors they found in other’s comments. This indicates that the students were involved in a collaborative learning process during the exercise, learning from others’ errors. Four of them responded that they had learned from their own errors. A total of 60% of the students indicated that they found at least one error in their own comments after it was posted. This proves that some also read their own comments after posting them which gives opportunity to analyse their writing more carefully. Two of them said that they felt ashamed knowing that other might also see the errors he/she found in his comment. One student said that he read the book more carefully so that he could “answer more precisely” as others would read his comments.

The only way in addition to the DHS that the students used to communicate about the homework among them was when they met during the class face-to-face. We asked the students to evaluate and motivate from a scale from one (fail) to five (successful) the success of the discussion in DHS. The result was 2.55 (sd=0.7). Most agree that a real discussion was never carried out. The most common reason mentioned was that the students just answered the questions they had to and they considered that the homework was done. They also mentioned that the group was not enthusiastic while doing the homework. Another negative aspect was that the period of the homework was “too long”, as one student said. Interactivity might increase if the time is shorter as more comments might be posted the same day. A total of 60% of the comments were posted within the first 5 days of the exercise. We also asked what they would said if a moderator for the discussion were participant in the discussion. Only two students thought that this was a good idea and the rest were not sure if such a role would indeed generate a discussion.

One of the students mentioned that the language knowledge level was different from student to student. Having plenty of time to write the comments might give those who have a lower level the chance to express themselves in a better way and blur the difference between them. Some students mentioned that in this way they could see the writing level of his/her class mates. “Normally you know how they talk but not how they write” one of the students said. These kind of evaluations might be important as the students can compare their level with the rest of the class. This information could be valuable when the students set up their goals during the course.
Another positive aspect mentioned was that all could express their ideas, indicating that during the class this is difficult to do mainly because of lack of time. Participants treasured the fact that all the comments and the different groups’ homework were easy to access via the system.

Several of the students indicated that it was very easy to forget to do the exercise. Postponing the activity for “tomorrow” was easy to do taking into consideration that it would not have to be presented or demanded during the class. Several of them indicated that receiving an email sent through DHS not only served to notify them that a new comment was added, but also to remind them of the homework they had to do.

Also some of the students said that oral practise was also important, not just reading and writing. This is more related to the course content and not to the DHS. Nevertheless, it might be interesting to combine conversation and text communication as a reading comprehension test.

The fact that the book had not been discussed in any of the classes was not well received by the students. A few mentioned that a face-to-face discussion about the book would have been useful. The opinion of the students was that the exercise should not be interrupted during the vacation period. In general, the students considered that it was a “fun” way of doing the exercise. One even wrote “For me it was very fun. I did not feel it as a homework.”

4.4.3.3 General conclusion

The present study suggests that the use of a Web-based communications support in a cooperative learning setting can be a source of motivation and challenge for reading, writing, understanding and discussing in a second language class. When a space is created supporting a permanent dialogue, it provides the student with a common encounter point. This space offers the possibility of interacting with other students outside the classroom. The comments made by the student were diverse in presentation (e.g. the way they structured their comments), and the content (e.g. a film, a place that the student visited) reflected very much the students’ everyday experience. The plurality of the interaction provides the student with the possibility of having more examples to read with different content and describing different situations, that are necessary for the whole learning process.

This kind of reading control gives the student time to reflect, to consult dictionaries, to develop his/her ideas and confirm grammatical rules, strongly contrasting with any spoken communication that requires an answer in real time. Using the DHS for the reading comprehension gave the student the possibility of integrating tools that the Web makes available, for example: dictionaries, reports, grammatical rules and so forth. However, based on experiences from other investigations, the organization and integration of these resources on the Web requires a lot of attention taking into consideration that the student could spend time or become distracted when incorporating them into his homework, which would distance the student from the homework missing the goals of the exercise.
The fact that the system does not allow editing of the comments proved to be positive in this context. For example, according to the students they dedicated more time to planning which would improve the quality of the text. Evidence that they were more careful is that only 94 words, out of the 1350-word vocabulary, were misspelled. Of course they might have used a spelling checker program. Only three of the students said they made use of such a program before sending the comment. However, there is a second effect that is predisposed by the public nature of the system. Errors in their writing might discourage them to write a comment. We will develop this topic more in chapter 7 in which we will write about the public aspect in collaborative learning.

The nature of the tool (DHS) and the task carried out made it possible for the students to explore a level of the language to which they probably would not have had access to either through oral interaction (e.g. conversation) nor written work (e.g. synthesis) as is the case of written communication mediated by computers using a persistent dialogue. This language, sometimes described as a hybrid between the spoken and the written language (Severinsson Eklundh, 1986; Bordia, 1996), is a new element that has appeared during the last decades. The same way that the spoken and written languages are practiced in the classroom, it is also probably necessary that this new means of communication, using the hybrid language, be practiced in the classroom of foreign languages. The comments made by the students show that when they were doing their homework as a group they had to communicate and coordinate using this new form of conversation that digital communication has facilitated.

On the other hand, having all the comments that the students made in digital format offers certain advantages. It is easy to generate a list of the vocabulary used by the students and the frequency with which they use it. In our particular case it was observed that, for example, the word “democracy”, appeared three times with the same grammatical error. If this error has been made by the same student the system will help identify the person with the purpose of directing feedback in an effective and timely way. If feedback is given making use of the system it has a public character. Furthermore, the frequency of the vocabulary that is being used can help the teacher to identify the aspects that have been sufficiently practised and those that require more effort.

**Recommendations and discoveries of the study**

- The public character of the exercise makes it possible for the student to analyse the contributions of other students at the same time that he becomes responsible for the form and content of his contributions. No doubt this has a pedagogical aspects in the process of learning foreign languages.

- The freedom of working independent of the space and time is very much appreciated, both by the students and by the teacher. The student has the opportunity of preparing his homework and of using other resources of writing.

- The use of this kind of tools, must be handled with care. It is necessary for the teacher to be attentive to the interaction among students because they could easily forget their homework. Email could alleviate this problem, but we must not forget that the users could feel overwhelmed by the number of emails they receive every day.
• The lack of feedback from the teacher was not welcomed by the students. It could be too much work to give feedback to every student. This would request a continued evaluation from the teacher who might not have the time. Instead, commenting on one student will be used as example for the whole course.

• The teacher must give detailed information about the pedagogical and technical aspects of the exercise, as well as the requirements and advantages. The teacher must make sure that the students immediately report the problems of technical nature that appear.

4.4.4 Case study series 3: the DHS as an annotation system (A-samples)\(^1\)

During the reviewing process, the reviewer role can be played by the author or by a third party. Clearly, an annotation by a third-party reviewer demands more elaboration than if the author-reviewer is one and the same person. Annotations made by third-party reviewers can also have distinct purposes. They could be used to advise on reading material, or to schedule a meeting with the author. Some annotations can be classified as corrective. A corrective annotation aims to instruct or persuade authors to perform a correction (change) in the text in question. It could be as simple as marking a misspelt word or suggesting a language style change; making corrective annotations mainly implies suggestions to add, delete, move, or change the text. These kinds of annotations are very important during the process of learning to write. For example, they are valuable when learning to use an appropriate register, such as the language of academic papers and reports, of journalism, or of promotional literature; when learning to write in a foreign language, they are crucial.

These annotations can be made on paper or in digital form. The benefits of annotation on paper far outweigh those of on-line tools (O’Hara and Sellen, 1997). Nevertheless, today it would be fair to say that behind every document on paper, there is likely to be an electronic version. Yet, House and Lewis (2000) predict that “it would take another 10 years before technology made it possible to treat the electronic document as a real document and the printed version as a derivate”. To reach to this state, technology has, among other things, to support that the entire revision process could be done in electronic format. Current word processors include features for digital annotation, such as the revision feature of Microsoft Word, and the change bar and comparing documents of FrameMaker. A number of more complex systems have been developed, such as the Anchored Conversations system presented by Churchill, Trevor, Bly, Nelson, and Cubranic (2000), which provides a synchronous text chat window that can be anchored to a specific point within a document, moved around like a post-it note, and searched via a database. This chat window can be regarded as an annotation.

As early as 1993, Mosaic, a browser developed by NCSA, could make an annotation to a document found on the Web. Mosaic was capable of handling both personal and group annotations. Today, surprisingly, none of the currently most popular Web browsers offers an annotation feature like that of Mosaic. As a result, documents on the Web can normally only be passively read by third parties. However, some systems have been developed to

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\(^1\) This section is an extended version of (Rodriguez and Brunsberg in press and Rodriguez and Brunsberg, 2003)
allow Web annotation, including CoNote (Davis and Huttenlocher, 1995), CritLink (Yee, 1998), ThirdVoice, WebCT, Ceilidh (Hughes, Jake, and Okelberry, 1998), Annotea (Kahan and Koivunen., 2001), Futplex (Holtman, 1996), and Virtual Notes (Koch and Schneider, 2000). Vasudevan and Palmer (1999) note that Web-based “annotations systems are constrained both in capability and efficiency by the limitation of the Web” infrastructure, and that HTML is limited as a layout language for annotation; for example there is no way to render annotation on the sidelines of a Web page. Thus, annotation features on the Web are very limited compared to stand alone word processors, like Microsoft Word.

Little is known about how third party reviewers make corrective annotations in digital form using the Web. In this section we report on a study of 46 Ph. D. students and two teachers making corrective annotations using the DHS.

What we are mainly concerned with here is to identify the needs experienced by third party reviewers using a simple, generic Web-based tool when making corrective annotations, that is, how the digital annotation was used to describe changes in the text. The rudimentary nature of the system has forced users to make up their own notations, thereby indicating their needs. Another goal of this study was to develop the DHS from a reviewer/writer perspective, and to draw design conclusions for Web annotation systems aimed at supporting corrective annotations. Analyzing the data collected with the DHS, we found a basis for discussing how reviewers make digital annotations and which strategies they used to do so. Here, we do not include the reaction of the author to the annotation, or the extent to which they accepted/rejected or understood the annotations.

The general assumption is that, given an interface with only a few basic features intended to support a particular task (in this case making corrective annotations), after some practice, users would develop schemes that would afford us insights into the design of support tools for such a task.

4.4.4.1 Method

The DHS was used in four successive English academic writing courses given in a technical university in Sweden, one case study for each year in the period 1997-2000. The use of the DHS was not mandatory; nevertheless all the students used it to share their homework and to make annotations on other students’ homework. This environment was suitable for our study because corrective annotations were to be made by third party reviewers. In total, 289 annotations made by 46 PhD. students and two teachers were recorded by the DHS. Table 3 shows the case studies in which DHS was used as an annotation system. In that table we can the number and the proportion of comments that were produced by the students and the teacher. It also shows whether some of the most relevant features of the system was available or not in the version used in the case study.

The annotations in this study were written using the DHS. HTML tags could also be part of the annotation but no support to edit them was given. The intention of this study was to observe the strategies and patterns that the reviewers used to communicate suggested changes to the author using a system that offers no particular support for indicating the context of the annotation. The second aim of the study was to consider the impact of the
tools in the classroom both for the teacher and for the students. After each case study, using the users’ responses and our observations, a new version of the DHS was released.

In 1999 the DHS was introduced two weeks after the start of the course and it was hardly used at all. Therefore, no further studies on this group were made.

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Participants</th>
<th>Comments made</th>
<th>Words in comment</th>
<th>Relevant Features of the system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>by Teachers (%)</td>
<td>by Students (%)</td>
<td>by Teachers (%)</td>
</tr>
<tr>
<td>A1997</td>
<td>15</td>
<td>19 (26%)</td>
<td>55 (74%)</td>
<td>5094 (30%)</td>
</tr>
<tr>
<td>A1998</td>
<td>13</td>
<td>16 (20%)</td>
<td>63 (80%)</td>
<td>2377 (26%)</td>
</tr>
<tr>
<td>A1999</td>
<td>4</td>
<td>10 (91%)</td>
<td>3 (9%)</td>
<td>1913 (84%)</td>
</tr>
<tr>
<td>A2000</td>
<td>16</td>
<td>29 (24%)</td>
<td>94 (76%)</td>
<td>5765 (32%)</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>74 (26%)</td>
<td>213 (74%)</td>
<td>15149 (33%)</td>
</tr>
</tbody>
</table>

Participants

The students that participated, 14-16 for each group, were non-native English speakers. They were Ph. D. students that had different engineering and scientific backgrounds, e.g. chemistry, metallurgy, and physics. In our study, participants were only those students that made at least one annotation using the DHS. The teacher of the course also took part in the study and wrote several annotations. An outside teacher took part as a reviewer on a voluntary basis in 1999 and 2000. She was also a teacher of English and was located in Boston, USA during the course. Both teachers were native English speakers. All the participants had a computer with access to the Internet and students reported that it was the first time they had taken a writing course. Participants reported that they had little experience in using the Web as a tool for supporting course activities though all of them had used the Web for at least two years. The Web had been a means to retrieve information, e.g. from the homepage of a course. All had used email to communicate with the teacher and, very infrequently, with classmates in other courses.

Apparatus

The DHS was the Web-based tool we used to collect the annotations made by reviewers. In our case studies (see figure 3 on page 33), the index-frame displays the student’s name and his/her assignments. Each assignment is a hypertext link.
Procedure

Each course had a duration of 10 weeks and it was given once a week for three academic hours. During each class, a new topic was discussed and homework was assigned to the students. The homework normally involved writing a short text, about one page long, using the techniques and writing styles that were discussed during the class. The class was divided into groups of three students, who reviewed each other’s texts, so that each student’s work was read by two others. Each student sent his/her homework to us via email, we made an HTML version of it, and included it in the DHS system. Once the homework was in the DHS, the students had to read and make annotations on other students’ homework using the DHS. This was done during the week before the next class was given, so that the authors could read the annotations made on their text. In the next class they were supposed to discuss the annotations face-to-face with the students who played the role of reviewers.

We included one document in the DHS describing some informally developed conventions; it was hoped that this would serve as a model to help the students make interlinear corrective annotations using digital plain text. These conventions were mainly oriented towards distinguishing the annotation from the original text. This choice was made to prevent students spending an excessive amount of time figuring out how to make a corrective annotation, the danger being that they might perceive the DHS as an obstacle to accomplishing their homework. These conventions were used by most of the participants, but several of them developed their own methods for making annotations or they adapted some of the conventions to their personal preferences, as was expected. This document also included an explanation of how they could copy-paste the original text into the text input area (the input field in HTML used to enter the annotation in DHS), and eliminate unnecessary line breaks originating from the cut-paste; see section “Total copy of the original text” below. This was taken away when the function “Paste original text” was implemented in the case study A2002. Table 4 shows one example of the conventions that we suggested to the students.

We have analysed all the annotations that were entered by the students in these four years to find a common pattern. Additionally, we counted words and phrases in the text of the annotations recorded in DHS. Before counting the phrases or words, we corrected some
obvious misspellings that were entered in the annotations. For example, sentance, sentece, sentencs were changed to sentence; firts, firstat to first; etc. This was done to establish how many times a specific phrase was used, for example “This sentence”. We were also interested to observe how the genre of the end comment was treated by the teacher and the reviewers (the students in this case). We will present and discuss the findings of this analysis of the objective data in section 4.4.4.2.

Subjective data was also collected. The teacher of the course participated in an interview just after the end of every course. The purpose of the interview was to discuss how she perceived the experience of using the tool. Another focus of the interview was to compare the students who used the tools with those who did not use the tool but were attending a parallel issue of the course. These interviews aimed also to collect data for the design of the new version of the DHS. The interview was done in her room and the current version of the DHS was running while the interview was carried out. The students were asked to fill a Web-survey after the course. The survey aimed to get information for the design of a new version of the system and also to determine how they perceived the use of the tool. The result and discussion of this analysis of the subjective data will be presented in section 4.4.4.3.

4.4.4.2 Results of the objective data

The annotations entered by the students in the DHS are the basis of this study. We wanted to observe how participants cope with the system, so that others could understand their corrective annotations and how they related the annotation to the original text. The simple interface that the system offers also allowed us to estimate how much effort the participants were prepared to make to render suggested changes unambiguous. The examples that we present in this section are fragments of the comments, written in italics and they are taken verbatim from the reviewers’ annotations in the DHS.

Strategies used by reviewers to write their annotations

In general, there were three ways in which the reviewers made their annotations: total copy of the original text, partial copy of the original text, and straight annotations.

Total copy of the original text

One strategy was to copy the entire original text and work on it. This was observed in all the case studies, even those in which the “paste” function of the system was not available. When the DHS did not have the “paste” feature, the users had to drag the text of interest using the mouse to copy-paste it. When the copy/paste function was introduced, by pressing only the “paste” button, members of the class in 2000 had the original text copied in the text input area. For this group, it was easy to copy the original text, while the other groups had to copy-paste using the mouse pointer.

Copying text from a Web browser window has the inconvenience of adding an extra break at the end of each line relative to the browser window’s width. The DHS conserves any line breaks that the user might enter. There is, therefore, no way to distinguish one line
break made by the user from another added while copying from the browser. So the extra line breaks added by the reviewer when performing a copy-paste from the browser window were also conserved. The extra line breaks meant that the DHS showed the annotation in a strange layout. An example is shown in figure 8.

![Netscape: Example of bad using the space](image)

**FIGURE 8. Example of how the system could present a copy-pasted text from the original breaking the flow and bad using the space. The arrows show the empty space.**

Despite the browser window being wide enough to show a sentence as long as the very first line of the previous text (*The aim of the workshop was* …), the DHS breaks the line where a line break (added by the copy-paste action) is found and does not use the rest of the space. To solve this problem, instructions on how to eliminate extra line breaks were included in the DHS with the conventions about how to write digital annotations. Only some students followed the procedure. Eliminating the extra line breaks required a great deal of effort on the part of the reviewers. When they used this strategy they made interlinear annotations.

**Partial copy of the original text**

For corrective annotations it is very important that the reviewer has access to the original text and is also able to copy it. This will save time typing (or cutting-and-pasting) the text that will be annotated. Almost all the comments made by the participants included part of the original text. In the following case, the reviewer quotes the sentence he or she wants to refer to and then makes the annotations:

9) “*But the most important thing is to change the mentality*. I feel this sentence is in the wrong position as the word “but” puts it in the opposite of the previous sentence.

Reviewers did not always copy-paste the whole original text. Sometimes they copied only the portion they wanted to annotate, for example, a sentence or part of it. We do not know exactly how this was done. They could have copy-pasted the interesting portion or they could have typed it. In these cases the correction context was given by the copied portion and the reviewer did not mention it. Below are three examples of partial copy. The annotations were put in the next line after the text splitting after the original text (example 10), aligned with the text (example 11), or were interlinear (example 12). Observe that in these examples the participants sketch the three common annotation interfaces presented in figure 2 on page 14. When partial copy of the original text approach was used, we found no cases in which the annotation was made before the copied text. It is also difficult to
distinguish between the original content and the comment. Different conventions used by
different reviewers make this even more difficult. However, the system always shows the
original text with no changes in the content frame and the annotations in the comment
frame. For the authors of the commented text, however, distinguishing between the
original content and the comment might be easier. Observe that in the examples 11 and 12
the reviewers use special characters to distinguish their annotations.
10) whether genetically modified (GM) food is hazardous to human health or not.
   /you could leave out “or not”, gives a better flow I think but it’s not necessary/
11) The process are the repeated >> The process is then repeated
12) These (*+factors*) include(*+:*) flow velocity of mobile phase.,

Straight annotations

Reviewers who made no copy at all of the original text clearly felt the need to clarify the
correction context. As can be seen in example 13, the reviewer used the ordinal position of
the paragraph and the sentence in the original text to create the correction context.
13) Paragraph 2:
   You give some “solutions” here. Could you make sentence 2 clearer by starting with some-
   thing like “One way is by using.

Need to represent the nature of the corrective annotation

It might be important to support the common actions for corrective annotations, namely:
add, delete, change, and change the place of a word to avoid extra effort by the reviewer.
14) in a sandwich structure (I would suggest you add a comma here, and possibly also “however,”) the faces take the place

In the case, of example 14 the reviewer had to type 65 characters to indicate the changes.
Authors and reviewers would benefit from using the same change representation in the
text. Using, for example, the annotation conventions that we have discussed above, the
same reviewer’s annotation would look like:
14a) in a sandwich structure (~however,) the faces take the place

that is, 53 fewer characters. Unfortunately, reviewers and authors have to learn the
conventions, an effort which would be justified for long revisions. On the other hand, a
corrective annotation in which the reviewer addresses the author as is done in example 14,
in a more personal and friendly manner, might result in better communication between the
reviewer and the co-author, but this topic is outside the scope of this section.

We observed that when some reviewers abided by the convention that we suggested, they
produced annotations that were hard to read and to produce as well. Example 15 is the
whole annotation that one of the students submitted to the system.
15) The totals of Canadian and Japanese students in U. S. colleges and universities (*universities*) fran (*from*) 1955 to 199 As can be seen, both(*-both*) the number of (*+ Japanese and Canadian*) students (*-from Japan and the number from Canada*) seem to have an upward trend although the =Canadian student number= (*:=number of Canadian students*)
   had a steep (*+of*) fall in 197 =The student came from Japanese was about 1,000 in 1955=.
   (*:= The number of Japanese students was about 000 in 1955=*). This number =remained a
low steady increasing rate = (*=steady increased*) until 1970, when (=and as result of this*), there was (=were*) about 3,800 student(=*s*) (=~;*) after (=after*) then it rose at an accelerating speed. By (=in*) 1990, the number of which (=What do you mean by= the number of which*, Japanese or Canadian students it's difficult to understand. *) had reached 28,00 In contrast, the growth of Canadian student (=s*) was much moderate. Despite the fact that 7,500 student (=s*) already (=already*) studied in U. S. In 1995, =it only grid to about= (=the number of students has reached*) 9,000 in 196 There was (=were*) an obvious upsurge in 1970, (=following*) a (=a*) steep (=of*) fall in 1975, and then a sharp rise which expanded the number (=of students*) to 18,000 in 198 After this dramastic (=speling*) change, the growth rate was similar with that of betien 1955 and 196 In fact, there were about 22,000 canadian (=Canadian*) students in 1990, which (=and this number*) was on 6,000 less than (= number of*) Japanese student (=s*). it might be possible that the number of Japanese students keeps increasing at the average growth speed (=growth / speed*) from 1955 to 1990, which is about 770 increment every year. In the meanwhile, the number of the (=the*) canadian (=Canadian*) students might remain (=at*) a very (=a very*) slow growth, most probably, (=most probably, *) with a increment of 260 every year.

Example 15 also shows the amount of effort the students were willing to put into writing the annotations in the DHS. Counting the characters used to follow the conventions we suggested for making annotations: (,), =, ~:, +, -, we found that the reviewer made 182 keystrokes just to type these marking annotations. If we separate the annotations that were written by the reviewer from the original text we find that the minimum number of keystrokes necessary to make the annotations is 604. In other words, a little more than 30% of the keystrokes were made just to produce the characters that the convention suggested.

In the following example, the reviewer writes the original text first and his or her corrective annotation in the following line. This makes it simpler for the authors to compare what they have written with what the reviewer suggests.

16) in most bigger towns in sweden we have something called “tidnings insamling”.

use of parenthesis to highlight annotations

Parenthessis was the most common sign reviewers utilised to make a distinction between their annotations and the original text. However, the use of parentheses is not a good strategy because it could be used in the original text as well and might therefore be confusing. The following example is a case in point:

17) (But) Unlike to (omit) the concentrated narrow Web in an I-beam.

In this case, the reviewer suggests some changes but it is not clear which ones. The sentence could be understood in a number of different ways, listed in table 5. Here, words that are struck-through mean “to be deleted” e.g. word, and underlined words mean that they should be added to the text e.g. word.

The reader might interpret the word “omit” as a new word to include and not as an action, as is shown in case a) of table 5. On the other hand, if the reader interprets the word “omit” as an action, it is not clear on which word the action should be taken: it might be on the word “to” as shown in case b), or it might be the word “the”, a common error for speakers of languages that lack the article (e.g. Russian), as shown in case c).
Parentheses were used in our conventions, which may explain why they were commonly adopted. Nevertheless, what we want to bring out is how confusing a convention can be if it is not made clear what action has to be taken, and on which part of the text.

<table>
<thead>
<tr>
<th>Potential interpretation</th>
<th>It would read</th>
</tr>
</thead>
<tbody>
<tr>
<td>a But Unlike to omit the concentrated narrow web in an I-beam</td>
<td>But to omit the concentrated narrow web in an I-beam</td>
</tr>
<tr>
<td>b But Unlike to the concentrated narrow web in an I-beam</td>
<td>But the concentrated narrow web in an I-beam</td>
</tr>
<tr>
<td>c But Unlike to the concentrated narrow web in an I-beam</td>
<td>But to concentrated narrow web in an I-beam</td>
</tr>
<tr>
<td>d But unlike to omit the concentrated narrow web in an I-beam</td>
<td>But unlike to omit the concentrated narrow web in an I-beam</td>
</tr>
</tbody>
</table>

**Defining the change representation**

In many cases, reviewers explained the notation of their annotations and their meaning as we can see in example 18, in which mathematical signs were used and in example 19, where colour was used:

18) + means adding a word and
- means take a way a word

19) What is in RED means to delete
What is in BLUE means to add what is in brackets [] or my annotation
What is in Violet means that I am not sure if that should be used or could be replaced by something else.

The words RED, BLUE, and Violet were coloured with the colour they described. The reviewer in this case used HTML tags to achieve the colour effect.

As we can see here, reviewers used signs or colours to represent the actions add and delete which are the most common ones used for corrective annotations. In example 19, the reviewer decided to assign a colour to those cases in which he or she was not sure whether his/her annotation was valid/right (see next point.) The most important point here seems to be that the reviewer is trying to reach a common understanding with the author. The reviewer tries to guide the author on how to read his/her annotations. This explanation was found at the very beginning of the corrective annotation sent by the reviewer.

We found the following situation while analysing the data. John made his first corrective annotation, used his own change representation (sign meaning), and explained to Mary how to read the annotations. For the next homework, John revised Peter’s work for the very first time. John assumed that Peter had read the explanation of his own change representation (made to Mary), and therefore did not bother to explain it to Peter. This assumption is probably a consequence of the shared space that the DHS offers.

In a recent study about the use of change representation tools, participants reported that these tools save time trying to understand changes, and that as well as providing a sense of
where and what changes were made, they also constitute a measure of the extent to which the text was revised (Kim and Severinson Eklundh, 2002, 2001).

For participants in the DHS, the log files of the case studies provide evidence that student regularly visited the model document giving the marking suggestions.

**Reviewers need to express uncertainty**

The question mark (?) was the second most commonly used sign by reviewers in their annotations. The question mark was used in the following format: `word?`, see example 20. In this way the reviewer showed uncertainty about the understanding of the context and whether the writer should accept the remark as valid. At the same time, the reviewer is inviting the writer to reflect on the context based on the word marked with the question mark. Here are some examples:

20) *During (in?) the sixties Sweden was in*
21) *between the word’s appearance and its meaning, which is the (a?) typical characteristics (remove) of the Chinese language*
22) *Actually (“maybe you don’t need to use it”), virtual crashes are*
23) *I don’t know if it’s right or wrong, but I think it sounds better to say “suitable for mapping, monitoring. ”*

In some cases, the question mark was repeated more than once in a row (e.g.???), which suggests that probably the reviewers need to express the extent of their doubts. The primary reason for this could be that all students, in our case study, were non-native speakers of English. Secondly, as PhD. students, one is highly specialised, i.e. it is hard to write authoritatively about others’ work if not in a closely related area (see example 23). A third interpretation could be that questions are regarded as more like suggestions for change, rather than instructions (see example 22). They are also typical features of interpersonal communication rather than transactional and could serve as a means of establishing a dialogue between writer and reviewer. Furthermore, they signal respect for the writer and acknowledge that there might be other possible interpretations of the text. Keh, cited by Smith, S. (1997), found that her students considered the question mark a very helpful form for commenting because of its interactive nature.

Uncertainty was also manifested, however, when reviewers modified some of the suggested changes with words like “perhaps”, “maybe”, “I would rather”. In this case the reviewer in a very subtle way suggested that the author accept his/her correction. This can also be seen as a negotiation protocol between the reviewer and the author.

**Global annotations appended**

Not surprisingly, general annotations were mainly given at the end of the text that the students had reviewed. The natural sequence is probably the main reason for this behaviour. Participants probably read the text on line and then commented on it. An interesting observation is that the reviewers clearly labelled these annotations with such word as “General”. When the reviewer did not label them, blank lines (two-three lines) were left between the annotated text and the general comment so that readers could
identify the annotation as special (see Smith, S. 1997). Example number 24 was appended after the original text.

24) (*General: Clear and easy to understand. Would it be of interest to annotation the shape of the decline in spontaneous polarization with increasing temperature*)

General corrective annotations related to a specific paragraph were also written immediately after it and were delimited by parenthesis.

**Positive comments and their position**

A teacher can make “comments to motivate, explain, or chastise her students” (Smith, S. 1997). In our study of the comments made by the teacher or the outsider reviewer 84%, 86% and 100% made a positive evaluation (in 1997, 1998, 2000 respectively). Similar results were presented by Smith, S. (1997) who made studies on end comments written by teachers on papers produced by students in a rhetoric course. In her study more than four out of five teacher evaluations of the entire paper are positive. She wrote (p. 253) that teachers may be reluctant to write a negative global evaluation because they might consider it more important to pinpoint failings which can be corrected or to protect the self-confidence of the students.

In our case studies, we found that students, though not so often as the teacher, included positive sentences in their comments. In total 51%, 34%, 70% (in 1997, 1998, 2000 respectively) of the students’ comments encourage the author’s work. This behaviour might also have been influenced by the public nature of the DHS.

We also observed the position in which these positive sentences were found in the comment. Here, we find a significant change over the years. In the case study in 1997, 93% (15 of 16) of the teacher’s comments that had a positive sentence were placed at the end of the comment. Only 7% were at the beginning. In contrast, the same teacher changed this pattern in the case study in 2000, in which 92% (27 of 29) were placed at the start of the comment (8% and the end). Students behaved in a similar way. In 1997 these positive comments were placed 50% at the start and 50% at the end. On the other hand, in the case study in 2000, students placed 92% (53 of 57) of these comments at the start. This contrast might be explained by the nature of the system. In 1997 the DHS did not have the feature “paste” which was present only in the case study 2000. It is very likely that users, who had already the intention to make an annotation, the first action he/she made was to use the “paste” button and then write his/her comment.

Few comments, three of 289, presented a positive sentence both at the beginning, and at the end of the comment. In one case one of the students sent a comment just to say “I forgot to mention that I found the text well structured and easy to understand.”

On the other hand, we observed that the only person who sent greetings (e.g. hi, hello) was the outside teacher who did so in every comment sent. This, of course, is related to the personal manner of every individual. However, one reason could be that this was the only person who never met the students face to face.
Justifying the corrective annotation

In many cases, the reviewers mentioned not only the error, but also a solution or the rule to be applied.

25) *Sides come in contact with English in several ways, (I would use colon here instead. You are introducing a series) through movies, TV (here must be a comma,) and recently also over the internet.*

In the next example, the reviewer indicates the action and then supports the suggestion made. In this example, the action to be taken is represented and explicitly indicates the rule that supports the correction:

26) *Some examples of such words used in Swedish are “site”, “mail” (+,) and “freestyle”. Rule: Use a comma before and, or, nor in a series.*

From the annotations presented in this section we could discern the same model as that used in the spelling and grammar checker programs: the error is detected and diagnosed, then a solution is suggested and the rule given.

Helping the author to find the correction context

Reviewers used invisible location marks to help the writer enter the context. They used the spatial context to make reference to their annotations. It was very common to find annotations in which the spatial context was very important in understanding the annotation. Some of the situations found were:

Ordinal position

One common strategy was to use ordinal position to locate annotations. Expressions such as “the last”, “the beginning”, “the next”, “the sentence before”, and “the opening” were adjectives commonly used by reviewers.

27) *The last paragraph needs rewriting*
28) *The first sentence in the last paragraph I would write*
29) *in the middle of the paragraph you start three sentences with “The”*

Numbering position

Being unable to point to the text or to link an annotation to a specific part of the text during the revision, reviewers help the reader to locate the annotation-related text by enumerating the sentences or paragraph.

30) *Your sentences are too long. Paragraph 2 and 3 are one sentence each, containing 3 resp. 5 lines!!*
31) *You introduce sentence two by “in other words”*
32) *in sentence 2, your verb describes you could probably combine it with sentence 3*
33) *the first 6 sentences in paragraph 3 with references to*

We have examined the text to see how the participants made the link between the original text and the annotated text using the ordinal and numbering position approach. We have
The domain help system: Web annotation and discussion around documents

used four “text markers” words as unit of observation: text, paragraph, sentence, and line. The motivation for this choice is the hierarchical structure in writing. For the sake of validity we have also counted the number of times these text markers appeared in the original text. It is worth mentioning that the word line occurred many times in the original text because some of the homework was related to graphics.

From table 6 we can see that the most frequently mentioned word in their corrective annotations was sentence, then text, paragraph, and line in that order. Participants hardly ever used the text marker text, or line when using numbering position; they referred mainly to a paragraph, and seldom to a sentence. Many would agree that locating a blank line (a common separator for a paragraph) is easier than locating a full stop or period (the separator for a sentence) in the text. Probably that is why numbering position was more used for paragraphs than for sentences. When using ordinal position, participants referred mainly to a sentence, though they also frequently referred often to a paragraph.

| Table 6. How participants used the ordinal and numbering position approach for helping the author to locate the context of the annotation |
|---|---|---|---|---|
| Appeared in original text | Appeared in annotated text | Numbering position | Ordinal position |
| Text | 9 | 111 | 66 | 1 | 1 | 0 | 1 | 1 |
| Paragraph | 1 | 90 | 14 | 22 times: Paragraph 1, 5 times Paragraph 2, 9 times Paragraph 3, 6 times Paragraph 4, 2 times | 27 times: first paragraph, 16 times second paragraph, 6 times third paragraph, 5 times | 4 | 0 | 10 |
| Sentence | 2 | 220 | 105 | 8 times: Sentence 1, 2 times Sentence 2, 5 times Sentence 3, 1 time | 34 times: first sentence, 22 times second sentence, 7 times third sentence, 4 times fourth sentence, 1 time | 11 | 2 | 32 |
| Line | 43 | 11 | 1 | 0 | 0 | 0 | 0 | 0 |

The logical sequence used in making a comment (first reading then commenting) is also reflected in table 6. First, participants work on a micro level, that is, on the sentences in a paragraph. As they are closely involved in the task, it might be easier for them to remember the ordinal position or simply comment on the sentence they are reading which is compatible with our result in which participants used the/this sentence 105 times. Clearly participants worked more on a sentence level than on a paragraph level (220 and
90 times mentioned respectively). After reading the last sentence of a paragraph they appear to zoom out and “count” which paragraph they have just read and if appropriate, comment on it using the cardinal number or ordinal position. What is relevant here is not which approach (numbering position or ordinal position) participants used but to show that they have to perform a “counting task”. Numbering the sentences and paragraphs in the original text would alleviate the cognitive load of the revision process in this context.

It was interesting to see that the recency effect and primacy effect are present while reviewers make comments. The last sentence was mentioned 32 times and the first sentence 22. This might also be because the first and last sentences in a paragraph are typically topic sentences, and therefore contain key information.

Observe that the text marker line was not used at all. This is different from the case when revision is made face to face on paper. In this context the text marker line was not likely to be used because it was too demanding to count the lines, which might significantly vary depending on the Web-browser window.

If the reviewer uses numbering or ordinal position, this also means that authors, when editing the revisions, will probably have to go through the same counting task that the reviewers had performed. The authors’ system of counting might be distinct from that previously made by the reviewers, creating confusion and wasting time.

**Topic related location**

Another way to locate the sentence was to mention what it was about: its content or theme. Reviewers usually wrote the words “the sentence about”, but in some cases they just used the structure sentence-topic (see example 36). For example:

34) *in the sentence about diffusion I have doubts*
35) *The sentence about that method could be left out*
36) *I would like to change the sentence about how enthalpy*
37) *The only sentence I don’t like is the one with the explanation to why?*
38) *Then you continue with a sentence about knowledge*

Quoting the beginning of the sentence. We observed that reviewers identified a whole sentence just by quoting its beginning. In none of the cases did we find that the number of words copied by the reviewer was less than five.

39) *the sentence starting with The increasing sensitivity of NMR.*
40) *Might I suggest a minor change to the sentence starting /Due to the fact that./ Can you reduce this*
41) *Finally, the sentence:*
   > *The mechanical pulps are of course bleached in order to doesn’t sound very formal.*
42) *Just ignore the sentence “The scientific community is clearly”*
4.4.4.3 Result of the subjective data

Student perceptions of the DHS

The common space that DHS supported for sharing the homework was extensively used by the students. Most reported that they used to read others' texts. This information is supported by the log file which shows that they were reading not only those contributions they were supposed to comment on but also others. The main reason, reported by most of the respondents, was that they wanted to see how the others wrote and made comments and in this way compare or have a pattern for doing the homework. Another reason was that they wanted to know whether they had “understood the assignment correctly”.

Once a comment was submitted, it was sent via email to the author of the homework (this feature was, however, not available in the 1997 version). Respondents appreciated this feature, saying that it allowed them to save time as they did not have to visit the system to check if a new comment had arrived on their homework. They also reported that having the homework on line saved time because they did not have to “run after” other students (as one student put it) and everything was in the same place.

As for getting comments, respondents liked when this happened; several of them described it as “fun” to receive comments on their writing. One student even wrote about this question “I was glad”. In contrast, they reported that it was a waste of time writing a homework assignment and getting no comment on it. Students from the 1998 and 2000 case studies reported that the comments they got helped them in their academic writing. However, in the interviews made with the group of 1997, students felt that the tool had not helped them to “learn more” about academic writing itself but it had helped them take a more active part in the course. Sharing the homework assignments had been easy and fast, and they had had access to others' text, that is, to many examples. Going through a great number of examples is very important in any learning process.

On the other hand, students could observe the comments made by the teacher or outside teacher made and to whom. One student complained openly indicating that comments from experienced people were missing and that so far neither the teacher nor the outside reviewer had commented on his/her text. However, others mentioned that the lack of comments could be a question of time; as one student stated “When I don't receive any comment it must be due to lack of time.”

All of the respondents thought the DHS was a good tool and all of them encouraged the work and the use of such a tool in an educational environment. As one respondent expressed it, “I felt more motivated to study”. However, the response was not wholly positive. Some experienced a conflict; they felt that the texts were being discussed twice. Others seemed to take the discussion a step further in the classroom. It is important to point out that in this case study of the DHS very few comments show evidence of a dialogue. Only five times did students react to a suggestion by trying to explain themselves or by posting a new version. This was probably because that was not part of the homework and because they met on a regular basis in the classroom. Also if the content of the
annotation was not such that a new version was required, users might not see the need to send a new version, for example if the annotation referred only to misspelling.

Example 43 shows that students became used to working with their peers, which may have improved team work productivity.

43) Excellent writing as usual.

Students could browse others' homework. In our survey we found that all of them except one regularly checked the system. The main reason reported was that they wanted to compare what they had done with the others and they were also interested in reading the comments received by others. One respondent said “Interesting to see how others have written and how they make comments”. Another said “I think we learn a lot looking at what other people do”. This was also a form of collaborative learning.

Teacher perceptions of the DHS

The teacher of the course was interviewed after every case study focusing mainly on usability issues in the system. We also discussed the impact of including the DHS in a traditional classroom from the teacher's perspective. We would like to point out that the same teacher ran two traditional courses in parallel with each DHS course.

The interview was itself used to involve users in the design of the Web tool. The teacher described situations she had experienced and in many cases proposed features that were subsequently incorporated into the system.

The teacher felt that the layout of the system afforded a general overview of how the course was evolving on two levels. One was a more general level, in which she could see how the course as a whole was developing. The fact that all the homework assignments were available in the DHS meant that she could monitor how well the students had understood the assignments; access to the student-reviewer comments allowed her to observe the way students approached this task and to offer guidance as required. The ability to move so quickly and easily from one student’s assignment to another was appreciated; it enabled her to study a student’s homework assignments cumulatively, or to compare a particular assignment by a student with the same one written by others. Figure 9 shows a shot of the index frame in one of the courses. The teacher could, for example, see the assignment “Homework 1” for all the students one by one consecutively.

The other, more specific, level is given by the index frame itself. The teacher could monitor at a glance each student’s progress in the course in terms of the homework assignments submitted. Looking at the index-frame, the teacher could for example see that Luis Alberto is behind in relation to the other students. This information is useful as a measure of a student's commitment to the course, or it could be an early indication of a variety of other problems. In either case, it gives the teacher an opportunity to act promptly. Also, the last version in particular showed clearly which students had received comments and how many. This allowed her to give priority to those who had received fewer or no comments.
Another area that came into focus in our discussions was that of the teacher's role. Being able to read all of the comments made on a student's work gave the teacher valuable insight into those aspects of writing that students considered to be important. This became a particularly useful learning experience for the teacher as a “non-expert” in the highly specialised fields of PhD. students. Moreover, since all of the comments were posted chronologically, the teacher's comments were less obvious: she felt more as a participant than as a teacher in these circumstances.

It was convenient to be able to work on the texts from home and outside normal working hours. However, occasionally the work load felt excessive: while some students sent in their contributions immediately after a class, many of them waited until the day before the following class. This meant there was extra pressure to read the work of as many students as possible before meeting them, with the risk that the comments would not be as useful as they might be. With traditional classroom teaching, the teacher is perhaps more in control of correction time, having an interim period between meetings. Thus, using a Web-based tool not only places extra demands on teachers to respond quickly to assignments, it can also affect the scheduling of correction time. Teachers need to factor in these inherent features of the medium when planning their courses.

The DHS was used as a complement to a traditional writing course, and we were looking for indications that working with texts on the Web had somehow changed the character of the original course. However, the teacher noticed no clear difference in behaviour during classroom discussions. The students still discussed their texts at length in groups, which suggests that they had not exhausted all of their ideas in the Web comments. Nevertheless, in the light of comments from students who considered the classroom sessions to be superfluous, she felt that the two discussion spaces could be better utilised and integrated.

4.4.4.4 Conclusion

The main objective of this study was to observe how reviewers devise means to communicate their thoughts to the writer in electronic format using a Web-based tool, the DHS, that supported only plain text. We were also interested to study how the impact of
using Web-based tools in the classroom both on the teacher and the students. A secondary aim was to design a tool that would supplement and support traditional classroom activities in an academic writing course.

We found that few change representation artefacts could be satisfactorily expressed using plain text. Furthermore, these representations might be weak and misleading. Thus, a common system or standard for change representation needs to be created between reviewers and writers. Users should have easy and constant access to the convention for the change representation. The DHS fulfils this need by including a link to the conventions in the index-frame.

Reviewers clearly needed to have access to the original text on the screen, both when commenting and when making corrective annotations. For example, they frequently quoted the beginning of the sentence referred to; wrote interlinear comments, even when the paste function was not available; invested great effort in cut-pasting using their mouse. The last-mentioned might be a problem if the Web is used as infrastructure because unless the reviewer removes the carriage return, this involves more work. In order to locate relevant sentences, reviewers often referred to their position in the paragraph (First, second, third, etc.). Particularly the adjectives “first” and “last” were extensively used, “last” more than “first”. It is not clear whether this was because these sentences more often contain key information in a paragraph, or because reviewers found it difficult to allocate the correct number to the intervening sentences.

Tools oriented towards supporting corrective annotation should support automatic numbering of sentences and paragraphs in the original text. This will reduce possible conflicts between reviewers and authors. Also, adequately supported line numbering could provide an alternative to the use of text markers.

As a Web-tool in the traditional classroom, the DHS constitutes a valuable supplement to the usual channels of communication. It is accessible from any computer with an Internet connection, enabling students and teachers to work flexibly both in terms of time and location. Furthermore, it gives students a quick response to their work, avoiding the time lapses of scheduled lessons. The use of a simple Web-based tool that has taken shape on the basis of users’ needs in traditional classrooms might be the key for the acceptance of Web-based tools in education.
5 VISUALIZATION OF THE DISCUSSION IN THE DHS

In the case studies in which the DHS was used as discussion tool, we noticed that the discussions were different in several aspects. However this perception was gained only after a close study of the data collected. It was difficult to have a global understanding of the ongoing discussion. How interactive was the discussion? Were all the documents in the domain discussed? Who were the most prolific discussants? How did the author react to comments? Participants might not follow the conversation step by step, but perhaps join the discussion later. How could they be supported in catching up with the discussion?

As a potential tool, to find a suitable and prompt answer to all these questions, we have used visualization of a domain and its activity. The purposes are mainly explorative: to assess the interactivity of a particular domain, how different participants contributed to the discussion, and who responds to whom. Moreover, we believe that visualization, like the ones we are experimenting with, can also provide input into further design of the system, and eventually be made available to users as optional reading and overview tools. This would increase the accessibility of the discussion space, and thereby its “social translucence” (Erickson et al., 1999), i.e. the degree to which other people's activities are immediately available and visible to a user.

The potential end user of the visualization tools that we have designed could be:

- **Participant as reader.** Participants might need support to establish coherence in the ongoing discussion. For this the participant might need to see the links between the comments, who has said what and when, and identify threads of conversations. There are structural elements in a discussion that, because of the characteristics of the medium (text based and asynchronous), are not supported easily. For example, in a face-to-face discussion in a group it is easy to determine who are the most active participants, turn-taking is easier to control, to have an overview of the discussion, to what extent a participant is aware of the content of the ongoing discussion, if the participant has paid attention to the discourse, etc. These elements can facilitate a better understanding of the discussion as a whole and in this way improve coherence.

- **Outside reader.** The information and the discourse in a domain might be of interest for outside readers (non-participants). We assume that the needs of these two kinds of readers (participants and non-participants) might differ in some aspects, but that some basic requirements are the same with respect to how the system should present information to facilitate understanding.

- **Researcher of CMC.** The visualizations have also been designed taking into account that the discussion could be observed for research purposes. It could, for example, reflect the different patterns of interaction in an asynchronous discussion: the strategies that the participants used to read the content of the domain or to reply to comments. The log file of a domain can also be used to generate information valuable for the researcher. For example, how long it took for a participant to make a comment, which was his/her visiting and navigation pattern in the domain, and time elapsed between comments of a particular discussion.
5.1 Domain Interactivity Diagram (DID)

We have designed a set of tools in order to visualize the interaction of participants in a domain. These visualizations are produced by a program that can be run in the same computational environment as the DHS, that is, the Web. The system DID uses the data that has been collected by the DHS to produce a set of diagrams. A link from the DHS will activate the DID system. The design of the visualizations was based on the experiences from the D-case studies. The reason is that in these domains the density of comments per document was greater than in the other studies. Furthermore, the task was suitable for the purpose that a DID aims to support. In the next section, some issues about the visualization of a domain's interactivity will be presented.

5.1.1 Coherence and visualization in CMC

One of the most important problems that text-only CMC faces is what is called interaction coherence (Herring, 1999). Lack of simultaneous feedback and disrupted turn adjacency are the two most important obstacles to interaction management. In our data, we found unrelated messages from other participants intervening between an initiating message and its response, although less frequently than in many other CMC contexts. Coherence is more difficult to get when the relation between comments is clearly presented to the readers. In this sense, threading is a mechanism that helps readers to grasp the coherence of the discussion. Cherny (1999), Lunsford (1996), and Paolillo (1997) have found that the “intervene” situation was proportional to the number of active participants involved in the communication. These studies were done on chat environments with occasional users. In our case studies the groups were not large (10-15) and the groups of participants were pre-defined. Moreover, the asynchronous nature of the system implies fewer postings in comparison to synchronous communication (as e.g. in chat programs). It was also clearly indicated that in order to pass the assignment the students had to make constructive comments.

In a discussion, a plurality of topics that can be touch on is common. Topical fragmentation over time is characteristic of spoken conversation, even in small groups. This term refers to the movement of some of the participants away from one topic to another, while the rest continue with the original or possibly a new topic. In this way several threads of conversation are created. Topical fragmentation is more severe in CMC due, mainly, to the lack of feedback (Herring, 1999). For example, there is no way to know that two participants are simultaneously writing a comment about the same topic. Lambiase (cited by Herring, 1999) indicates that even when groups using CMC consciously try to keep on-topic, “on-topicness” is difficult to enforce. In our systems the topic of the conversation is not given by a subject line as in most CMC systems. Nor is it possible to make visible that a new topic within the discussion of a document has been created. The topic of the conversation in the DHS is given by the content of the document, that is, the topic is to discuss the content of document. The document is shown every time a participant intends to reply or just read the comments in its conversation. This might be the reason why we have found that comments made by participants were mostly related to the document in question. A dual reference was often found, so that a comment referred
both to a previous comment and to the document in question. In this sense, participants were indeed keeping the conversation on-topic. Even comments posted long after the first comment that started the discussion were on-topic. It has to be mentioned that the task in question when the DHS was used in the CSCW course was to discuss the document in the domain.

Comments in the DHS are persistent. From a discourse perspective, the comments in the Comment Frame form a dialogue history. In spoken conversation, utterances are evanescent. Referring back to what has been uttered can be difficult and confusing (Carenini et al. 1990, cited by Lemaire and Moore, 1994). The ability of the computer to store and display information allows the dialogue history to be reified (materialized). Lemaire and Moore (1994) made a study on tutorial interaction. They presented a user interface that enables both the tutorial system and the user to refer to the past dialogue. They claim that an explanation is more effective if it is linked to what has been previously said and that providing a visual representation of the dialogue history facilitates the referring process: “participants know without ambiguity what they are talking about because they can see the text of the utterance to which they are referring.” What is interesting for us in the study of Lemaire et al. is that they have evidence that the most frequently used functionalities in their interface were the scroll bar and the “go back” capability to look at previous messages (page 21), the users could better focus on the conversation because they could see the text, and that they found these features useful. This also can be applied to the DHS. As the comments in a domain are persistent, users can use them as a dialogue history.

5.1.2 Description of the Domain Interactivity Diagram (DID)

The need to have an overview of the domains led us to develop what we have called a Domain Interactivity Diagram. A DID is an interactive program that uses the information saved by the DHS to generate graphics that represent the interaction in a domain. The DID presents a domain at two levels. The first level is a general overview of the domain and the second level focuses on a single document. The first level is generated by the system. To generate the second level, the help of an analyst (a person) who will create the links between the comments, is needed. More about this is presented in Section 5.1.4.2 on page 84. Every participant in a domain is assigned a colour. Objects created by him/her, that is comments or documents, are presented in the same colour. With this information it is easy to see how each person has spread out his/her activities among the different discussions. However, it could be a problem to distinguish between colours when the number of participants increases.

The second level provides a reader with a quick and global view of the discussion of a particular document in a domain without reading the content. It provides information about members’ participation in the discussion, conversational threads, the pace of the conversation, and its relation to external discussion within the domain (if there is any). In the sections below, we explain the DID in more detail and some particulars of its design.

The DID has been designed taking into account the results of case studies using the DHS system, in terms of the characteristics of conversations actually occurring. For example, in
the cases analysed, only 10% of the documents (N=75) had more than 10 comments; no more than 10 members took part in the discussion of one document (which means that not many colours might be needed to represent them in our visualization); 95% of the comments were no longer than 200 words; and 50%, 68%, and 80% of the comments were submitted within one, two, and three days respectively. It is important to indicate that, in another context, the information in a domain could diverge from the one that we had in mind when the DID was designed. For example, a domain with 100 documents might be difficult to visualize with the DID.

5.1.3 Panorama view of a domain

It is important to bear in mind that the DHS is oriented to supporting mainly small and/or middle size groups of authors who discuss their document. Therefore, we expect that all participants in the domain are authors of at least one of the documents included in the domain. A unique colour block is assigned to every participant, or author. However, in case a participant is not the author of any of the document in the domain, the colour black is assigned to him/her. No distinction is made if several “non-author” participants are found in a domain. A participant, in this context, is anyone who has sent a valid comment (see Section 4.3.1 on page 38 for details). When the DID is invoked, a new window is opened and three elements are shown. The first element is a pull-down menu (see figure 10). It shows the statistics of the whole domain: the number of documents that were included in the domain, the number of participants, the number of comments made, the number of words held by the comments, and the duration of the interaction from the first comment to the last one posted.

The second element is a column chart. The legend of this chart is composed of coloured bars to which participants' names are assigned. In the chart the documents are spread along the x-axis. The documents are labelled by a short nickname tag of the same type as the one assigned to its author in the legend. The y-axis presents the number of comments that any of the documents in the domain received. Columns in the chart are built up by
coloured block separated by a tiny white line. Each block represents one comment and the block’s colour represents the comment’s author. The colour of the bars in the panorama view can give additional information. For example, if the colour appears many times, this indicates that the participant has been very prolific. If that colour is grouped mainly in the base but absent in the top of the columns, the participant participated at the beginning of the discussion but not at the end. If one column does not have a block with the same colour as the short nickname tag, the author of the document has not participated in the discussion. If the column is rich in different colours, the document has been discussed by many of the participants. If the column is formed by just one colour, only one participant commented on the document. The size of the column also gives valuable information. For example, at a glance it could be seen that a document was not discussed at all.

The third element in the panorama view is a menu list. This list consists of the documents that belong to the domain. The items of the list are: the short nickname tag used in the column chart, the name of the author, and the titles of the document. Note that in the index frame, the titles of the documents that are included in a domain are presented. This menu list shows up to four titles and is scrollable. The user can select an item from the menu list and activate what we have called the document interactivity view that is described in the next section.

5.1.4 The document interactivity view (DIV)

Once the user has requested the document from the panorama view, a new layout is displayed. It is divided into two horizontal frames. The upper frame presents the document interactivity chart, the bottom left frame shows the document, and the bottom-right frame the text of comment that was selected from the document interactivity graph. Observe that some data about the comment can be presented.

Once the user has requested the document from the panorama view, a new layout is displayed. It is divided into two horizontal frames. The upper frame presents the document...
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interactivity graph. This diagram is interactive (see figure 11). The bottom frame is divided into two vertical frames. The left frame displays the Web document that was selected by the user. The right frame presents the text of the comment that the user might select from the document interactivity graph. This can be done by clicking on one of the comment icons (see below) that are shown in the document interactivity graph. In this frame some statistics can be shown by opening a pull-down menu. These statistics are: posting date, number of words included in the comment, and references made from this comment to other objects in the domain (e.g. to other comments or documents). The purpose of the bottom frame is so that the reader can access, in detail, the text-based communication that has been going on while using the DHS. It also gives some support for “rebuilding” the context in which the comment was made as the document in question is presented.

5.1.4.1 The document interactivity chart (DIC)

The document interactivity graph is two-dimensional (see figure 12). The x-axis (the baseline) represents the document under discussion, and showing the time sequence in which the comments on the document were received. In the y-axis, we have the names of those who made at least one comment in the discussion of the document in question and within parenthesis the number of comments made by him/her. This number is used to sort the list. The closer a participant's name is to the baseline, the more comments he/she has posted in that discussion. This allows the reader to see at a glance how many members participated in the discussion and who were the most active. This principle has one exception. The author's name is always part of the list and it is placed closest to the baseline regardless of whether he/she took part in the discussion. Thus, one can easily see how the author has interacted in the discussion about his/her document.

On request, below the baseline, a table could be presented showing the development of the discussion in terms of the time elapsed (row 1) between two adjacent comments and the
accumulated time (row 2) until a certain comment is made, (see figure 13). A similar table is designed for the number of words in a comment and the accumulated number of words in the discussion\(^1\).

![Figure 13. A close-up of the base line that shows the time elapsed between two comments and the accumulated time](image)

In this graph, comments are represented by four icons that are presented in figure 14. The colour of the icon corresponds to the colour of the author's comment. These icons are placed in the graph area relative to who made the comment, and the order in which it was received. In this way, all the comments made by the same author are at the same level. The icon 14a represents a comment that adds something to the discourse or refers to a previous comment in the discussion. The next one, 14b describes a comment that mentions another comment in the discussion and/or explicitly makes reference to the document in question. A comment that makes reference to another document in the domain is represented by icon 14c. The most complex one is icon 14d that represents a comment that makes reference to a previous comment in the discussion, to the document in question and to another document in the domain. Furthermore, when a comment makes reference to the document in question, a perpendicular dotted line is drawn from the comment to the baseline (see icon 14f). Glancing at the baseline and seeing how often it is intersected by a perpendicular line provides an easy way to determine the extent to which the discussion has been focusing on the document in question. If a comment makes reference to a previous comment, this is linked by an arch line and an arrow that links the comments in question, see 14e. These links can be used to identify conversational threads within the discussion, and altogether, they show the interactivity of the discussion around a particular document.

Additionally, a comment can make reference to the content of another document in the domain, or to a comment made on another document. Icon 14g represents such case. The

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\(^1\) This is planned for the next version of the DID
link to this document is represented by a dash-dotted line. This link may also present a tag with a number, \( n \), within parenthesis. This indicates that the comment makes reference to comment \( \#n \) of the other document. In case a comment makes a dual reference in another discussion, say, to the content of document A, and to comment \( \#n \) in document A's discussion, the tag is represented by \((0, n)\).

### 5.1.4.2 Creating the links between comments and documents

For every document in a domain, all the comments are presented in the order they were received. There is no visual sign to distinguish the possible threads that the discourse contains. When analysing the comments, we found that such threads indeed exist. For the visualization of the interactivity in a domain the required data includes to which document a comment belongs, its author, and the posting date. The log file provides most of the information needed when charting the interactivity. However, the most important relationship for the purpose of a DID is not available: the links between the objects that constitute a domain (the comments and the documents in a domain). Our data shows that a comment often points to the ongoing discussion or to the document being discussed; seldom to another document in the domain; and rarely to a comment in another document's discussion. Moreover, one single comment could simultaneously refer to several of the objects, in particular to two or more previous comments. The links are established by references in the text of the comments. The DHS provides little support to create these links.

The links can be of two sorts: explicit and implicit. In correspondence with our data, some procedures used by participants to create an explicit link from his/her comment to a previous comment were by a) addressing the comment's author by his/her name, b) using the id number of the comment, or c) quoting from the previous comment. The procedures were shaped in an individual way and we did not observe any regularity. Implicit links are those that are given implicitly in the discourse reference.

To establish the referential links in a domain is indispensable for the generation of a complete DID visualization. There are three alternatives for collecting these links. The first alternative is manual analysis after the domain has been closed, e.g. by a domain editor. The other alternative is that users themselves do this work when posting a comment, with support from the system. The third one is using complex Natural Language Processing (NLP) methods to determine referential relations among turns based on their content. The choice of alternative depends partly on the purpose of the visualization, and who is the user (participants, outside readers, or researchers). Once these links are grasped, then a web of the relations, mainly conversation threads, could be represented by graphs, trees, etc.

Participants in the DHS discussion used several techniques when making links to previous comments. For example, using the number of the comment, or addressing the author by name. However, the logical and successive flow of the conversation over time, and the new comments' adjacency to their objects was the most common invisible link. Thus automatic linking of comments in the DHS will require many advances in the field of natural language processing. It can be difficult to define the relation between comments because
they might be based on common experiences of the participants who made them, unknown to the rest of the group.

![Image](image-url)

**FIGURE 15.** An interface for creating the links between the objects in a domain. In the example David makes reference to the previous comment number 3 and to Document 2 that belongs also to the domain.

Having in mind that the users themselves create the links and using the observation of how our users marked links to previous comments, we have designed an interface for marking these links so that they can be used by the system. However, it has not been fully implemented nor tested yet. In this interface, a comment can be linked to previous comments in the same discussion and to the documents in the domain. The optimal setting would be that the marking is done just after the comment is written by its author. Another scenario in which this could be done is that a person after reading the comment, marks the links found. Observe that in the last scenario the person in charge of the marking can be the editor of the domain or a researcher. This idea has been implemented by adding two new fields to the Add Comment Window. For marking that a particular comment is linked to a previous comment the user can select from a check box list. This list is formed by all the previous comments represented by id numbers. The check box list allows for multiple references to previous comments. For marking that a particular comment is linked to a document in a domain (or when the comment makes explicit reference to the document in the discussion) the user can select from the menu list that presents the title of the documents in the domain (see figure 15). By default, none of the check boxes are marked and the option “does not apply” in the menu list is selected. Multiple selections can be done in both cases covering most of the possible links that can be defined in a domain. Note that the only link that cannot be defined by this interface is when a comment makes reference to a particular comment in another document, which is very rare in our experience. Figure 15 shows that David is about to make a comment to the Document 4 which has received 4 comments so far. His comment is related to the previous comment 3 and also makes reference to the Document 2 that is part of the domain.
5.1.5 Remaining issues with respect to visualization of the activity of a domain

How to represent inactivity or “no changes” in a domain is an important aspect of the visualization. We learned from our case studies that if no changes in the domain were made, it does not mean inactivity. Participants could just use the system for reading, or browsing the system looking for new comments. Indeed, the log files show that most of the time spent by participants in the system consists of navigating in the domain without making comments. The time in which a domain has not been changed can be determined and in addition, we can identify the particular objects that have not been changed in a particular period. Observe that the first entrance in the table that can be shown below the base line of the document interactivity graph represents the time from when the document was entered until when its first comment was added (10 minutes in the example shown in figure 13). The log file can be used in various ways to reflect the activity in a domain and how it developed. For example it could be asked what happened in a particular period of time. Even a more complex query could be made; which documents were commented on in a particular period of time?

We have also experimented with animation of the growth of the domain, i.e. the gradual build-up of the panorama view. This can give a sense of the sequence of the comments posted on different documents, how active was the discussion and how participants performed during the discussion. Using animation, in this case it would be easier to perceive the peace of the discussion, for example.

5.2 Examples of the use of a Domain Interactivity Diagram (DID)

In this section we will present and discuss some examples of graphics that the DID system generates. The aim is to show in practice how this tool might be used. In the first section we show the panorama views of four of the domains. In the second section we show some examples of the document interactivity view. The data used to generate the graphics is taken from the D-sample. In those case studies, students in a course were asked to write an essay on the topic “Collaboration with and without computers”. The essays were then distributed, shared, and discussed using the DHS system. The exercise was done in four versions of the course and the documents and the discussion for each domain have been stored and analysed.

To illustrate the use of the diagrams generated by DID we will focus on the following scenario: Luis is interested in the topic of the D-sample discussions. Carlos, a friend of his who used the DHS in one of these discussions, informs Luis that he can find information about the topic in the domains. Luis decides to explore and read the material in order to learn more about the topic, but he does not have much time for this. He finds the DID system and uses it to explore and read the domains. Lusi got also interested in reading about the DHS.
FIGURE 16. Panorama view of four domains
FIGURE 17. Four document interactivity charts (DIC) generated by DID
5.2.1 Using the panorama view

The panorama views in these cases are ordered by the number of comments that a document in the domain got. There is one exception, we have reserved the first place in the base line of the graphic for the ATP document regardless the number of comments it got. In this way, it could be compare the proportion of the discussion (amount of comments) dedicated to the documents in the domain and to the system DHS.

At a glance it is possible to say that all the documents in the domains have been commented. The time restriction might impose the reading strategy that Luis might use. One possible way would be to read those documents that had the most comments. The number of comments received by a document could reflect the interest that participants showed for the document, therefore it might indicate whether the document is worth reading. Furthermore, Luis could learn not only from the document content but also from the discussions around the document.

Another possibility would be to explore only one of the domains. The number of documents and the number of participants in the domains was approximately the same. When comparing the panorama views, it can be seen that the number of documents in the 16c domain is less than in the others. Moreover, all the documents in that domain have got at least four comments, which could mean that a more thorough discussion can be found in that domain. Additional, in the domain represented by figure 16c, the ATP document was extensively discussed. The number of participants in this case does not help Luis to decide which of the domains to choose. However, he noticed that Carlos was part of this group. Also, it can be seen that Carlos has commented several times and on almost all the documents in that domain. Finally, Luis decides to explore the domain presented in figure 16c and leave aside the others.

5.2.2 Using the Document Interactivity View (DIV)

Once Luis has decided to explore the domains shown in 16c, he gets interested in exploring the discussion in the domains. For simplicity, let's say that he is interested in those documents which presented at least six comments. Figure 17 shows four DICs selected by Luis.

5.2.2.1 Interpretations of the discussion

Luis can see that the discussions in the documents he selected refer to the document content in question several times. If we compare 17a and 17d in relation to the links between the comments, we could say that the discussions in 17d are more closely related to each other that the ones in 17a. A clear sign of this is that even the last comment made in the discussion makes reference to the very first comment that initiated the discussion in 17d. Of them all, the unique comment sent by the author in 17d looks interesting or controversial as it is linked to all the other comments in the discussion. This might indicate it is worth reading.
5.2.2.2 Information about the participants

From 17s, Luis can observe that in all these documents at least four and no more than six participants have taken part in the discussion of the documents, and the author has participated in all of them. Most of the participants posted only one comment in the discussion. Exceptions to this are the authors of the documents presented in 17a and 17b, and one of the participants in 17b who sent three comments each within one discussion. The author of the document was not the only one who replied to a comment. In all the examples apart from 17a, a participant who was not author of the document in discussion replied to another participant’s comment (e.g. 17c comment #6). Observing in more detail, Luis notices that Carlos has taken part in the discussion of the four documents that he has selected. Moreover, Carlos posted only one comment in each discussion.

5.2.2.3 Reply strategy

The authors in 17c, and 17d participated only once which could indicate, at first glance, that these authors were not concerned about the discussion. However, this could just be the result of the when-to-reply strategy that the author of the document adopted. The author could reply as soon as possible after the comment is posted (see 17a, 17b) or wait for several comments to reply (see 17c, 17d). The response could refer to a single comment (see 17a) or to multiple comments (see 17c, 17d).

5.3 Remarks

It is important to say that the discussion of the scenario that we have presented makes use only of the graphics. The DID system offers other interactive possibilities (e.g. statistical information) that we have not taken into account to describe the possible interpretations that Luis might make of the pictures. We have limited the discussion here to use just the visual cues that the system gives.

Another point here is that as any other graphical model, users will get from the graphics generated by DID much more out of the representation as he/she learns to use this representation. The aim is to enable the user to make inferences about interaction patterns from a quick view of the graphs.

5.4 Related research on visualization

In this section, we will present previous research in information visualization and how our visualization tool connects to it. We also present our visualization as an alternative to some of those previous findings.

An important study on visualizing on-line conversation was done by Donath (2002). The idea was to “help the viewer to perceive the on-line space as an intuitive and legible social environment”. The approach used here is what is called “semantic visualization”. It introduces assessments of the meaning and relevance of the data into the visualization.
process. There is always a great set of statistics that can be derived from a database of online communication (e.g. the posting, the log files, etc.). Donath indicates that “resolving these statistics into socially meaningful classifications is the essence of the analytic of the semantic visualization.” In our visualization we also take into account this approach. It could be appreciated how populated the discussion was both for the whole domain and for a particular document at a glance. For a particular document, moreover, it can be seen who the primary participants or the most prolific authors are. We can also observe the participation of the author of the document. The last point could be very important depending on the context in which the tool is used. One concept that Donath also tries to represent is conversational cohesion: “how the participants maintain a common topic.”

Bonvillain, cited by Donath, says that topics introduced by higher-status participants are more likely to catch-up. In our case, the DHS supports conversational cohesion by presenting the Web-document in discussion every time the ongoing discussion is viewed. Nevertheless, in a DID it could be perceived who these “higher-status” participants are. In DID the leadership in the domain can be easily depicted.

Weippl (2001) proposes a technique to visualize a text database containing 500-20000 articles. The 2D visualization that was used creates a landscape in which all these documents are represented. The relationship among these documents and how they are grouped is based on key-terms, stemming from reducing the number of terms, deleting words that are not good for classification (stopwords e.g. “the”, “and”), self-organizing maps algorithm to calculate the projection, hubs (or index pages) and sources (or detailed information). Our case studies are different to the situation that Weippl studied. While the information landscape technique needs to relate documents, in a DID this relation is already pre-defined. Remember that the Web documents in a domain described the same topic, in the case of DHS, or were collected because the “collector” thought it was related to the topic that was studied, in the case of Col·lecció. Also the number of Web-documents is significantly less (10-30). However, as we have said, in the discussion in our tools a comment might refer to other documents in the domain. It might be valuable to create automatically a landscape as the one proposed by Weippl and compare it with the relations that are established by the participants between the documents and comments in the domains.

Novák, Eisenstadt, & Slavík (2002) indicate that the most important aspect for visualization of dynamic graphs is their behaviour in time. Their study was made on synchronous communication which clearly is more difficult to represent because of the huge number of visualized objects that are continually changing. In online communication some aspects are treated in different ways depending on the mode that is used, synchronous or asynchronous. For example, in synchronous communication attention plays a very important role. How to catch the attention of the participants in the chat? How to visualize this aspect for the participants? Asynchronous communication, commonly, is not that dynamic. Using data from our log files, the dynamic of the domain can be visualized. This could focus on a participant: how much time did the participant spend reading, writing a comment? Even more detailed information could be disclosed. For example, the navigation pattern could determine if the participant's reading intention was explorative or thorough. The visualization of the dynamic could also focus on a document level. Which was the document that most caught the attention of participants?
Which documents were ignored? Taking the domain as a whole, the “peak” of the interactions (reading or making comments) could be seen. We believe that visualization of the changes and activities in a domain could give valuable information. For example a researcher (a potential user of DID) could observe hidden information patterns as “pauses”, reading or navigation strategies.

One important aspect in the visualization of a digital space, as a domain, is navigation and representation. Most of the techniques that are used to represent a digital space and support its navigation provide an overview of the whole structure to the user and enable him/her to visualize specific objects presented, opaque or not, in the overview. The visualization tool should be able to sketch the structure of the digital space and the relationships of its components. It also has to provide the ability to zoom and select objects on request so that information can be filtered in real time. To do all this, different representations of the digital space are needed. The overview aims to achieve a global understanding of the digital space. One problem that Lokuge and Ishizaki (1995) pointed out for interactive systems that account for visual representation of information object is that these systems do not relate one presentation with another. They do not provide “a mechanism to maintain a model of the user’s information seeking goals from one query to another”. The visual complexity of the representation can make it hard for the user to discern specific information and interacting without getting lost. A common approach in information visualization is multi-layer that provides users with an interface that controls the display based on layers in order to simplify the interaction and information overflow. We use this approach. In a DID, the user can hide/show different sets of information in order to provide a simpler graphic, thus easier to understand. Moreover, the user can select one comment in the graphic so that it is shown in one of the frames. Activating a menu, statistical information about the comment can also be given (date of the comment, length in words, references to previous comment or document).

Another technique that is used in information visualization is the fish-eye view. Sarkar and Brown (1992) presented a system for viewing and browsing planar graphs using a software analogue to a fish-eye lens (it shows places nearby in detail while also showing remote regions in successively less detail). Tyson and Scott, cited by Sarkar et al. (1992), have found that browsing a large layout by scrolling and arc traversing tends to obscure the global structure of the graph. Due to this problem we have decided to avoid scrolling in a DID. When the graph is too large to fit in the screen it is scaled. This approach has the drawback that important parts of the graph could be very difficult to see, for example a comment. However, it is clear that the fish-eye view is more convenient in visualizing graphs where the distance between the objects is important. This is not so in our case. If we can think of the situation that a domain consists of a great number of documents and participants, or that a document has received a great amount of comments and/or a high number of participants who have commented in that document, then the fish-eye view could be a potential alternative to scanning a domain in the panorama view and the document interactivity graph.

Another problem that we have faced when developing a DID was labelling. Experimental studies have shown significant task-completion reduction and recall-rate improvements when using graphical displays instead of tabular text display (Lindwarm-Alonso et al.,
cited by Fekete and Plaisant, 1999). On the other hand, Najjar (1998) found that text is better than graphs for conveying abstract concepts. We need to distinguish between the different Web documents in a domain, and each of them can be considered as an abstract concept. Text information labelling is essential in this context. For example, the title of the document is very important. The document will be known by its title and it will attract readers. There is no rule to define the length of the title. When it comes to representing the participants in the visualization it might be more natural to use his/her name than a short cut (better Luis Albert than LA) or any other graphical representation as a colour. A label does not have to be orderable; it simply has to be remembered and recognized. Colour is often extremely effective as a label (Ware, 2000, p 133). However, using text information labelling or colour is a problem when the data density increases (e.g. the number of Web documents and participants) and the labels are very long; as titles might be. There are two techniques for presenting labels: static (e.g. in cartography) and dynamic (e.g. interactive computer graphics). We are combining text information labelling and colour to identify the documents and the participants in the DID. Every author is represented by a different colour. This colour is used to represent the document and the comments he/she might write. The first page in the DID uses static labels. The label technique “label-at-all-cost” is used, meaning that all objects will be represented by a label. When labelling the documents, a generalization technique is used. Every document is identified by a unique key tag formed as follows: Doc + number. This label is used only for this purpose and is unfamiliar to participants as it is not used by the DHS. The label in this case gives little information to the participant when deciding which document to read. To mitigate this problem, in the panorama view of our visualization, a scrollable menu is also shown. The menu presents a table of contents using the tag of the document, its authors and its title. Fekete and Plaisant (1999) propose “excentric labelling” to address the problem when too many objects have to be tagged. Excentric labelling is a new dynamic technique to label a neighbourhood of objects located around the cursor. When the cursor stays more than one second over an area where objects are available, all labels in the neighbourhood of the cursor are shown without overlap, and aligned to facilitate rapid reading. A circle centred on the position of the cursor defines the focus region. This approach could be a potential solution when the density in a domain is too high. However this technique does not offer a suitable solution for long labels such as the document titles. Truncation is likely to be a useful method here.

A tool similar to the DID is the Conversation Map system (Sack, 2000). It is a Usenet newsgroup browser that analyses the text of an archive of newsgroup messages and outputs a graphical interface that can be used to search and read the messages in the archive. The similarity consists in the fact that both are trying to use social interaction to help participants navigate the information space (the newsgroup for the Conversation Map system, and a domain for the DHS). The Conversation Map system creates a social network by automatically identifying who has either responded to and/or quoted from whom. In the DID a social network is not created automatically but a text analysis procedure could produce the social network. In a newsgroup, when a participant replies to a comment, the new comment is indented. That is to say, this relation is clearly defined. The reply-to is in fact a structural element in newsgroup and email systems. It is interesting to mention that even when no visualization is created by the reply-to element, it is still a way to create relations between the messages. The creation of new topics in the
discourse is also identified by indentation in newsgroups. This is not the case in the DHS which presents the comments just in the order in which they were received. If a new topic is indeed created it is known only by its content, and no visual cue (such as text indentation) is given.
6 COL·LECCIÓ: COLLECTIVE BOOKMARK DISCUSSION APPLYING SOCIAL NAVIGATION

6.1 Introduction

The exponential growth of the Web has made retrieving any particular Web page difficult, and people need better ways of searching than what is possible with present information retrieval technology (Hardin, 2002). One increasingly popular solution is to use other people’s suggestions in order to find things on the Web (Wexelblat, 1998). This is known as social navigation (Benyon and Höök, 1997).

For an individual, the usual way to access a Web object is through its URL (Uniform Resource Locator). Almost all Web browsers let users manage their URLs via the bookmark feature. Generally speaking, bookmarks allow users to retrieve later those objects included in the bookmark list. This helps reduce the user’s cognitive workload by eliminating the sometimes tedious and time-consuming work of searching for Web sites containing specific content. In the bookmarks, URLs can be organized or annotated according to the user’s preference and they are searchable. However, bookmarks are based on an individualistic approach, that is, they are directly accessible only by the person using the computer on which the browser is situated.

Groups that use the Web as a social infrastructure for knowledge-oriented work (teams, see Severinson Eklundh, Groth, Hedman, Lantz, Rodriguez, & Salnäs 2003) may find it more difficult to share information found on the Web. Making sure that everyone has access to the Web objects is problematic. Commonly, URLs can be distributed via email, but this requires that every member adds that URL to his/her bookmarks. It is also very difficult to be sure that other members have access to the object represented by the URL as usually bookmarks are saved in a private space. Furthermore, discussing the object’s content via email can be cumbersome because if its content is shown in the body of the email, managing the discussion may be problematic as both the discussion and the content use the same display area. On the other hand, if only the location (URL) is shown, the discussion is carried out of context, making it more difficult for participants to reach a common understanding. A common space for sharing where the user can have an overview of the URLs and the possible discussions simultaneously would be of help for group activities.

In this chapter, we present Col·lecció, a prototype aimed at collecting URLs that members of a team wish to share and discuss. By using a social navigation approach and centring the interaction on the dialogue between users, this system presents a potential alternative for organizing information from the Web that a team may need in its activities.

1. This chapter is an extended version of (Rodríguez & Noël 2003)
6.2 Related work

Some systems try to create communities by searching in users’ bookmark files to find similarities and then sharing the URLs among the users. For example, CoWing (Kanawati and Malek, 2001) uses assistant agents called WINGS to collect and organize URLs. TopicShop (Amento, Terveen, Hill, and Hix, 2000) helps users evaluate and identify high quality sites using site profiles and a work area presenting thumbnail images, annotations, and grouping techniques. In order to benefit from using bookmark files to create a collection of links, algorithms are required for clustering and categorizing web pages. One problem with this approach is that empirical studies indicate that many users bookmark “just in case” and not many of these bookmarks are frequently used (Abrams, Baecker, and Chignell, 1998). Another approach to supporting social navigation is to allow users to put their bookmarks on a remote server1. These links can be shared though users are required to set access rules to support privacy. A different approach to using agents to grasp users’ bookmarks files or putting them a server is used by WebStickers (Ljungstrand, Redström, Holmquist, 2000). This system couples Web pages with physical representations, or tokens. These tokens are used to access Web pages by scanning an attached barcode. The tokens can be handed over to another users. An original way of collecting Web pages is offered by Hunter Gatherer (Schraefel, Zhu, Modjeska, Wigdor, and Zhao, 2002). This system, aimed at a single user, collects, represents, and can edit components from within Web pages. The idea here is to collect specific content inside a Web page and not the Web page as a whole. In other words, a collage of Web pages can be made. WebTagger (Keller, Wolfe, Chen, Rabinowitz, and Mathe, 1997) provides both individuals and groups users with a shared space of URLs that can be organized and that is searchable. Users can supply feedback on the utility of the URLs that is mainly used for ranking. None of the systems mentioned here dedicate special attention to the need that users might have for discussing either the “collection” globally or any particular item. The recommendation that users get from others is limited to the fact of including the URL in the shared space. Our prototype addresses these issues and also provides support for social interaction that helps users navigate in the collection that the team has created.

6.3 Main characteristics of Col·lecció

Col·lecció is based on the DHS with some innovations that give the tool a new perspective. The layout of the system is the same and it works on the same principles. The new features that are available in Col·lecció are presented in the Command Frame. The first one is that the users can add the Web document (or Web-site) to the domain on their own. This function is activated by the Add URL button which pops up the Add URL Window. The Add URL Window is shown in Figure 16. The link to the document can be placed under the user’s name or under a topic that had been previously created. The user has to enter a title for the Web-document and the URL. Once this information is submitted the Index-Frame is updated and the just added URL is available to all the users. Figure 17 shows the Index-Frame in the system Col·lecció. Observe that the Web-pages added to the system are

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grouped by the topic “Web-based Collaborative Writing Tools” and by the users. In this way other users can know who was the user who added a particular URL. This information could also be used as a search strategy if needed. One of the reasons to let users include a document in the domain themselves was to lower the amount of work the editor of the domain had in the DHS. Col·lecció covers all the functionalities that the DHS has and therefore we think that it can also be used in the same context in which the DHS was used; a discussion context and annotation context around documents. With this function, the user does not need to send his/her file to the editor of the domain. However, if we consider these two contexts in which DHS was used, we expect the user to be able to create a Web-document and upload it on the Web.

The second feature in this system is an awareness mechanism that allows users to see the last events in the domain. This feature is activated from the Show-last-events button. It opens a separate window which presents a chronological report about when a document was added and by whom. The same list also specifies when a comment was added, who made the comment and on which document, and who added that document. This would supplement the Comment Counter tag of the Index Frame. As every action is chronological ordered the user could see at a glance how much the domain has evolved and also who are the users who have added the latest links or comments. Based on this feature more mechanisms of awareness could be developed, for example a “what has happened since my last visit” marker.

Furthermore, the third new feature is that the system can show the Web document in an independent bigger window than the Content frame. This function is enabled by the “Open in a separate window” check box that is presented in the Index-frame (see figure 17). The intention is to provide the users with a more ample view of the Web object than the one given in the Content frame. This window, if the function is selected, works as a mirror of the Content frame. The need for this feature has two reasons. The first one is because having a global overview of the document is important (Severinson Eklundh, 1992) and the space in the Content Frame was not that big. The second reason was because user could add not only a Web-document but an entire Web-site. A Web-site is usually designed to be navigated from an independent window and not embedded in a frame as it would be the case in Col·lecció.
6.4 Case studies

We present here three recent case studies of the use of Col·lecció. In two studies, participants were located in different countries. In the third case, 20 students in a co-located class used the tool to fulfil the requirements of a course. The URLs collected and the interaction among participants (the comments) were analysed. We also asked the 20 students in the third case study to evaluate the system via a Web-based survey. Our main interest has been to explore the possibilities this tool can offer to a team that needs to collect Web sites. First we will present briefly the three case studies and the we will present the results and the discussion.

6.4.1 Case study 1: Collecting e-journal Web sites

Six graduate students distributed in Europe, Asia, and Latin America with at least four years of experience using the Web and Web design wanted to establish a new research journal Web site (e-journal). This work was done to fulfill personal goals and not for professional reasons. Five of the students were familiar with Col·lecció and had participated in the system’s graphic design, while two students had worked in the publishing industry for at least two years. The group was encouraged to use Col·lecció to gather some examples of e-journals, the intention being to collect models that could be used for the design of the new e-journal. The users were also asked to hold a discussion of the collected e-journals using the system. The group collected 11 e-journals during a period of one week. These e-journals were discussed over a two-week period. The discussion consisted of 69 comments containing approximately 5,500 words. The comments were distributed among the commenting spaces of the e-journals. The URLs were grouped by the name of the member who included it.

6.4.2 Case study 2: Collecting Web-based collaborative writing tools sites

Four researchers in HCI located in North America and Europe were encouraged to use Col·lecció to develop a discussion on a topic of mutual interest (Web-based collaborative writing tools). One of the researchers had used the system before. Again, this project was done for personal, not professional, reasons. The participants used the system for a one-year period. However, only two of the members used the system regularly. Nineteen URLs were added to the system. Two main topics were created: “Web-based collaborative writing tools” which held more than 47% of the URLs collected; and “Readings on...”
collaborative writing”. In addition, the researchers could add links under their own name. There were 72 comments, containing 6,866 words.

6.4.3 Case study 3: Collecting articles from digital newspapers

Twenty students in a course given in a university in Sweden were asked to use the system to collect articles (a maximum of three per student) from newspapers’ digital versions. All the students had at least two years of experience using the Web. Only five of the students knew someone else in the class before the course started and this was their first lab. The article’s length was required to be between 500 and 1000 words, could be written in English or Swedish, and had to be related to the topic of “collaboration”. All the articles were grouped under the students’ names, not under topics. To fulfil the course requirements, students had to collect the articles in the first week and were to start discussing the articles in the second week. Students were asked to comment on the reasons why they had selected that particular article. A total of 39 articles were included from 17 different domains. A total of 191 comments were posted holding approximately 12,500 words. The average of comments per document was 4.8 (sd=2.7). This is the only study of Col·lecció in which the use of the tool was mandatory. Just after the second week, a survey was submitted to the students, with the intention of 1) evaluating the design of the tool and 2) seeing how the system supported the activity of gathering Web articles. We report here the only on the second part of the survey. We collected 19 responses to the survey.

6.5 Discussion and results of the studies

Some teams’ work may need to be done around a collection of Web objects. Our case studies show that certain tasks do not need a complex system in which access rights need to be set up or analysis of the users’ bookmark files be made. In general, our users’ tasks were to collect Web links and discuss their content. Col·lecció supports discussion of a specific, selected sub-set of the Web created by the user.

6.5.1 Navigation

Bookmarks are a “personal web information space” to help users navigate on the Web (Abrams et al.1998). Pitkow, as cited by Abrams et al., reports that a great number of users rely on bookmarks as a strategy for locating information and that bookmarks were used slightly more than other navigation strategies such as a search engine. A collective bookmark implies a “collective web information space” that can be used by members of a group. Adding a URL to the link collection in Col·lecció means: 1) The user who adds the URL is automatically recommending that URL to the group; 2) The user is filtering the added URL from other URLs he/she has probably found. The agent here is the same user; that is a human.

Comments can contain relevant information about the web page that could help the user make decisions as to whether or not to read the page, as in the following example from the case study 2.
44) **Comment # 2 Date: 02/04/05 Time: 17:13:37**  
Laura Craig:  
*Ok, about EquiText. First it's in Portuguese, so I haven't been able to try it out and see:-). …You can write on-line within your Web browser.*

**Comment # 3 Date: 02/04/05 Time: 17:20:28**  
Charles White:  
*I will check this system later. I do not speak Portuguese but knowing Spanish I can read and understand…*

Col·lecció could be classified as a direct social navigation tool where the advice–giver intends to share information. In Col·lecció, the advice-giver is part of a group who, very likely, is similar to other group members in terms of interests, profession, knowledge, or task.

The students in case study 3 were asked about their reading strategies. Not surprisingly, the article’s title was indicated as an important factor in selecting a particular article to read. Students mainly used the original article title for the title included in Col·lecció. However, some formulated their own titles. We observed that the titles formulated by the students were related to a common ground or to the task itself. For example, one of the titles was named using the topic during a discussion held in class. The original title of the Web site might be an inadequate descriptor of the site content (Abrams et al. 1998) and even if it is adequate we consider that the user could give a more informative name to the site in relation to the task in which they are involved. In fact, the most commented article (12 comments) was one of the few articles in which the users formulated its title and adapted it to the context of the task. Furthermore, this article was the one most selected by students when they were asked to select three of the articles that they liked most in the survey. According to the log files this article was also the one which students spent most time retrieving. This suggests that adapting the document’s name to the group’s goal helps users understand how that document is relevant to the group. The title of a Web page does not always correspond with the common ground of the team. Members of the group could formulate titles that correspond better to the group’s goals or to the task itself. Col·lecció requests the user to enter the title of the homepage. This is not the case of the bookmarks facilities that most Web browsers provide which automatically assume the title given by the <TITLE> tag of the Web document. However, forcing the users to create a title for the Web document might imply an additional cognitive load for the user.

Another navigation strategy mentioned by many students was the use of the comment counter presented in every item of the index of contents. For example, one student said “*I read those articles that had few comments and made a comment to them as I think that everybody should get a comment, then I read the articles that had more comments as I thought that they should be interesting*”. In some cases, navigation could also be based on how interesting students judged a particular comment: “*If I came across a very interesting comment, I also checked what articles that person had added.*” Also the interaction among the users influenced the navigation through the articles. As one student wrote “…*I read all the comments my article got. Furthermore, I got more interested in reading the articles that were included by those who had commented on my article.*” Only one student reported being familiar with all the Web domains from where the articles were taken and 62% had
bookmarked at least two of the articles in his/her personal bookmarks. All this means that the interaction of the group was influencing students’ navigation patterns in the shared space and in the Web.

### 6.5.2 Supporting collaboration

Collecting, sharing and discussing Web pages can be very important. For example, in case study 1, each URL collected by the participants was an example of the object that they wanted to design. The role of examples in any work is essential. When a participant added an e-journal Web site, he/she indicated what aspects of the site were interesting for him/her. Doing this the users helped other users focus on particular details that could otherwise be overlooked by them for different reasons. Some comments suggested strategies that the participants thought the rest should follow in order to accomplish the task. This can be seen in this example.

45) **Comment # 1 Date: 00/11/19 Time: 09:50:57**

   Luis:
   
   *I like this magazine very much, its design. We should start by collecting those e-journals that we like most indicating WHAT it is that we like: Of this magazine I like the headings that they have designed, not the homepage in general because…*

In study 3, we asked the students to choose at least three others of the students to work with in a project based on this experience. As expected, in general, they selected those with whom they interchanged comments. In addition, students that were more prolific proved to be the most popular ones. One student wrote in a comment “I think that I have learned to know some of the students a little bit better. It is interesting to see that one can know a person by the way they write and by the topic they select to comment”. This suggests that users who were not familiar with the other members of the group could learn to know each other better by the URLs they added, by the topics they selected to comment, as well as by the content of what they wrote. Even more, the user might expect others to estimate him/her through his/her comments and choice of URLs. Below is a fragment of an email sent by one of the students when looking for a partner for another lab in the same course.

   …My name is Pedro Páramo So now you can look at my articles or article comments, and see if I'm a worthwhile lab partner.

It is important that team members could find the way to create trust around them when needed. In fact, researchers can also use these criteria to determine who to work with: the two most prolific participants in case study 2 later decided to work together on an article.

### 6.5.3 Other aspects and future work

Users displayed a feeling of ownership for those links that they included in the system. In case study three, for example, several times students referred in their comments to the article they included as “my article” even though the student was not its author. When a comment is made to a particular link, the system sends an email notification to the person who included it. This might support this ownership feeling shown by the authors
One of the students stated, “I don't care who put the article but I care about the topic. So I
don't need to see the name of the people. Later on, I was looking for the articles of the
ones that added comments to my articles.” The system supports both these tasks to some
extent. It seems it would be useful to be able to switch between different modes of
organizing the index of contents.

There is potential for improving Col·lecció’s user interface. For example, when URLs are
grouped by topic, the system does not show who added each URL. While adding such a
label would be simple, it could potentially overload the information presented in the index
of content. Another improvement could be to add a URL and its title automatically with a
simple click.

There exists a potential legal problem with Col·lecció, if Web site subscribers choose to
publicly share documents for which the site owners require paid access.
7 THE PUBLIC AND SHARING ASPECT OF WEB-BASED TOOLS IN EDUCATIONAL SETTINGS

The information on the Internet is shared by or open to everyone, in a general sense. In our case studies the information in the domains (documents and comments) was disclosed to every member of the group. It was clearly identified, by using the user’s name, who submitted a document and who made a comment in the domain. Furthermore, comments and documents were persistent during the time inside the domains. This actualises a set of issues about privacy and publicity with respect to the Web information collected in these domains.

Palen and Dourish (2003) suggest three factors, disclosure, identity, and temporality as particularly important with respect to privacy and publicity because they are “conditioned by our own expectations and experiences and by those of others with whom we interact”.

The first factor is information disclosure. Citing Altman’s privacy regulation theory (1975), Palen and Dourish point out that privacy regulation is not simply a matter of avoiding information disclosure, but that “participation in the social world also requires selective disclosure of personal information”. We constantly make choices as to which information about ourselves to make known or visible to others, and which to keep private. In general, privacy boundaries are re-negotiated continuously according to different circumstances. In the context of cooperating with other people on the Web, choices about disclosure are particularly important, but also difficult. This is partly because of the wide accessibility of anything published on the Web. Even if a shared workspace on the Web is primarily designed for a limited group, there may be ways for outsiders to break in, perhaps anonymously, and for reasons that are not transparent. Having password protection of shared information is a way of preventing at least some unwanted participants from entering the space.

The second privacy factor is identity; “the boundary between self and other” (Palen and Dourish). When do we act as individuals, and when do we represent a social group? How does our professional or educational affiliation create expectations on our behaviour, and how does the design of technology affect this? Ideally, technology used for collaboration should be transparent in this respect, so that we feel certain about our roles, and can act with some confidence in the role relevant for a certain purpose. This also may shape our chance of adequate “recipient design” - the way that one’s actions and utterances are designed for and directed to certain specific others. In some situations an individual may prefer to act anonymously, but it is not clear that this choice will benefit the recipient of that action. According to Palen and Dourish, our “reflexive interpretability of action”, i.e. our ability to understand and anticipate how our actions will appear to other people, may be compromised through the use of information technology. For example, if someone else can log in under our own user name, and post messages in different discussions, it means that we no longer know exactly when and how our actions will or will not affect other people.

The third factor, temporality, is defined as “the shifting expressions and implications of disclosure and identity in time”. We will not be concerned with this issue here.
In the first section below, we present how different access modes were designed for entering into the domains that were used in the various versions of the DHS and Col·lecció systems. These modes were suggested by the experience we had from each case study and the responses we had from the users. As such, they provide a constraining framework for participants’ choices with respect to disclosure and identity.

In the second section, we summarize how users identified themselves when posting comments with respect to the name or nickname that was used. This can be associated with issues of identity; i.e. how users presented themselves to others, and to what extent they tried to protect their identity when interacting in the contexts studied.

Finally the third section presents the results of the survey with respect to two issues of information disclosure in the domains: the choice between password protection or not, and the general attitudes to sharing information on the Web.

7.1 Access modes to enter into the domains

It is normal that members of a team would like to regulate the access to shared data and that they can identify who has done what during a collaborative process. To satisfy these basic requirements participants has to “register” as user of the system by disclosing some information as his/her email address. A username-password protocol is commonly introduced before users could interact with the system. Different methods are used to accomplish this protocol. For example, both the username and password can be assigned by the system or by the user. It is also common that users forget this information. The most common support to solve this problem that Web-based systems have used is by presenting the option “I forgot my username or password.” This option will usually send the needed information to the corresponding email address, previously given by the user. A mechanism that Web-based systems have used are cookies. Cookies recognize the user who had previously accepted to be tracked and free the user from remembering the username and/or the password. This, of course, makes the user aware that he/she has been tracked and therefore identified, noted, named.

We did not want the users to feel that the system was demanding from them “one more username/password to remember” because this could diminish the use of the tools. Furthermore, we wanted the users to have the chance to make comments anonymously, having in mind that they could be more open and therefore send more comments. Therefore, the cookies mechanism was not suitable for our initial intentions and we decided not to use it.

We have tried alternative access modes with respect to the username-password protocol. One aspect focused on the username, the other on the password. To alleviate the problem

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1. The main purpose of cookies is to identify users and possibly prepare customized Web pages for them. The user has to accept it. Once it is accepted the browser send automatically the necessary information to the server to identify the user whenever later the users enters the system.

2. They could enter a fictitious name
of remembering a username, we decided to have two alternatives. In the first one no
username was needed to enter the system. In the second one, the user selected his/her
name from an alphabetically ordered list. In relation to the password we also used two
alternatives. In the first one no password at all was used. The second alternative was to use
one password for the whole group instead of having a unique one for every user. To make
it even easier to the users, we agreed that the password to be used would be the course
code that was presented in the homepage of the course. Combining these alternatives we
came out with the four modes presented in table 7.

<table>
<thead>
<tr>
<th>Access mode</th>
<th>Username</th>
<th>Password</th>
<th>Used in case study</th>
<th>To inscribe the comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jump in</td>
<td>Not needed</td>
<td>No password</td>
<td>R-group, D1998, D1999, D2000</td>
<td>Entered by the user</td>
</tr>
<tr>
<td>Jump in with password</td>
<td>Not needed</td>
<td>One password for the whole group</td>
<td>A1997, A1998, A1999</td>
<td>Entered by the user</td>
</tr>
<tr>
<td>Name selected</td>
<td>Selected from a users’ name list</td>
<td>No password</td>
<td>D2001, D2002, DL2002</td>
<td>Automatically presented by the system</td>
</tr>
<tr>
<td>Name selected with password</td>
<td>Selected from a users’ name list</td>
<td>One password for the whole group</td>
<td>A2000, C2003</td>
<td>Automatically presented by the system</td>
</tr>
</tbody>
</table>

When inscribing the comments, in the Jump in and Jump in with password modes the
name-input field of the Add Comment Window was presented blank (empty), so the user
to type in his/her name every time a comment was sent. Moreover, requesting to sign a
comment every time might increase the trust that nobody is tracking them when sending
anonymous comments. These modes were used in the first versions of the DHS. In the
version used by the case studies R-group, D1998, and A1997, if the user did not write any
name at all, intentionally or not, and sent a comment, it was still accepted by the system.
Later we made this input field mandatory.

Based on the experiences that we had of using these modes (see below), we implemented
the Name selected and Name selected with password modes. In these modes the name-
input field was automatically filled by the system with the user’s name. Note that in all the
modes the users could edit the name-input field in the Add Comment Window.

### 7.2 Identity: how users named themselves when posting a comment

In most work-related and educational contexts, computer supported collaboration requires
that members can identify each other. In the contexts studied here, the way to do this was
by entering information about who included the document in the domains and who posted
a comment. The simplest, and most natural, way of identification in text-based
communication, is by using one’s real name. The need to identify oneself was not just a
question of being responsible for one’s actions but it was also the way to show the user’s
participation, for example, to the teacher. In our case studies the need to be identified was a requirement imposed for administrative reasons rather than personal ones.

The analysis of comments posted by the users show that hardly anonymous comments were sent. There were several comments (9) with anonymous sender in all domains, e.g. “anonym”, “ghfg”, or no identification at all, but in most of the cases (7) these anonymous comments were classified as not relevant (see Section 4.3.1 on page 38). One possible explanation is that users might have known that indeed, if needed, their actions on the net could be could be identified\(^1\). In all the case studies that we have included in this analysis, users received via email the URL of the page from where they could enter the system.

To let users send comments anonymously could lead to some problems but we did not experience any embarrassing or serious situations. The list of the participants’ names was available so it was possible to determine if the comment was indeed inscribed by a member of the group or if it was sent by an outsider.

<table>
<thead>
<tr>
<th>Case</th>
<th>Unique nickname (%)</th>
<th>Two or more nicknames (%)</th>
<th>Participants that submitted at least 2 comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-group</td>
<td>5 (63%)</td>
<td>3 (37%)</td>
<td>8/16</td>
</tr>
<tr>
<td>D1998</td>
<td>16 (70%)</td>
<td>7 (30%)</td>
<td>23/26</td>
</tr>
<tr>
<td>D1999</td>
<td>6 (75%)</td>
<td>2 (25%)</td>
<td>8/10</td>
</tr>
<tr>
<td>D2000</td>
<td>12 (75%)</td>
<td>4 (25%)</td>
<td>16/18</td>
</tr>
<tr>
<td>A1997</td>
<td>7 (64%)</td>
<td>4 (36%)</td>
<td>11/15</td>
</tr>
<tr>
<td>A1998</td>
<td>9 (90%)</td>
<td>1 (10%)</td>
<td>10/13</td>
</tr>
<tr>
<td>A1999</td>
<td>3 (75%)</td>
<td>1 (25%)</td>
<td>4/4</td>
</tr>
<tr>
<td>A2000</td>
<td>8 (53%)</td>
<td>7 (47%)</td>
<td>15/16</td>
</tr>
<tr>
<td>Total</td>
<td>67 (71%)</td>
<td>31 (29%)</td>
<td>95/118</td>
</tr>
</tbody>
</table>

An analysis was made of how the users named themselves when using the Jump in and Jump in with password modes. In these modes, the Add Comment Window presented the name field in blank. Did they use their own name or a nickname? Or both? How many did always use the same name? Table 8 shows how many users adopted only one name (or nickname) or at least two different names to identify themselves in the domains, for example, Jose Rivas or J. Rivas. To build up this table, we took into account in every case study only those users who sent two or more comments. The comparison of the names was not case sensitive, e.g. “Martin” and “martin”, were considered as the same entry. Additionally, obvious misspelling errors in their names; Helgsreand - Helgstrand, Mikael-Miakel, for example, also were counted as the same entry. The protocol to do this was similar to the one made face-to-face. Very often the very first comment was inscribed with first name and last name, later the user used just his/her first name. This situation was not

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1. HTTP servers use to track the necessary information for this purpose
present in the our pilot study, R-study, in which members from the very beginning just signed with his/her first name. The reason for this might be that members of the group were co-workers.

At least 29% of all the users who sent two or more comments adopted at least two names. In general it was easy to determine that the two, or more, different nicknames that the users employed were posted by the same person. For example typing only the first name or both first name and last name. However, it could be very difficult to determine who is the sender like in the case in which one of the users used a fragment of his email address. This case was observed in the R-study. Probably the user relied on previous contact with other members, thought that others could identify him.

Although the number of users who falls in this category might not be alarming, the same would not be true in cases where the exactness of the names is of vital importance; for example if the system would offer to present the list of the comments made by a particular member of the team. This situation would be more remarkable if we consider misspelling or case sensitive letters in the names. This suggests that it is important to provide users with an automatic authentication system while they communicate in a text-based asynchronous mode.

An automatic authentication feature would provide different benefits for the user:

- The basis for filtering functions, e.g. comments posted by a particular member.
- Saving time; user will need to enter their name once per session and not every time a comment is sent.
- A security policy could be implemented, for example, a users could delete his/her posted comments.
- Private comments might be supported by indicating to whom the comment is sent.

However, using the “Jump in” modes in our system has some advantages. For example, two or more users may sign and/or write one comment together. Note that in example 46 Maria and Juan are the authors of the comment and that they used we several times in the body of their comment. This might increase the sense of collaboration.

46) Comment # 44 97/05/13 14:37
Maria & Juan:
We think that it would be nice .... We agree with Pedro when it comes to.... Moreover, we think...

These observations were the basis for the design of the two other modes that we used in our case studies, that is: Name-selected and Name-selected with password. In these modes the Add comment Window presents an input text field with the name of the user. where the user could edit it and if needed, change it.

Note that using the “Name-selected” mode any student in the class could enter the system pretending to be another student. Moreover, any student could inscribe a comment in someone else’s name as the input name field in the Add Comment Window was editable. A few students in the surveys mentioned this situation and indicated that they felt somehow
uncomfortable about it. No users reported that his/her name had been used by another person.

### 7.3 Subjetive data about public aspect and sharing

The empirical material that we collected while using the DHS and Col·lecció in educational settings has made it possible to explore how the users perceived the disclosure and identity aspects of a public space as the Web. After each case study with DHS and Col·lecció, a Web-based survey was sent to participants. It was mandatory to fill it only for the students of the CSCW course excluding the ones from D1998. A total of 97 responses to the Web-based survey were collected. The set of questions was not quite identical for every case study. The main reason was that the iterative enhancement of the system required that different questions were given so that the new features were evaluated. However, since the very first survey there was a set of questions that were common in all the surveys, aiming to explore how the public aspect of the Web was experienced by the students.

#### 7.3.1 The users

The survey was sent to the graduate or undergraduate students that used DHS and Col·lecció in our case studies that sent at least a comment. In total, all the students but one had access to the Internet from their home. The background of the respondents was diverse; physics, chemistry, computer science, etc. The 97 responses we got were distributed as follow: 20 from the WSP course (the A-case studies), 42 from the CSCW students that used DHS (D-case studies), 20 from the CSCW students that used Col·lecció (C2003), 16 from the Spanish course (DL2-2001).

#### 7.3.1.1 Experience with the Web

All the respondents indicated to have at least two years using the Web. However, almost all the students indicated not having a previous experience using a Web-based tool\(^1\) in their courses to carry out a collaborative task during a course. In the context of education, they had used the Web mainly to retrieve information from the course’s home page course (e.g. the syllabus and literature of the course). Those who indicated (12 out of 97) that they had used a Web-based tool before in a course were from the CSCW course. Students from this group were the one that had good or excellent knowledge of HTML. This was not the case for the students of the WSP course and the Spanish course. Only one reported to have good knowledge, four indicated to have basic knowledge and the rest poor or none knowledge of HTML. In general we can see the users divided in two groups as well. One formed by the student of the CSCW course whose knowledge and familiarity with the Web was greater than the other group. This other group was formed by the WSP and Spanish course.

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\(^1\) We asked them not to regard email as a Web-based tool though it could be also as the service given by http:// www.hotmail.com
7.3.1.2 Authorship

Generally speaking, our users; for both DHS and Col·lecció, can be classified in two different groups in relation to whether they were author or not of the document they included in the domain. In other words, two groups were presented. In the first group, members were authors of a document in the domain. This group was formed by students from the CSCW course not including the class that use Col·lecció and by the students of the A-case studies; students from the WSP course. In the second group, members were not authors of the document in the domain, they only discussed the documents. These were the students from the CSCW who used Col·lecció and by the students of the second language course (Spanish course).

7.3.1.3 Confidentiality

According to the survey, there is an important difference within the participants, with respect to how confidential they regarded the content of the document they included in the domain. Students from the CSCW course and the Spanish course regarded their documents or comments in the domains as non-confidential. On the other hand, students from the WSP course regarded their documents in the domain as confidential.

7.3.2 Information disclosure: password or no password

In the surveys, we asked the students whether they considered that having a password was necessary. The reply of the students could have been affected by the access mode they used giving preference to the mode they were familiar to. To back up their response they were also asked to motivate their choice.

Table 9. The groups and their characteristic in relation to authorship, knowledge background, and how confidential the information in the domain was considered

<table>
<thead>
<tr>
<th>Case study</th>
<th>Context and task</th>
<th>Commitment to the document (e.g. authorship)</th>
<th>Background knowledge using the Web</th>
<th>Confidentiality of the material in general</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-case study</td>
<td>In the WSP course commenting on fragments of research papers written by the student</td>
<td>High</td>
<td>Basic</td>
<td>High</td>
</tr>
<tr>
<td>D-case study</td>
<td>In the CSCW course commenting on a document written by the students</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>C2003</td>
<td>In the CSCW course commenting on a document written by an outsider to the group</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>DL2-2001</td>
<td>In the Spanish course commenting on a book content</td>
<td>None</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>
For the analysis of this question, we present the case studies taking into account the authorship, confidentiality, and knowledge background about using the web. In table 9 it is shown the group characteristic in this respect.

When the DHS was introduced to the very first class in the A-case studies, it was intended to work in the mode *Jump-in*. But the students asked explicitly that they wanted to have a password as they considered confidential the information to be included in the domain. Not surprisingly, the results of the surveys shows that the choice whether or not to have a password is closely related to whether the user has submitted a document that he/she is author to (see figure 18). Even when the user might not consider the material to be shared confidential the authorship played a big role when deciding whether or not to have a password. We can see that the groups where the choice was more heterogeneous were the one from the D-case studies and C2003. A total of 57% would like to have a password vs 43% who would not like in the D-case studies and 32% would like to have a password vs 68% who would not like in the C2003 case study. A possible explanation to this is that members of these groups had similar background knowledge and more experience using Web based tools and might be aware of the advantages and disadvantages of using a password to log in into a Web-based system. The task might also have played a role in this. For example, disclosing the discussion of one’s own document (D-cased studies) might be more sensitive than disclosing the discussion on a document that was written by an outsider to the group (C2003). A total of 95%, 57%, 32%, 13% corresponding to the A-case studies, D-case studies, C2003, DL2-2001 groups thought that a password was needed.

![Graph showing the number of students who would like to have a password to enter the system.](image)

**FIGURE 18.** How the students responded to whether they wanted a password or not. The data label shown represent the number of students.
7.3.2.1 Why I would like to have a password

The A-case studies’ students motivated their choice (to have a password) mainly by saying that unpublished data from their research was presented thus security was very important. They considered that the information should be only reached by members of the group. A few students were worried not only about an “outsider” reading their documents but also about s/he reading the comments that were made to their contributions. As one student said “I don’t want anyone to read the comments on my homework.” Observe that with anyone the student could refer even to other students from the class. They also mentioned that in this way they could “feel safer” and people could be “less intimidated” while working with the system. Another participant motivated the reason why a password was needed by saying “So my ‘superb’ writing can not be seen by people not attending the class”. This suggests that the users were not only concerned about the content of the homework but also about how someone else could regard his/her writing skills. Furthermore, it shows that the student might be ready to accept comments only from other students in the same class.

The students from the D-case study motivated the preference of having a password in a different way. The main two reasons were 1) because in that way more functionality could be added to the system and 2) to avoid name usurpation when making a comment. Several also mentioned that in this way it could be ensured that the information in the system was indeed coming from one of the members of the group. Namely, the users could trust that the information included in the system was indeed posted by one of the members. All this would make users more confident. For the students in the C2003 the most important was to avoid name usurpation and also they indicated that more functionality could be added to the system. Finally for the students in the DL2-2001 the reasons given were to avoid name usurpation and to ensure that only members of the group could access the discussion.

7.3.2.2 Why I would not like to have a password

In the A-case study only one respondent indicated the he would rather not have a password. He motivated his choice by saying “I have to remember so many passwords nowadays that I have to carry with me a list …” In the D-case, this was also the main reason given by respondents. Many from C2003 and DL2-2002 justified the lack of a need to have a password by saying that the information that was included in the system was not confidential, so no protection was needed. Nevertheless, a few of them added to their negative response that if the information would have been confidential, a password would have been needed.

Students from the D-case studies and C2003 focused also on technical elements that were supported by their computer science background. For example, it was indicated that the number of participants was an important factor to take into account when deciding the security level of the tools they used. A common comment that backed up the position of not having a password to enter the system was that they indeed met the other participants during the class. One student said “As we met regularly in the classroom, I did not feel the need to have a password, the risk that someone could do things under someone’s else name feels too small.” One of them indicated that since the URL to access the system was
known only by the participants, then it was unlikely that an “outsider” could enter the system arguing that guessing the URL was almost impossible.

### 7.3.3 Sharing on the Web using DHS and Col·lecció

The possibility to share documents and comments using DHS or Col·lecció on the Web is, at first glance, an advantage. We wanted to know what the students thought about this. So, we asked the students to mention the advantages and disadvantages of sharing the documents on the Web to discuss them. When answering this question, some students evaluated some functionality of the system (e.g. sending email notification, possibility to view the document and the comments at the same time, the use of frames). I have excluded these evaluations as they do not really address the point of the question. The following topics (ordered by frequency) were mentioned in the answers.

#### 7.3.3.1 Advantages

1. **All at hand from anywhere in one place.** Students valued the fact that all the documents and discussions were in one place and that they could access them “at a click”
2. **The ubiquitous aspect of the Web, accessible wherever- whenever.** I have time and plenty of time. I can always take part in the discussion if I want as I do not have to wait to take the floor.
3. **No need to coordinate with others students to interact with the system or to meet them to swap the texts.**
4. **A great number of examples (documents and discussions) to explore, which gives a possibility to learn more.**
5. **The current version is available to the whole group.**
6. **The possibility to interact with more students in the class than when using in-class methods.**
7. **Avoiding repetitions.** As one student wrote “You see all comments and you do not need to make the same comments as everybody else”. Another student from the C2003 said “I noticed that someone else had added the article I wanted to add so I looked for another one”
8. **Creates a space with the opportunity to “collectively build a large database of relevant information”**
9. **Easier to be critical than in a face-to-face meeting**

#### 7.3.3.2 Disadvantages

1. **You miss the personal discussion (oral).**
2. **Anyone** can read everything posted.
3. **Comments on documents written on paper can be richer.**
4. You need a computer and Internet connection
5. You miss the personal contact. Some people might be interested to know how the person you are writing to looks like. In this way it is too impersonal.
6. Extra work as one might like to write one’s comments on paper first and then they have to be “uploaded” to the Web.
7. Making comments on a computer is not that common, some people might have problem to give comments just because of that.

7.4 Conclusions

It is clear that the level of security that the user would like to have to enter the system depends on how confidential he/she regards the information in question. To show others what one has written oneself might be a sensitive question. We see that in the task in which the students wrote a document to be shared using the system, a great number of the students considered that a password was needed. On the contrary, when the students did not write the document to be shared, many considered that no password was needed. Publishing on the Web could present some legal aspect, moreover. One student said that she did not dare to include in the system a fragment of a paper that had been accepted for a conference because the conference required upon acceptance copyrights to the publication. She said that “any search engine” could find her document on the server and make it “reachable.” In this case, it was not enough for this student that the system required a password to enter. A possible solution to this problem is that the system could encrypt their documents.

To share information on the Web can be of great benefit, but there are also factors that can be negative. It is important to observe that the social interaction that the student had in the real world (in the classroom) was complemented and influenced by their interaction in the virtual world.
Designing, evaluating and exploring Web-based tools for collaborative annotation of documents
8 COL·LABORACIÓ: A WEB-BASED COLLABORATIVE WRITING TOOL - SUPPORTING DIALOGUE

8.1 Introduction

From the experiences of the DHS prototype, many ideas for more refined collaborative tools were brought out. We decided to go on using the document as the main entity, while the goal was now specifically to support collaborative writing. Furthermore, Kim & Severinson Eklundh, (1998) focused on collaborative writing practices in academic settings. The results pointed especially at the importance of communication among co-authors, and the need for a good network infrastructure for sharing common documents within a group. Col·laboració is a collaborative writing tool that uses the Web as its infrastructure. It supports document sharing and takes into account the need for dialogue which co-authors might have during the writing process. In this system, the communication among co-authors is text-based. Col·laboració inherits several features from the DHS, among the most relevant ones we find making annotations to Web documents, sending email notification to co-authors for relevant events, and the screen layout of the system.

It is important to bear in mind that in the system Col·laboració the term document is treated in a particular way. A document is defined in this study as follows:

- A document is a set of HTML files related to each other. Each HTML file represents a distinct self-contained portion of the document called section. A section, being a separate file, can be added, changed, or deleted independently of the other sections. Merging the sections produces the document as a whole.

Col·laboració presents the document to co-authors displaying the titles of its sections which are hypertext links that show the section’s content. It also allows co-authors to work on different sections simultaneously. It should be stressed that the system is not designed for the transcription of the document to be produced. Rather, it supports sharing of the document and the discussion among co-authors that the production of the document might demand.

We also rely on the possibility that word processor systems have today of transforming the format they use to save document into HTML format and vice versa. Indeed, we expect the transcription process be done with the author’s everyday word processor. The general idea is that the section’s content is produced by the co-authors and then included in the system for the planning and reviewing stage. The results of these processes are reflected in the new version that the co-authors might produce using their word processor and then include it in the system. Every co-author could work on any the document’s section and edit it.

The structure of a document could be complex. Representing the structure of a document as a graph, we can assume that every section of a document is a node in the graph. A
document’s hierarchical tree structure could be both deep and broad. However, there are certain kinds of documents that have a relatively simple hierarchical tree structure, that is, shallow and narrow. Research papers often belong to this type of document. They usually have a fixed content format i.e. introduction, methods, results, and discussion. I have restricted myself to studying collaborative writing tasks of small groups using the Web to produce documents that have a simple hierarchical tree structure. This study addresses (a) the communication needs co-authors might have during the writing process, (b) how they made off-side annotations in digital format using a split-screen interface, (c) the characteristics of a text-based communication in a collaborative writing task. The intention is to gain new insights into the design of the development of Web-based collaborative writing tools.

8.2 The Author-Document-Author workspace

Our approach to building a collaborative writing tool on the Web needs a shared workspace for co-authors. A graphical representation of the shared workspace consists of the illustration of nodes of two types: 1) document nodes, and 2) author nodes (see figure 19). These nodes might be related to each other but two nodes of the same kind cannot be related directly. In other words, a document node can be related to an author node but never directly to another document node. Document nodes must have at least one relation, namely, related to at least one author. Author nodes can be directly related to document nodes or stand alone. A stand alone author node corresponds to an author who is not co-authoring a document (yet). This would be the case when a new author node is added to the workspace (see figure 19a). The documents are therefore the elements shared between co-authors.

Col·laboració uses the concept of the graph, a well-known data structure representation, to personify different views of the shared workspace. The type of node taken first determines

![Graph representation of the shared workspace](image-url)
the process that Col·laboració uses to build up the sub-graph. Consequently, there are two processes.

In the first, say that a given author node is the first node that is taken. All the documents connected to this node are presented on the second level. Finally, all the authors’ nodes connected to these documents form the bottom level of the sub-graph. That is, we have a three-level graph counting the root as level one. We named this the author-document-authors graph, see figure 19b. The system uses this when a co-author enters the system.

The second process assumes a given document node as the taken first to build up the sub-graph. In this case only a two-level graph is built up as author nodes become the second generation. We named this the document-authors graph. This is used by the system to determine who are the document’s co-authors, see figure 19c.

8.3 Description of the system Col·laboració

In the next few sections I will describe the system Col·laboració with two modules:

1. **The document development module**, which is directly related to the development of one document (adding a section to a document, editing the document, and adding a comment to a section, etc.). This module has been implemented, tested, and evaluated.

2. **The author management module**, which handles the authors’ objects in the shared workspace (i.e. creating a new document, joining as co-author to a document, and setting preferences). This module does not handle changes in the document itself. This module has not been fully implemented yet nor evaluated.

8.3.1 Description of the document-development module

Col·laboració borrows the layout from the system DHS. There are two important differences here (see figure 20). Generally speaking, the index frame contains links to the sections of the document. In other words, the index-frame reflects the structure of the document. The other change is in the command-frame that has several commands in addition to the “Add comment” command it.

8.3.1.1 The index frame in Col·laboració

In the system Col·laboració, the index frame is divided into three parts: (1) the title of the document; the only item of the list that is not a hypertext link, (2) the standard areas part, and (3) the document’s sections part, made up from the different sections’ titles. The links in the standard areas part are added automatically by the system when a document is created and the sections in the document’s link are added by the authors as the document is developed. Also, a short text input field is presented at the top of the index frame. It is used to inform co-authors which section was last activated by showing its title in that field. As in DHS, every hypertext link shows the number of comments a section has received so far.
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by the comment counter tag. Next, I will describe the three elements that constitute the standard area part and discuss the reasons why we decided to include these elements here.

The standard area part

From our initial experience using a draft of the system, it was clear that there were some common areas that should be present for every document that was going to be produced using this system. I have called this the standard area part and it is made up of the “About this prototype”, the “Version of this document” and the “Ideas for this paper” link. In this part we have three items of the hypertext link list.

The “About this prototype” link

The “About this prototype” link shows a document that briefly describes the features of the system and how to use it. It is a default section that is loaded when the user enters the system. It also provides a list of known problems related to the system and how to overcome them in order to support the users. Because of our experience in the case studies for the system DHS, we know that many users feel the need to make comments, not on the document content, but on the system they are using, in this case Col·laboració. A similar finding was made by Mhashi, Rada, Beck, Michalidis, & Zeb, (1992) in a study about the

FIGURE 20. The screen layout of the document-development module

The standard area part

FIGURE 20. The screen layout of the document-development module

The standard area part

FIGURE 20. The screen layout of the document-development module

The standard area part
use of a discussion system as an annotation system. A great amount (75%) of the comments they analysed were of an administrative matter (see Ideas for this paper below) and system-specific type. Thus, the “About this prototype” section is intended to receive co-authors’ comments on the system. In this way we could keep the comments relating to the system and to the contents of the document in separate spaces.

The “Version of this document” link

Using Col·laboració co-authors may work sequentially or concurrently on the document and all of the users may modify the document. Thus, there must be some form of version control. The system provides a facility to create a version of the document or any of its sections. We decided to separate the version management section from the rest of the document. The second link in the standard section part is the “Versions of this document”. The activation of this link displays a document that has a list of hypertext links that can be activated to show each version made by the co-authors.

The “Ideas for this paper” link

The third link in the standard sections part is the “Ideas for this paper” in which co-authors may have a discussion about the writing task. A discussion of the document as a whole is often needed. In this section co-authors could discuss co-ordination matters, administrative aspects, as well as the content of the document to be produced. The particular objective with this section is to improve performance by offering a shared space for co-ordination in distributed decision making. Co-ordination is informally defined as the activity of interdependent agents making harmonious, non conflicting decisions (Malone and Crowston, 1990). Interdependence means that, in co-operative settings, activities flow from one individual to another, in our case from one co-author to another. This space is used mostly for communication of plans, to consider the ideas that co-authors have for the content and the structure of the document. Communication of constraints is used to refine co-authors views of the goals and in this way increase the likelihood that co-author will generate a compatible product (Neuwirth, Kaufer, Chandhok, and Morris, 1990).

8.3.1.2 Commands of the system

Create a section. When this option is selected a separate window is opened in which the user can enter (1) the name of the section, (2) the email addresses of the co-authors that are responsible for it, and (3) the section content. The system will update the index frame, appending the new section to the document section list. The email address is used to broadcast when a comment/change has been provided to this particular section. If no email address is entered, the email notification will be sent to all co-authors.

Add a comment. Comments can be attached to every section of the document. When this option is selected a separate window is opened in which the user can enter his/her comment. These comments can include HTML tags. When a comment is sent, its content is also sent via email to the co-authors.
Edit a section. Co-authors can make changes to the content of the document. This option will show in the document section frame the HTML source of the section. Any changes made to a particular section will be available to the rest of co-authors immediately. This function is more suitable for minor changes in the section, because the editing environment is simple.

Delete a section. This option updates the index frame and erases the link that was specified from the active document section. Co-authors cannot undo this action, only the editor of the domain can do it.

Change position of the sections. If co-authors need to change the sequential order of the sections they can do so by using this option. For example, if the “Abstract” section, in a scientific paper, is created when the introduction section already exists, it can be moved to the first position of the document section.

Make an overview of the document. Co-authors can select different sections of any particular document to have a personal view of the document and their comments. The order of the sections will be kept in the same sequence they have in the index frame. The “Ideas for this paper” section can be included here. Also, this overview presents the information in a format suitable for printing, e.g. it provides a margin in the hard copy.

Make a version. The system gives the possibility to create a version of the document. Being the document a set of sections, it is possible to save a version of one or more particular sections of the document. Furthermore, it is possible to append the comments that have been made to the section included in the version. A version can be also created for the purpose of saving a back-up copy of it.

8.3.1.3 Logging function

The system has a log file feature that registers every change that is made on the browser of the user using the system. Once a commands is executed in the system (see previous section) it is registered in the log files.

8.4 The author management module (AMM)

In this section a complement module to the system Col·laboració is presented. Though it is not fully implemented, it has been defined to supplement the work that has been done so far. This section assumes that the AMM would be integrated with the previously presented module, the document development module.

Once an author enters the system Col·laboració (login-password based) it will present a view of a shared workspace. This view is automatically generated using the author-document-authors graph that the system builds using the author node. In other words, the first level of the graph is the author who entered the system (see figure 19). This can be compared to a folder in which each author has in their possession all the documents to which they are a co-author. Figure 21 shows a picture of an author’s management module.
8.4.1 Information given in the AMM

The following information is presented in the form of a table for each document to which the author is a co-author:

1. The title of the documents he/she is producing in collaboration with others. This text also works as a hypertext link that activates the document development module for that document.

2. When the document was created, the last time any of its section was modified and the last time the author activated the document development module for this document.

3. The co-authors’ name list for that document. This list names the co-authors and activates a script that allows the author to select in a flexible way to whom an email will be sent as an awareness mechanism (this will be explained later).

Additionally, the commands (see next section) that the user can perform from the AMM are also available.

8.4.1.1 Commands that can be made from the AMM

To create a new document

Graphically, creating a document in the system Col·laboració means adding a new row to the author management node table (see figure 21). An author creates a new document and 1) inputs the document’s title and 2) selects the co-authors from the list of all authors registered in the system.
Once this is done, all selected co-authors will be sent an email inviting them to participate. Upon acceptance, the AMM will be updated for the rest of co-authors indicating his/her acceptance. When this confirmation arrives, the name of the co-authors will be labelled properly to indicate the waiting status.

**Join a document**

Authors can join active documents at any moment, that is, become co-author for that document. To take this step, one of the previous co-authors has to invite the new one.

**Edit profile**

Authors can edit their profiles and set up their preferences for each document. This includes to which email address they want to receive their awareness messages and which label the email address should have (see below), how often they want to get notification via email, which font/colour they would prefer to use for their comments, and the preferred size of the pop-up windows. The system Col·laboració offers authors the possibility of putting an author-defined label on their email address.

The profile can be set up in three levels. The first is the general one. These values will be set up as the default for the author’s preferences. The second level is set up for a document as a whole. Finally, the third level can set up preferences for a particular section of the document.

**8.4.1.2 The use of email in the AMM**

Supporting communication between distributed participants is important. Email is well known because it is “the most widely-used computer application today for person-to-person communication” (Bälter, 1998). Furthermore, using the Web as infrastructure, as Col·laboració does, allows the members of the groups to use email as a channel of communication. In the next section, I will present two modifications to the use of email designed to improve communication, and thus the productivity of the distributed groups.

**Multiple labels on the email address**

Generally, the format of an email address could be structured as: label <email_address>. The email_address field is given in the following way user@domain, where the fields user and domain are mandatory. In most cases the email address label will reflect the name of the user (at least in institutional settings). However, the label might be any text.

The idea presented here is to use different labels in the email notifications that Col·laboració sends. These labels would support co-authors organizing their incoming email notifications. Most email programs contain filtering functions that help users structure their email messages. Filters use the information contained in the message itself, either in the header of the email (e.g. To, From, Subject). Filters aim at lowering the user effort in the identification of messages for later processing. Filtering can be triggered
automatically for incoming messages with the help of the email program’s filtering function. These filters can, for example, group the messages by automatically moving an incoming email to a specific folder.

The non sequential patterns of related messages (Palme, Karlgren and Pargman, 1995) is one of the problems that the use of filters faces. As we said before, Col·laboració sends email notifications to co-authors automatically. As this is done automatically, it can be assured that a sequential pattern of related messages would be satisfied. On the other hand, email notifications sent by Col·laboració may contribute to an increased stream of messages for the co-authors. According to Palme et al., applying a filter to a stream of messages reduces information overload. To illustrate the idea, consider this scenario:

An author in the shared workspace might be the co-author of several documents. Suppose Author A, is a co-author for document D1 and D2. If the system sets the email notifications as “D1 <collaboracio@domain>”, and “D2 <collaboracio@domain>” respectively. Using the filtering function, the incoming email messages can be placed automatically in different folders. At least the label D1 or D2 will notify to the recipient that the email is related to the co-authoring work that he/she has taken part in and further, which document the message refers to. A more detailed level can reached. The subject of the email notification indicates the section from where the comment was produced e.g. “Comment on section Abstract”. For example, a filter function could place all the incoming emails sent from document D1 and related to the Abstract section in one particular folder defined by the co-author.

**A flexible mailing list**

The co-authors’ list for each document in the AMM is a hypertext link list which activates the email application from the author management view (activating the mailing program connected with your Web browser). I have designed a flexible mailing list. The term “mailing list” derives from the conventional feature that most email programs have, in other words, sending an email to many individuals under a single email address. It is flexible because, by selecting a checkbox, users can easily set up a subset of members from a pre-set participants list. It is worth noting that all members of the list can be selected with one click. Although selecting a large subgroup from the list could be cumbersome, it is important to bear in mind that this script is designed for small groups (2-9 participants). In figure 21 we find a co-authors group formed by Pedro, Mario, Carlos, Miguel and Hector Zeal. Using a flexible mailing list, Hector can send an email to a subset of the co-authors (e.g. all but Carlos - say the others are preparing a surprise party for Carlos, see figure 21). Using a mailing list it would not be possible, because the email would be sent to all the members of the group, not allowing the sender to select a subset of members. To do that, users would have to create a new mailing list (e.g. make a copy of the original mailing list but excluding some people), or search in their address book for the email addresses of the co-author and add them to the email. Note that this subset might be relevant for just one message and the effort that has to be put in doing that, using a mailing list or the address book, might discourage users from sending the email.
8.5 Case studies of Col·laboració

The Col·laboració system has been used to support collaborative writing in eight different tasks in which 2-9 co-authors took part. Table 10 presents the case studies in which Col·laboració has been used so far.

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Co-authors</th>
<th>Duration (days)</th>
<th>Co-located or distributed</th>
<th>The task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poster A</td>
<td>3</td>
<td>23</td>
<td>co-located</td>
<td>To design and write the text for a workshop poster.</td>
</tr>
<tr>
<td>Report Alpha</td>
<td>2</td>
<td>24</td>
<td>distributed</td>
<td>The author had to write a technical report. The author and the reviewer were located in different countries.</td>
</tr>
<tr>
<td>Report Beta</td>
<td>9</td>
<td>42</td>
<td>co-located</td>
<td>To write a 10-section technical report. Co-authors were responsible in different sections in sub-groups of 2-3.</td>
</tr>
<tr>
<td>Poster B</td>
<td>3</td>
<td>6</td>
<td>co-located</td>
<td>To design and write the text for a conference poster.</td>
</tr>
<tr>
<td>Masters’ thesis proposal</td>
<td>2</td>
<td>22</td>
<td>distributed</td>
<td>The author had to write a Masters’ thesis proposal. One reviewer participated. Both were co-located in different places in the city.</td>
</tr>
<tr>
<td>Flyer</td>
<td>4</td>
<td>11</td>
<td>co-located</td>
<td>To write a flyer for a presentation in a conference.</td>
</tr>
<tr>
<td>Workshop</td>
<td>4</td>
<td>15</td>
<td>distributed</td>
<td>Co-authors had to write the final report for an international conference they had participated in.</td>
</tr>
<tr>
<td>Short paper</td>
<td>4</td>
<td>24</td>
<td>co-located</td>
<td>To write a short paper (two pages) for a conference.</td>
</tr>
</tbody>
</table>

The case studies are presented in chronological order. The duration of the case studies is counted in relation to the date of the first and last registered comments that were made to any of the sections apart from the ATP section. Another unit of measurement in this study is the number of words that the submitted comments contain. I decided that the number of comments is not sufficiently a representative unit because the length in words of the comment found in the system varies from two to 800. That is why I decided to complement the number of comments unit with the number of word in the comment. Also, the number of words closely represents how much was “said” in a text-based communication. The number of words can also give some information about the participants. For example, it could indicate how active a co-author was during the task and in which sections of the document s/he was participating. In the result that I present, all the counting refers to the number of comments and number of words in the comments.

It is also important to indicate that in all the case studies the developer-programmer was following the discussion that was supported by the system and giving technical support to the co-authors or was one of the co-authors. Also, problems reported by the co-authors were tackled immediately after they were sent in the form of comments in the ATP document. Co-authors gave suggestions too, some of them implemented after the task, so the system was iteratively improved after each case study.
In none of the cases, the final formatting of the document was done within Col·laboració. By mutual agreement one of the co-authors took the current version from the system and finished the document using a word processor. Email awareness for each case study was set up in different ways. Generally, all co-authors were coupled to all sections of the document. Thus, they received an email notification when a comment was added to a section.

In total there have been 14 participants who have used the system in real cases as co-authors of documents. All of them are experienced computer users and are familiar with the Web and Web-browsers. They had experience in writing and most of them had previously published a report or a paper in collaboration with others in an academic environment. Two of them were undergraduate students and one was from the industry. All the others (11) had a PhD. or were graduate students. Three of the participants were part of the project that supports the development of Col·laboració. Two of them participated in six of the eight case studies and the third in seven.

It has not been the purpose of this study to analyse the content of the document produced or its evolution during the writing task. Rather, I wanted to study the communication and the characteristics of the comments that the co-authors produced during these studies. Overall, we have divided the comments that were found in each case study into three categories. The first is related to the system itself. Most of them are found in the ATP section. However there were very few cases in which the co-authors placed a system-related comment in another section different to the ATP. I have included those comments as part of the ATP and the number of words for each section was counted after the “transposition” of the comment. The second category is the one related to the “Ideas for this paper”. Comments that were found in this section are related to the document as a whole. No misplaced comments for this category were found in those case studies (7 of 8) in which this section was included. In the third category are those comments that were made under the context of the document’s sections.

The case studies will be presented initially in a brief way presenting the method and quantitative results of the studies. Later, in section 6, I will discuss the results and the communication process of all the case studies.

8.5.1 Case study 1: Poster A

8.5.1.1 Method

This was the first study in which we used Col·laboració. It was done in June 1998 and lasted 23 days. Three co-authors took part in this task, all based in the same research department. The task was to design and write the text for a poster about one of the projects in which they were involved. Additionally, the co-authors were interested in the design of collaborative writing tools and had experience with such tools. When this case study was performed, Col·laboració included only one of the standard sections: the ATP section. That is, the “Ideas for this paper” and “Versions of this document” were not part of the sections of the document in the system. Co-authors decided to communicate as little as possible
using other channels, i.e. face-to-face, when they were going to discuss the task. At this time the system did not keep a log file of the actions co-authors performed in the system.

8.5.1.2 Results

The co-authors created seven sections and sent 38 comments that contained almost 3,000 words. One of them created a version of one of the sections as a section itself in the document. This was the only one that did not get any comment. The other six sections received at least one comment. However, only 18% (524) of the words were comments on the document's sections. Most of the conversations co-authors held using the system related to the system itself and 82% of the words they produced during this task were related to the ATP document.

As can be see from figure 22, the document's sections were almost un-attended by co-authors. Instead they were discussing the system itself. This is probably a consequence of their unfamiliarity with the system and certainly of the interface-related problems the system presented at that time.

8.5.2 Case Study 2: Report Alpha

8.5.2.1 Method

The task in this case study was to write the final report of a project that had run for two years. The two co-authors were located in two different countries in the same time-zone. Both co-authors had experience of the system. One of the co-authors was acting only as a reviewer of the report. All the task-related communication was done through the system. It
lasted 24 days and in this case study we had all the standard sections mentioned in section 3.1.2. At this time the system did not keep a log file of the actions co-authors performed in the system.

![Graph showing distribution of words and comments in the case study 2](image)

**FIGURE 23. Distribution of the number of words and comments in the case study 2**

### 8.5.2.2 Results

Co-authors produced about 5,700 words in the 70 comments that were sent in. The report consisted of 12 sections. Five of the sections did not receive any comments but this might be because the information they contained was not worth discussing at that time during the writing task. The title page, appendix, and conclusion were some of these non-commented sections. Seven of the sections were commented upon but this discussion occupied only 23% of the words (1,300). The ATP document was the most discussed topic with 43%. The “Ideas for this paper” section got 34% of the discussion. Two of the comments had embedded pictures and some of the comments used HTML tags.

### 8.5.3 Case Study 3: Report Beta

#### 8.5.3.1 Method

Nine co-authors took part in the production of the annual report of a project they had been working on. This project focused on four different areas, each constituting a separate sub-project. Eight of the co-authors were located in the same department and only three of them had previous experience with Col·laboració. These three co-authors were involved in the same sub-project. The use of the tool was decided on a meeting that the group had, when they were also informed how to use the system. The report was divided into 10 sections. Four of the sections were the description of the sub-projects and the other six
were more global, for example, the introduction, references, connection between the sub-projects, etc. Each section was supposed to have been written by two or three co-authors, according to the project that the section described. The awareness notification sent by email was set up in this way: those who were responsible for one section (or project description) were to receive an email when a comment was added or a change was made to the section for which they were responsible, whereas for the sections of the document for which they were not responsible they did not receive any email notification. For the section “Ideas for this paper” the system sent an email notification to all co-authors when a comment was added to it.

After the task co-authors were asked to answer a Web-based survey to evaluate the system, to determine which other channels they used to communicate, whether they had read others’ sections, and which tools they used in combination with the system to perform the task.

8.5.3.2 Results

![Bar chart showing distribution of words and comments in the case study 3](image)

**FIGURE 24. Distribution of the number of words and comments in the case study 3**

Throughout 42 days this task was mediated by Col·laboració. Co-authors produced 63 comments in total with 3,300 words. Though the percentage of words relating to the ATP document was less than twice that of the first case studies, this section were still the most commented on (in number of words and comments). Again, the “Ideas for this paper” was the second most commented section and included 26% of the discussion. The next most discussed section was that of the three co-authors who had previous experience. This section included 21% of the discussion. The “Ideas for this paper” section was now used as a co-ordination point. The leader of the project required actions, sending comments to this section. The project leader submitted nine of the 15 comments that were related to this section.
8.5.4 Case Study 4: Poster B

8.5.4.1 Method

Three co-authors that were familiar with Col·laboració used it to produce a poster for a conference. They came from the same department. One point worth noting here is that the deadline for the poster submission was close. Co-authors worked for six days on the poster text using this system.

8.5.4.2 Results

The ATP section included only 12% of the discussion, possibly because the co-authors were familiar with the tool. The comments on this section were mainly related to enhancements suggested by the co-authors. Only one error was reported which turned out to be a Web-browser problem. Co-authors produced 3,017 words in a period of six days. The “idea for this paper” section included 45% of the discussion while the rest of the sections contained 43%. Five sections were created and the co-authors commented on four of them. Two of the sections were commented on very briefly, just to indicate that they were fine. Figure 25 reveals that co-authors concentrated more on the task than the system itself in this case study. A summary of one Web site was included as part of one of the comments (it was a guide about how to prepare a poster). Additionally, a hypertext link was also part of that comment. One point to make is that using Col·laboració, co-authors could easily include external information that might be helpful for the task's accomplishment and that a hypertext link might be seen as a “window” to the world of information that the Web offers today.
8.5.5 Case Study 5: Masters' thesis proposal

8.5.5.1 Method

The task in this case study was to write a Masters' thesis proposal (about four pages long) at a technical university. The student had a technical background and was familiar with Web-based applications. The student was trained in the use of the tool for two hours, after which he claimed to understand how to use it. The supervisor had also used it several times before. The student had no reward for participating in this study and initially produced one draft which the supervisor revised. Later the student updated the section according to comments made by the supervisor, revised it himself and communicated his comments through the system. After the task the student was interviewed in order to evaluate the tool.

8.5.5.2 Results

As shown in figure 26, the discussion around the “ideas of this paper” fell to 16%, the ATP section got 23% and the rest of the sections included 61%. The duration of this case study was 22 days. Co-authors produced about 2,700 words in 27 comments. Despite “Section 2” having only three comments, it was the section that included most of the discussion, with 48%. This supports my decision to use the number of words also as a reinforce unit of data analysis for these quantitative results. In this case the number of comment would have not been representative. In this case study we also found a hypertext link that pointed to a Web site that was related to a writing guide. The student said that the tool was easy to use though found that the editing function of the tool was difficult to use and laborious. That is why he avoided to do that using the Edit section command. He also indicated that it was very convenient to have the discussion on the Web and have access to it from
“everywhere”. The email notification feature was valuable indicating that he could read comments as soon as they were made. He added that it would be good to have the possibility to reply to the email notification and that the content of the reply be added to the corresponding section in the system.

8.5.6 Case Study 6: Flyer

![Case study 6: Flyer](image)

FIGURE 27. Distribution of the number of words and comments in the case study 6

8.5.6.1 Method

Four co-authors together wrote a flyer for a poster that was going to be presented in a conference. The text of the poster was produced in the case study 4, that is, Poster B. Co-authors had access to the sections and comments they had produced using the system when writing Poster B. Three of them were familiar with the tool and all of them were located in the same department. The new user was trained personally to use the system until a global understanding of the tool was reached. Co-authors started to revise the text. In other words, co-authors were working on a text that was already written. The group had to produce a one-page document that was going to be handled during the poster presentation in the conference. This flyer could include more detailed information than was possible to include in the poster.

8.5.6.2 Results

During eleven days the co-authors produced almost 4,000 words included in 64 comments. The most commented section was the “Ideas for this paper” with 58% of the discussion and only 16% of the discussion was dedicated to the rest of the sections. Closer examination of the comments found in the “Ideas for this paper” section reveals that a lot of effort was put into defining what information was going to be presented, and in which
order. It emerged that an old comment, made during the previous task of the Poster B, was used in this task as well. One of the co-authors copy-pasted it. Hypertext links were used here, four in total. Two pictures were also embedded in the comments.

8.5.7 Case Study 7: Workshop

8.5.7.1 Method

In an international workshop assignment was to write a report in group. This report was supposed to be written within one month after the last meeting of the workshop. Four of their participants formed a group and decided to use Col·laboració to mediate the writing task. Two of them were located in Europe and two in the USA. One of the co-authors had experience with Col·laboració and all of them had good knowledge of Web-navigation and. They communicated also via email. The leader of the team had been chosen during a face-to-face meeting while the users were in the workshop. Questionnaires before the use of the tool were given to participants to determine co-authors' computer literacy, writing experience, and collaborative writing experience. Post-questionnaires were also used to understand what happened during the task, and to evaluate the tool. At first, the co-authors used the system for one week, to learn how it worked. After this period they started to write the report. Each team member was responsible for the writing of one major section of the paper.

8.5.7.2 Results

This was the only study with “outside” participants, that is not from our department. This case study was the one that presented the least number of comments and number of words. The 21 comments included 1,838 words. Seven sections were created by the co-authors.
The “Ideas for this paper” was the most commented section. The leader of the group was the only one who submitted comments in this section. Only 11% of the discussion was related to the document content. This might be because of the nature of the task: each team member was responsible for one part of the document, so the need to discuss the content of the section was not high. They were mainly exchanging information and co-ordinating their efforts. The number of emails sent by the group was 67. The leader of the group sent almost half of them (34).

In the email text there is no evidence that the document content was discussed. One of the co-authors reported in the post-questionnaire that “we did not succeed in discussing the text, which is a sign of failure”. The ATP section included 15% of the discussion and two errors relating to the tool were reported, which were solved soon after being reported. Co-authors mentioned that face-to-face meetings are needed before the outset of a collaborative writing task, and that the motivation for performing the task was too low. The use of email was also a problem when exchanging files. They reported not being able to open some of the files sent by another member's team related to this task. An important error happened in this task: for some unknown technical reason Col·laboració sent the same comment 50 times via email to the same user, who found this annoying. The situation has not been reported again. One of the co-authors reported that Col·laboració was “dragging out the process a lot longer than needed” and another reported that using the system made the task even more difficult to accomplish because they had deal with a new system and eventually forced to use another technology.

8.5.8 Case Study 8: Short paper

8.5.8.1 Method

A short paper (two pages) to be submitted to a conference was the task that four co-authors had to accomplish using the system. All of them had had previous experience and were located in the same department. One of the co-authors worked on the task for a week in another country in the same time zone. The comments made by co-authors were parsed to pick out quotations from the text of the short paper. The quotation text was identified as such if the text included a quotation mark (“,”) as it is shown in the example 47 (see below) or when the co-authors in the comment makes it clear that the discussion is about the content of the section. In example 48 the co-author refers to the use of the word GroupWare found in the text of the short paper. These are two example that presents fragments taken from the case studies.

47) “When a comment is added to the system, it is sent also via e-mail”. This sentence seems interrupted.

48) I would not call GroupWare (Groupware like software, hardware, the capital W is not needed) a technology.

8.5.8.2 Results

This was the most discussed document produced by Col·laboració in terms of words. Through the system co-authors exchanged 93 comments that included 6,808 words in 24
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...days. Five sections were created and four of them were commented on. In the comments were found images and formatted text with HTML tags, used to highlight suggested changes by co-authors when playing the role of reviewers. In the discussion of the sections' content of the document, co-authors made 35 quotations of text. One of the comments contained a link to the conference Web site where detailed information about the requirements for a short paper was given. The number of words (for a section or paragraph) was an important factor that the co-authors used several times in their discussion. This was probably because of task-specific space limitations. I found also that co-authors were co-ordinating face-to-face meetings through the system.

8.6 Discussion

Col·laboració, as it has been said, is a Web-based tool that aims to support communication among co-authors. From the case studies three important observations can be made. The first one is that the amount of words co-authors dedicated to discuss the system (the ATP document) decreases drastically if we compare the first case study (Poster A) with the last case study (Short paper), from 82% to 13%. The most obvious reason might be the fact that those who used the system knew that we were developing a Web-based tool and it is logical that participants give some comments to improve the interface. Additionally, the very first versions were very simple and not thoroughly tested, therefore it was easy to find bugs and errors. Improvements to the system occurred after each case study. Most of the errors that were reported by co-authors were solved and many of the enhancements were implemented as well. Also, the participants gained more experience with the system and therefore they could cope with previous problem that the system presented and that were not solved by then.
It is worthwhile to highlight that in the case studies “Masters’ thesis proposal” and “Report Workshop” new users took part in the writing task. It could be expected that the new users could have more problems with the system that those who had used it before. Therefore, more activity in the ATP comment space could be expected. However, the activity in the ATP document was not that high like in the first case studies. The percent of the number of words produced on the ATP document did not exceed 23%. We also have to bear in mind that many of the comments related to the system were made to suggest an improvement of the system interface.

The second observation to be noted is related to the “Ideas for this paper” section. This section appears to be really needed in a collaborative writing context. In six out of the seven cases in which this section was included it contained more than 25% of the words produced during the task. In the “Masters’ thesis proposal case” it only reached 16%. This result would seem to stem from the role co-authors were playing. One was the reviewer and the other was the writer of the proposal.

In the case study “Flyer” we found that 58% of the words were dedicated to the “Ideas for this paper” section alone. This can be attributed to the nature of the task. Co-authors were working on a short text that had already been written and they were supposed to expand it. So they were more concerned about how to structure the text, discussing what to extend and how to co-ordinate efforts on the text as a whole than on the content of the document. Another relevant point is that in the “Report Workshop” where co-authors were distributed in different countries and time zones this section got 74% of the words produced during this specific task. One interpretation of this would be that the need to co-ordinate a collaborative writing task in such a condition requires more effort from participants. In
contrast to this observation we have the case study “Report Alpha”. In the latter, co-authors (2) were also in different countries but in the same time zone. In this case the co-authors’ role were defined as reviewer and author. As in the case “Masters’ thesis proposal” the need for co-ordination seems not to be so demanding as in those tasks that where co-authors had to interchange ideas and all were playing the role of authors.

The third observation is related to the comments co-authors made on the document’s sections. From figure 30 we can observe in the first five case studies an increase in the amount of words included in comments on the document’s sections, 18%, 23%, 38%, 43%, and 61% respectively. This seems to indicate that the system was indeed getting more stable and that co-authors could concentrate on the task and not on the system design. However, it is important to distinguish carefully between the tasks that co-authors were accomplishing. The tasks where the role of author and reviewer were clearly defined, that is where the reviewer was acting just during the revision process (case studies “Report Alpha” and “Masters’ thesis proposal”) seem to be more suitable for discussion on the content of document. In contrast, in tasks where co-authors had to co-ordinate their efforts (case study “Report Workshop”) or discuss and negotiate their ideas (case study “Flyer”) the discussion of the content of the document’s sections is mixed with the meta-discussion of the document and task as a whole. In our system that means that the discussion is moved over to the “Ideas for this paper” section.

8.6.1 Detailed analysis of the comments in the case studies

The last case study, “Short paper”, is the most interesting study in several ways. First, at this time many improvements to the system had been made and most of the errors reported were eliminated. Those that were not solved were known to the four co-authors and they knew how to avoid them. Also, during the first week, one of the co-authors worked in distributed mode in another country in the same time zone. That is, for a period of time in this case study the team was working in distributed mode. However, the group activity was not interrupted.

Co-authors were supposed to produce the text from scratch. Each co-author was responsible for one or more sections in the short paper. However, all sections were open to other co-authors and they were given suggestions and even changing others’ sections. In this case study, a sort of equilibrium was reached. The documents’ sections got 50% of the words and the “Ideas for this paper” received 37%. The task lasted 24 days and it was the case study that produced most words in comparison with the others (6808). I will take this case study as an example to make an analysis of the comments exchanged by co-authors. The principles discussed here cannot, however, be generalized because of the diversity of the collaboration contexts studied.

8.6.1.1 Discussion about the text

Many of the comments were oriented to discussion of the document content. One interesting strategy that was used by co-authors was to present a text that possibly could be part of the document content embedded in a comment. In several cases a text was sent as a
potential alternative. This text embedded in the comment was discussed while it was in the comment-frame and when a mutual agreement was reached this text was included as part of the section. This suits nicely with the hierarchical structure layout that is contained in the system Col·laboració. I remind the reader that the content-frame is above the comment-frame. So, the potential alternative text is discussed firstly in the comment frame and when accepted it is “elevated” to the document section frame to become part of it. This situation occurred 14 times.

To illustrate the discussion in this section I will quote some of the comments that were sent by the co-authors. In the example 49, the co-author Luis announced first that a new version of the abstract is ready and embedded the text of the abstract as part of the comment. Luis is not asking explicitly others to read because he expects them to read when the comment comes to them in the form of an email. Also, Luis decided to wait for others’ comments or for the version to be discussed before the abstract section of the document was updated. This might be related to the problematic interface that the system provided to change a section (see in section 8.3.1.2 for details) and that the text in discussion was relatively short (one paragraph).

49) Comment # 6 99/11/18 12:22:54
Luis:
This is a new version for the abstract.
Col·laboració is a Web-based collaborative writing tool. It focuses on communication, awareness, and sharing information. Surprisingly, many collaborative writing tools are focused on writing strategies, document control protocols, or co-authors’ role during the writing task. They overlook the relationship between communication and writing despite its importance. Experiences from user studies have shown that the support for a dialogue among co-authors gives users a sense of the current state of the document and its transformation during the task.

8.6.1.2 Trigger of actions

Another characteristic presented in this case study was that the opinion of the co-authors was requested by another co-author. There were 11 cases when the repetitive question “what do you think?” was sent as a comment. An indicator that could illustrate that co-authors were interchanging ideas is the number of times that the sentence “I think” was found: total 49 times. This indicates that a negotiation of their ideas was going on.

An important event in a collaborative writing task is when a co-author feels this his/her part is ready to be read by the others. Then, an invitation to read his/her contribution is often offered. The comments are sent via email, they were also used to trigger the act of reading/commenting from the other co-authors. Twelve comments that explicitly alerted that a co-author’s contribution was ready to be reviewed by others were found in this case study. See example 50 and 51.

50) Comment #6 99/11/09 11:48:43
Luis:
The new version of this section is on line, please read it and let me know what do you think.

51) Comments #10 99/11/09 15:06:46
Maria:
Hi! I have rewritten the introduction, i have changed a lot of sentences. Tell me if that reflects better what we would like to say.
8.6.1.3 The dialogue among co-authors

It is very important to support a dialogue among co-authors. The interface that Col·laboració provides contributes the sensation that co-authors are “talking” to one another. To support this assertion I will present some of the comments that were found in this case study.

52) Comment # 10 99/11/18 16:36:58
   Isabel
   ...
   I think the following parts are important, but they can be ordered in different ways:
   1. Collaboracio is a Web-based tool for cooperation during the writing process
   5...
   What have we forgotten in the abstract? [my font]
   6 ...
   ... I think we have to find a way of including the most important of those elements. All of them
don’t fit in an abstract!

In example 52 Isabel is making a list of points that are considered important. After a while, five points have been described. It is very likely that Isabel stops to reflect and think “What have we forgotten in the abstract.”

53) Comment # 7 99/11/18 14:57:15
   Maria:
   Luis, 
   this is a negotiation, right?
   Well, to tell you the truth when I read…

In example 53, Luis is named by Maria as while talking and also to index the comment. Observe that the style in example 52 and 53 is conversational. That is, co-authors are engaged in an asynchronous dialogue.

54) Comment #15 99/11/08 17:22:38
   Isabel
   Here are two possible titles:
   1. “Collaboracio: a Web-based tool for cooperation during the writing process“
   2. “Collaboracio: a tool for collaborative writing on the Web”

   Comment #16 99/11/08 17:43:33
   Maria:
   Title number one identifies quite well the purpose of Collaboracio, I think…. 

   Comment #17 99/11/09 11:41:30
   Luis:
   …I also think that the title number one is better.

   Comment #18 99/11/09 12:54:16
   Frank:
   I have no objection on both titles. I think it is good whatever we take.

In example 54, all the co-authors are involved in the discussion to decide the title of the paper after one of them suggested two alternative possibilities. It is very important to notice that between comment #15 and comment #18 more than 18 hours have passed. However, none of the co-authors makes references to the comments that initiated the
debate in the first place. Furthermore, they use the identification Isabel gave to the possible titles (1 or 2) to mention their preferred choice. It is conceivable that if the topic to be discussed is presented in the shared space, all co-authors may refer to and make use of that knowledge also. Co-authors can make reference to what others have said using deixis or the same code (for example the identification number Isabel used) that others have used before. Also, the time that has passed does not affect the “team” memory of the discourse context. In example 54 that shows comments #15 to #18 no recapitulation is found as the context itself is presented (cf Severinson Eklundh, 1986, 1998)

One way to reference a previous comment is accomplished by using to the comment’s number, see example 55. Co-authors used the comment number when they were making reference to a comment that was not adjacent to it. In example 55 comment #10 is shown which makes reference to comment #7. Comment #8 and comment #9 are in between them so co-authors solve this problem by explicitly naming to which comment he/she makes reference.

55) **Comment # 10 99/11/18 16:36:58**
   Isabel
   I agree with Maria's comments in #7.

This example indicates that the chronological order in which the comments are posted might create difficulties to follow the dialogue among co-authors as it might graphically be interrupted by other incoming comments, comment #8 and #9 in this case. Another situation is shown in example 54 where comment #15 to #18 nicely form a continuous flow. This, certainly, is the reason why co-authors did not use any device to make reference to a previous comment. Note that even though comment #18 has 2 different comments in between, Frank does not make explicit reference to comment #15. The contiguousness of the comments gives the flow to the dialogue and frees the co-author of using a device so his/her comments are placed in the right context by the others.

**8.6.1.4 Co-authors’ activities in the dialogue**

One interesting topic in computer supported collaborative writing is the sense of awareness co-authors have of other members’ activities. I found that co-authors in eight cases during this case study explicitly let other members know about their activities. Four such cases are shown in example 56.

56) **Comment #31 99/11/22 12:45:53**
   Luis:
   …I will write about CGI, JavaScript and WebDav on Thursday and the same day I will send the lines about it …

   **Comment # 28 99/11/17 15:34:40**
   Maria:
   …I will check the short paper again, print it in its official format and give you a hard copy to read it before I send it …

   **Comment #14 99/11/06 18:32:24**
   Luis:
   I will make a new version of the section Description of the system according to Isabel’s recommendations. I will not be in the office next week but you can reach me via email.
Comment #10 99/11/03 09:48:33
Luis:
I moved the section “Description of the system” just after the Introduction, I think that is the right place.

Note, that in the last case of example 56 (comment #10) Luis describes the transformation that the document has gone through so that others would be aware of the change. This is very important for team working because in that way the common goals can be clearly stated and the progress of the task is also presented. This information is important so that others can plan or execute their activities.

Using email it takes usually 6-48 hours from a statement to a response. As a result, processes that need many interactions might need a lot of time using email (Palme, 1999). For example, to schedule face-to-face meetings might be time-consuming using only email. The fact that messages in the Col·laboració are available immediately to all co-authors and that they are also in the same space presented in the form of a dialogue might reduce the interaction time in this mode of CMC. By clicking to a link in the system, co-authors do not have to wait for the email to arrive to check if a new message has been made. There can be situations in which co-authors might be aware that in a certain moment other co-authors are connected to the system. In that situation the system might reduce the gap of the interaction time and work in a semi-synchronous way. Email can also work in this way.

Face-to-face meetings were in fact scheduled using the system and its commenting function. Example 57 presents one sequence of comment in which co-authors were arranging a meeting.

57) Comment #3 99/11/01 19:40:11
Maria:
…Luis has a meeting at 16:00 with Isabel, What do you think if we meet between 17.00 and 17.30 ? how does it sound to you ?

Comment #4 99/11/01 19:40:33
Frank:
That's fine for me.

Comment #5 99/11/01 19:42:30
Luis:
Maria,
Looks like my meeting with Isabel will take a long time, we should change the meeting time.

Comment #6 99/11/01 19:42:45
Maria:
no problem, we meet on monday, Frank came and said that it is better to meet on Monday instead

This sequence took less than three minutes.

8.6.1.5 A window to the outside world

As the system is Web-based all the resources of the Web can be part of the writing environment. Furthermore, co-authors can include these sources in two different ways.
One method would be to insert an object inside the environment. An object can be anything Web-based, for example a picture, text, video clip, sound track, etc. The other alternative method would be to attach an object in the form of a hypertext link. The current version of the system supports this practice, although in a way that requires HTML knowledge from the co-authors. In example 58 Luis has included a link to a Web site outside the system.

58) **Comment #1** 99/11/01 19:15:50  
* Luis:  
…*Click on the link “Short paper for XXX-00” [XXX-00 inserted by me]*

As it was said before, the task for this case study was to write a short paper for a conference which had a Web site. Some administrative aspects related to the paper’s submission to the conference were given in this site. Luis sent a comment with a hypertext link that opened a new browser window with the conference site. Doing so, it was possible for the other co-author to have immediate access to this site. Co-authors can take from the outside world and put objects inside their “world” or attach them to it.

### 8.6.2 The use of the email notification

The system Col·laboració sends an email notification to all co-authors when a section of the document is added or deleted, or when a comment is made in the “Ideas for this paper” section. Because “Ideas for this paper” is a shared space for planning a writing task, in which meta-level discussions are carried out, it seems reasonable that all co-authors would be interested in these comments. Comments that are made on a document’s section are shared in a different way: they are sent via email only to the section’s responsible co-authors. However, the other co-authors can access these comments if needed, as they are saved in the public commenting space of the section.

According to our studies, the email notification feature has been perceived as a valuable reminder of the ongoing task. In the survey to co-authors in case study 3, Report Beta, one of the respondents said in relation to getting emails from the system “*That is good because it is like a trigger to go on working in the environment.*” Another thing that the users reported and found to be positive was that it was not necessary to enter the system simply to see if something had happened in their section, as the email notification functioned as an indicator.

Although most of the users reported that they appreciate this function, many of them also indicated that it could involve a problem. Experiences have shown that users may feel overwhelmed by the number of emails received. One respondent wrote “*If you get Email from all the sections you get too many e-mails (I have already 30 - 70 emails each day) If you don’t get e-mails there is a problem of knowing what is going on.*” This indicates that a balance should be found between supporting awareness and avoiding email overflow.

Another problem reported by the users was that the system sends an email to the responsible co-authors even if the one sending the comment is the co-author him/herself. Some respondents indicated that this could be felt as annoying and unnecessary. As one respondent to the Web-survey in case study three said, “*I do not need comments that state*
that I have added or changed something myself. I already know that.” Also it was mentioned that when a comment was posted they knew that it was sent also via email. However, there was not any possibility to know to whom the comment was sent and this was a source of confusion.

Some users indicated that an email warning that a comment has been added to a particular section would be enough and found that including the comment in the text was redundant. They motivated this alternative with the fact that they felt it to be more natural to read the comments in their discourse context, that is in the system. The comments made to a section are presented chronologically, often forming a dialogue.

When Col·laboració integrated email as a feature, a new communication channel in the collaborative task was introduced. It is very likely that the user is more familiar to email as a communication channel than to Col·laboració. So, including the text of the comment in the body of the email predisposes the user to, as usually, reply to that message using the channel that is been currently used. Unfortunately, the system does not support this possibility so far. However, it appends the URL to the email so that co-authors can easily access the system and reply to the comment there. Nevertheless, according to our studies, some users might like to perceive email as a special communication channel, in this case as an event notification (e.g. “You got a comment in Section Abstract”). Using email just as an event notification channel we might decrease the cognitive load of the user who could wonder which of the channel should be used (email or Col·laboració), or when to use one or the other?

Organization of messages can be a source of problems for users, as reported by participants in a study made on electronic mail in a working environment (Bälter, 1998). One point worth noting here is that the emails sent by Col·laboració are labelled so that co-authors can easily identify that the message is related to the writing task, who were the recipients of the message, what was the event that generated the notification, and, if applicable, to which section it is related and the comment itself. This information can be used to help co-authors to handle their email. For example, emails sent by the system could be directly filtered to a certain folder and be organized by writing task or section.

8.6.3 Problems with text-based communication within the system Col·laboració

In this section I will focus on some problems with the text-based communication I found in the comments sent by the co-authors.

8.6.3.1 Carriage return “noise”

In section 5.1.1 it was mentioned that co-authors very often made reference to the original text. In doing so, it is logical that instead of typing they just use the copy facility provided by the computer system. Very often this is done by a drag of the mouse on the text. Drag-copy from a Web-browser has the particularity that a carriage return character is appended at the end of every line of the browser window. On the other hand, when a comment is
written by a co-author, he/she could just press the return key when he/she thinks it is necessary. This action also produces a carriage return that breaks the text line. Line breaks independent of the browser’s windows size are produced by a special HTML tag, `<BR>`. So, the system changes the carriage return it finds in the comment text into this HTML tag in order to preserve the line breaks that the co-author commanded. While making a comment, co-authors can also paste text that they have drag-copied into the input text area that could also contain some “added” carriage returns. There is no way for the system to identify whether the carriage return was produced by the co-author’s pressing the return key or was appended during the copy-paste. For the sake of preserving the co-author’s line breaks, the system transforms all carriage returns into `<BR>` tags. This produces a sort of “noise” in the reading activity. Moreover, there might be empty spaces that are not used to present the information, as shown in Figure 8 on page 64. The version of Internet Explorer 5 has solved this problem.

8.6.3.2 Expired validity of comments

Once a comment is added to a section it remains in the comment window even after its validity expires. For example, one comment suggests changing the word “arcane” to “unusual” and one of the co-authors decides to do the change. If any other co-author did not get to see the text while the word “arcane” was used, then the comment will be meaningless and it might create confusion. Example 59 shows such a situation in a real case.

59) **Comment # 2** 99/11/03 13:02:41  
Isabel:  
I find it difficult to understand what you have done so far in the Introduction, because the comments seem to refer to some other text than the one displayed.

**Comment #3** 99/11/03 13:21:53  
Maria:  
that’s right Isabel, the comments correspond to an old version of this section. After a meeting I decided to rewrite the introduction and the version you read is the last one. At the moment, we don’t have any comments on this last version of the section.

We have discussed several times what we should do with those comments whose validity has expired, but the situation is complex. The first thing that comes to mind is to delete them but that would produce other problems. For example, deleting a comment implies re-numbering all the previous comments. This will probably invalidate those comments in which co-authors used the comment’s number to refer to. Also, one comment might address several issues and not all of them might fall into an expired validity situation. Finally, deleting a comment might break the flow of dialogue that the comments form. For the sake of avoiding these problems we have decided to keep those comments whose validity has expired and in this allowing a “design rationale”. We hope also that this conflict will be resolved quickly and easily. In example 59 we can see that only 19 minutes after Isabel expressed confusion a response was given in which the situation was clarified.

Cadiz, Gupta, and Grudin (2000) in their studies pointed out that a key complaint was the orphaning of annotations. In their system, annotations are anchored to the text in the document, when the document got changed, the annotations lost the link to it. This was
according to their interviews the main reason that people stopped using the annotation system. They point out that it might be frustrating for annotators to comment on a document, only to see the comments become meaningless through orphaning. In our system, though this situation can be found, co-authors can see their expired comments more from a historical perspective.

8.6.3.3 Probably too much “talking”

In this case study Short paper, we found a lot of communication between co-authors. The finished document that was submitted to the conference contained 1290 words. On the other hand, the text-based communication for this case study contained 6808 words. This is almost four times that of the finished document. Furthermore, there were some face-to-face meetings. Generally, the situation of communicating a lot of time is common in CMC communication. The main reasons are that there is usually no time limitations as in face-to-face and that there is no a mechanism to stop the discussion (Palme, 1999). One question that arises is: does this tool encourage too much discussion among co-authors making the collaborative writing process more complex? Much work remains to be done to find an answer to this question.

8.6.4 Supporting individual views and mutual awareness

Supporting mutual awareness is of great importance for the accomplishment of a collaborative task mediated by computers. This topic has gained much attention amongst researchers and is one of most debated ones in the CSCW community. Fuchs, Pankoke-Babatz, and Prinz (1995) suggest different modes of awareness. In relation to “when” an event occurs we have synchronous or asynchronous awareness. In relation to the scope of work someone performs we have coupled or uncoupled awareness. Coupled awareness is provided about events closely related to the current focus of work of the user, whereas uncoupled awareness is provided for the events independent of whether they are closely related to the user's current focus of work.

The relation between a co-author and the document can be diverse from co-author to co-author. There is evidence in our studies that co-authors perceive the document from different points of view. In a collaborative writing task, co-authors’ coupled/uncoupled awareness can be defined by at least two factors: the strategy co-authors follow to coordinate their efforts and the role (e.g. reviewer, project leader).

In general, the problem is related to how a collaborative writing tool helps each co-author to focus on his/her work without detaching him/herself from the teamwork; and from the document as a whole. To achieve a global perspective is crucial during any writing process (Severinson Eklundh, 1992), and presents particular challenges in a collaborative writing task. The approach taken here is that every co-author should be able to have an individual view of the writing task and at the same time should be able to get effortless access to the whole panorama of the writing task.

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1. This section is an adapted version of Rodriguez and Severinson Eklundh (in press)
8.6.4.1 The need for individual views in collaborative writing

During a collaborative writing task, participants may coordinate their efforts according to different strategies: parallel, sequential, reciprocal (Sharples et al. 1993). A common practice is to partition a document into sections and make each co-author responsible for a sub-set of them. A co-author would be expected to put more effort into, and would work more closely on, those sections he/she is responsible for. To put it another way, co-authors might be coupled more to some sections than to other sections in the same document.

In principle, co-authors can handle a document in two different ways:

1. As isolated sections - those that he/she is responsible for, leaving out the rest of the document. This is the case when a parallel strategy is used.
2. As an unbreakable unit with all the sections, even those that he/she is not responsible for. This is the case when a sequential strategy is used.

Both practices present some problems. In the first a co-author works more independently of the team. As a result, other co-authors might be poorly informed about his or her activities, and interaction in the group may decrease. Problems with regard to language style, flow, and establishing clear relationships between ideas may be presented when a co-author integrates a particular section into the rest of the text. In the second practice the co-authors are required to handle all the sections in the same way, regardless of which are the sections he/she is responsible for, demanding more effort to accomplish the task. This problem is more severe if the co-author is responsible for sections that are not physically adjacent in the structure of the document (e.g. the Introduction and the Conclusion in a scientific paper).

The role that the co-author plays is also important to define his/her coupled/uncoupled awareness in the writing task. It is clear that the first author of a scientific paper needs to be more coupled to the all the section of the document than the one who carried out the experiment (a common situation in pure science scientific papers).

To illustrate the need to present different views of the document we can take the case study 3: Report Beta, where nine co-authors produced an annual report of a project. As for the strategy, the report was a compilation of the sub-projects. Each sub-team had to report their own projects. That is that they were working in parallel on different sections of the annual report. A few respondents reported that they did not read others’ sections as they felt they were not responsible for them, nor should change their text. That is, co-authors were “uncoupled” to certain sections of the document and coupled to others. The log file confirms this pattern, indicating that co-authors might need to focus only on a particular section of the document. As for the role, the leader of the project in the case study 3, mentioned that it was very valuable to have all the sub-projects in the same place, easily accessible from any computer with an Internet connection. She was clearly interested in all the sections, in contrast to those co-authors who were exclusively interested in their own sections.
It is important to point out that the strategies indicated here are not the only ones that can be used. During a writing task, co-authors can move from one strategy to another. Yet, they could design a particular strategy fitting their particular needs.

The experience we had using Col·laboració helped us to explore the possibilities that the system and its infrastructure can give co-author to mitigate these problems. Col·laboració is designed to alleviate the problems co-authors might have while handling a document, using the strategies presented above. The system helps users to focus on the sections that they are responsible for, but does not isolate them from the rest of the document. The system offers a novel way of interaction with Web documents, viewing a document as a set of independent modules (sections) but keeping their relation as a whole unit, i.e. as a document.

Col·laboració is designed to provide both coupled and uncoupled awareness during the writing task. In the next section we describe how this is achieved

8.6.4.2 The email notification

The email function that the system offers can be set up in such a way that it reflects the couple/uncoupled relationship of the co-author and the different sections of the document. Co-authors can receive email notifications only of those events on the section that they would like. Some respondents in the case study 3, indicated that one of the negative aspects of the tool was that the system was sending emails that they were not interested to read as one wrote “Too many mails on subjects I was not interested in”. What is important to point out here is that the system can inform co-authors about the events on the “objects” (e.g. a section) that are coupled to them but does not hide the events concerning the uncoupled objects in the document

8.6.4.3 The index frame

When a co-author enters the system, the index frame is presented. This is the same to say that the structure of the document is presented. Co-authors can select to browse only those sections that they are coupled to, leaving the other, apart as long as not needed. From the log file we often observed that when a comment was added to a particular section, the person responsible for it soon visited the system and “jumped” directly to his/her section. Moreover, in case the co-author was involved in more than one section, he/she jumped directly to the section that just received a comment. This suggests that the user had read the comment and entered the system to read or to reply to it. If so, the email notification was indeed “pushing” co-authors to interact with the system.

8.6.4.4 The modular document

In Col·laboració, as already mentioned, the document is a set of sections. For each section there is one comment space related to it. Technically, the sections and the comment space are independent files, although, of course, interrelated. These files can be manipulated and organized by the system using a “modular” approach. For example, co-authors can handle
the sections as modules to create versions or to get different views of the document. This can be done by selecting which sections they want to include in his/her individual views.

Some co-authors might want to have a view of the document in which only his/her part is shown, and ignore the rest of the document. This can be achieved by the system in two ways. The first one is just by selecting a section from the index-frame. The system will show in the info-frame (the right frame in figure 20) only the content of the section and its comments. The second is by using the *Overview* command. This function is more suitable when a co-author is responsible for or coupled to more than one section in the document. The user can select the sections and their comments as modular parts and “build up” his/her view of the document. Doing so, the co-author can exclude those sections that he/she is not coupled to which very likely will alleviate his/her work, see figure 31.

However, the co-author is not detached from the whole document. Co-authors can still browse the rest of the sections at will, read their content, and become aware of the discussion the rest of the team has been engaged in. They might, for example, notice that others co-authors are using a certain style or spelling guidelines, which carries implications for their own work. At the same time they can notice the progress of the whole team, which is also essential in any collaborative task.

An alternative solution to the translation phase from ideas to text would be to use the same approach that is used in Col·lecció when adding a Web-page in the domain. Instead of including the section file in the domain as the current version of Col·laboració does, we could include just the URL of the section and the section file itself is saved in a server. This would represent a weighty change in how the co-authors would coordinate their
effort in relation to the current design of the system. For example a centralized or distributed scheme for the administration of document must be used. Both schemes might present benefits and shortcomings. In any case, all co-authors have access to the current version of the document and each section file can be processed locally using a word processor of the user’s preference and then “save for the Web” the file.
9 DESIGNING FROM INSIDE: THE COMMENT SPACE OF THE ATP DOCUMENT AS A DESIGN TOOL

For every case study of the DHS or Col·laboració or Col·lecció the ATP document was part of the domain. Users and designers used this shared space for making comments about the system. These dialogues evolving around the ATP document had a crucial role in the development of these three systems. This space for comments was used in very different ways, reflecting users' varying background and interest in system design.

The experience that I had during these years in which I have developed the systems DHS, Col·lecció, and Col·laboració has made me reflect on the design of collaborative tools. It is clear that users' participation in the design of information systems is very important. There are several ways to involve users in the design process. Participatory design (PD) and user-centred design (UCD) for example, foresee the importance of involving users as early as possible in the design process. The core of PD is to get active participation from users. “Something more than being [the user] used as mere data sources” (Muller, Hallewell, and Dayton, 1997). One of the claims PD makes is that the designer should have the knowledge of the end user's culture and needs. To know this, designers have to communicate with the users e.g. engage in a dialogue. However, getting users involved in the design is not an easy task. Often, users are not willing to co-operate for diverse reasons e.g. giving away their time or inconvenient time for asking. On the other hand, designers might find it difficult to communicate with the users for reasons e.g. of time schedule. All too often, designers use professional communication forms that users might, very likely, find difficult to relate to. Therefore, too much translation might be needed when designers and users meet.

During our pilot study for the DHS, users got involved in the design of this system using the commenting feature of the system. We call this method “designing from inside”. This method has been used in all of the case studies described so far in this thesis. The basis for designing from inside is to include a shared space “inside” the tool being developed as part of the system. Users and designers can add comments to this shared space and hopefully these comments would result in a text-based dialogue among them. The comments are sent to the design group via email. Furthermore, adding a comment should be easy and quick.

Designing from inside is a method that supports a) unobtrusive users’ participation, b) communication and discussion among designers and users, c) problem identification on different platforms, d) repository of data, e) visual prototyping.

The examples that I will present here are comments taken from the ATP document of different case studies. These comments were made by users or designers. I will identify comments made by the designers.
9.1 Unobtrusive user participation

Probably, the best moment to report about a problem or a need is just after it is experienced. At this moment, users might be willing to report it. Example 60 shows a situation in which the user expresses his opinion towards the system after he/she experienced a failure.

60) Comment #17 98/02/17 17:21
Benito:
I don’t like when the comment window erase all text I have written when I resize the window. I would also like to have a comment window that is a little bit larger than it is today.

Comment #23 99/05/18 15:25
Josefina:
I don’t like the behaviour of the frames and their relative size…

If the users have at hand the way to express or report a problem, they could do so. Users might feel that it is important to show that he or she has “discovered” a bug or a problem. Users can also experience needs that the system is not able to fulfil. The lack of this feature might ensue a feeling of frustration. Reporting this need might be a way to respond to this frustration (see example 61). Users can unobtrusively, opportunely, and spontaneously get in touch with the designers.

61) Comment #2 00/02/20 11:48:15
Maritza:
I really miss the possibility to respond to a comment. … Some kind of hierarchy in the dialogue structure would be great!

9.2 Supporting communication

9.2.1 Communication among users

Another point is that users can get in touch with each other and share their opinion about the system. They can just as well evaluate a suggestion made by another user or by the design group. Example 62 shows a situation in which one user suggests a change in the system and other users evaluate this suggestion (in the version used, the button to add a comment had the label “send”). After this dialogue we took the decision to label that button with “Add comment” as it is today in the current version of Col·laboració, Col·lecció, and DHS.

62) Comment #7 98/02/16 10:07
Armando:
…About “send” I suggest “add comment” or “add”. and I’d move clear [the reset button] far away from the ok button, so it makes a difference…

Comment #18 98/02/18 15:25
Susana:
…I agree that the Send-button is inappropriate, Add would be better….

Comment #22 98/02/19 12:50
Lucia:
Add or Send ? I would say Add, so that you recall the previously chosen “Add comment”….

150
9.2.2 Communication among designers and users

Users need to communicate with the designer to express their opinion. Example 63 shows how the designer approves the user’s suggestion and tries to justify the current interface. It is important to show interest in what users say. Explaining to the users the reason why the system works in the way it does is also important because the users are informed and they can be more benevolent when a problem arises.

63) Comment #6 97/04/03 15:16
Mario:
Wouldn’t “next” be more suitable than “more”…

Comment #9 97/04/03 16:58
Pedro:[designer]
Mario, (about Ref #6)
Yes, you are right.
Next is more suitable for this prototype. Let me tell you why the present prototype uses ‘more’ instead of ‘next’…

9.2.3 Communication among designers

It is important that designers communicate with each other as in any other work that is done in collaboration. Face-to-face meetings in a working environment might be difficult to set up. Decisions should be discussed within the group. Example 64 shows the very first discussion from where the method “designing from inside” arose. Observe that the comments in examples 63 and 64 were made in the pilot study and also that they are related. See the number of the comments to follow the sequence.

64) Comment #10 97/04/04 16:47
Carlos: [designer]
Probably “more”–is–a good name when there are more levels of information. Right now, “more” gets you to the next comment. We probably have to foresee the need for both..

Comment #11 97/04/04 16:53
Magnolia: [designer]
The iceberg model applies to the domain information, but not to the comments, as I understand it. I think “next” is a more suitable term for this reason…

Comment #12 97/04/04 16:54
Magnolia: [designer]
Right now, this is developing into an interactive discussion. I feel like we need other tools for this, since e.g. there is no way to see that there is a new comment. But on the other hand, we are not developing a conference system. What do the rest of you think?

Comment #13 97/04/04 18:27
Pedro: [designer]
I think that ‘next’ is more adequate for this prototype … I will change it.

It is important to notice that the discussion in example 64 was carried out in a distributed-asynchronous mode. Note that the trigger of the discussion presented in example 64 was initiated by the user Mario in comment #6, see above example 63. Each of the designers sent their opinion in relation to that comment. Three hours later the design group had taken a decision without a face-to-face meeting. Most importantly, they were taking into
account the user’s participation. This dialogue was also available for the users. Designers took the decision to perform a change in the interface following the user's suggestion.

9.2.4 Problem identification and error repair by mutual participation

The lack of compatibility between different platforms, browser versions, and user set-up preferences of their computers make the Web sometimes an unstable user environment. To simulate all the possible environments in which users might work would take a lot of effort and time. Users, who have their own, probably unique, environment, might experience some errors that no one else experiences. Therefore, problems or bugs can come exclusively to a particular user. This situation is almost impossible to detect unless the user reports it.

65) Comment # 27 97/04/17 09:51
Leonardo: 
My browser is set to check one per session, it still doesn’t give me anything else to see but “About this prototype”.

66) Comment # 37 97/05/05 23:41
Carlos:[designer] 
Using a simple 640x480 pixel PC at home, I find that the comment window has resize handles, but still cannot be resized. (It can, however, be maximised..) …

Example 65 shows two technical problems that the programmer did not experience in his own environment. It would have been very difficult to detect these errors if they had not been reported. In many cases these users were running the system in a different environment than the one used by the programmer.

Using the dialogue space, it is also very likely that errors which are not seen by the designer might be found and communicated by another person. Example 66 illustrates this situation. Mark discovered an error that is reported via the DHS. About an hour later the error was repaired.

66) Comment # 7 97/04/03 15:35
Carlos:[designer] 
I just noticed that the mail links to Magnolia and yours truly are missing: “The requested URL/~Pedro/mail was not found on this server.”
I would also like to be able to resize the comment window, but perhaps there is a reason for it to be fixed that I have forgotten? (Hopefully this, rather than the window itself, can be fixed? :)

Comment #8 97/04/03 16:47
Pedro:[designer] 
Carlos, Your Ref # 7 was a mistake of mine in the HTML tag. Now it works. Thanks.
About resize the comment window there is no way as ....

9.2.5 A designer’s logbook

Members of the design group, because of the ubiquitous accessibility of the Web among other things, used this space as a repository of ideas or logbook. During the design process, ideas for the interface could come at any time, especially during the interaction with the system to be developed. Designers could annotate their new ideas, describe an error, or a reminder in this shared space. The nature of the written representation of the
idea and its public nature, somehow force designers to be more elaborate when presenting it. They know that other designers will visit this shared space. We observed that when an individual idea was reported in the system by one of the designers, it was, generally, communicated in a clear and explicit manner. It seems that this was done because the designer wanted the rest of the group to understand the idea. As usual, if the ideas are only jotted down, it is very easy to forget what it was about, even for the person who jotted it down. A more elaborate and careful recording of the ideas could ensure accurate recall. If the idea was not understood by others, they asked questions until the issue was clarified.

Text-based communication is usually more elaborate than spoken. However, the language used in computer-mediated communication (CMC), that is the one we use in designing from inside, is more informal and speech-like than in other text-based communication e.g. memos, newsletters. Furthermore, it is well known that we read faster than we talk and in case we do not understand what we read we can always re-read (Chesebro & Bonsall as cited by Fåhraeus 2000). The nature of text-based asynchronous communication also requires one comment to be sent at a time. This reduces the case of extroverted personalities dominating the “talk”.

However, I do not wish to imply by this that the design process is improved just because it is public and text-based. Designers, for example, might find it inconvenient not to be able to jot down an idea or to present a draft to their colleagues. One of the results of my investigation is that people might be very sensitive to present in public draft version of their work in public. A number of aspects of the problem requires further investigation.

In example 67, one of the designers made an annotation. Pedro labelled the comment with “Problem to solve”. It is followed by a description of the problem. No automatic solutions were given in this comment. In any case, the problem was made public, users and designers knew about it. This resulted in two things. Firstly, it alerted designers to the problem. As no solution was given any of them could come up with one. On the other hand, if a solution was presented, they could evaluate it. Secondly, users reading the ATP document were aware of the problem and they could avoid it or the error would not take them by surprise. Note that the designer might give a temporary solution to this problem, as Pedro does in the last sentence of his comment. This temporary solution is also learnt by the users.

67) Comment #14 98/12/15 12:59
Pedro:[designer]
Problem to solve.
When a change is done to the left frame (add, delete, or order of section) and two or more users are working at the same time, changes are only reflected on the screen of the user who has made the change. For the other users this information will not be available until the left frame is reloaded again by them.
9.2.6 Visual prototyping

![Figure 32. A screen shot taken of a comment in which designers propose two alternatives in a graphical way](image)

It is important to bear in mind that the comments could hold HTML tags, thus pictures could also be included in the comments. Also, as it was said before, this seems to work fine for Web-based tools. To prototype an interface using HTML might be easy and, most importantly, it would be very close to what the end-system would look like. Making a mock-up, on paper for example, would not be the same because designers and users have to “translate” this representation. As users and designers are running the system in what, very likely, would be their workstation, the principle WYSIWYG (what-you-see-is-what-you-get) is valid. Figure 32 shows a picture of one comment in which the designers, here Pedro and Luis, presented two alternatives and the rest of the design group were supposed to decide which alternative was the best. Observe that the comment presents the two alternatives in a clear way. The design group will see these alternatives in their own environment under the principle WYSIWYG. Therefore, the prototype is very close to what they will finally get, whatever the decision may be.

9.2.7 Social issues

There are other advantages that are parallel to the above-mentioned, but in this case more oriented to social issues.
Comments made on the system are public. A comment from a user might get an answer from the design group. This reply is presented in the shared space. A reply to one of the users, because of its public nature, is not only the answer to his/her comment but also an acknowledgement that the design group is “listening” to them. Yet, those users that observe the interaction will understand that it makes sense to comment on the system because comments from other users have been noted. This might encourage their participation in the design process. Moreover, a public question or suggestion expects a reply in a social context. As the comment is sent via email, a timely reply is likely to happen. A quick response, even if it gives no solution, could also show the users that the design group cares about them. This might create the feeling that there is a person “inside” the system who is taking care of the users and their problems. A feeling of trust from the users toward the designer might be developed, which might decrease the social gap between users and designers. This is very important to facilitate further collection of data from the users.

9.2.8 A brief quantitative analysis of the users’ participation

We have counted and categorised the comments made in the ATP document in the pilot study. Additionally we have counted the number of words for the comment. The results were distributed in two groups in relation to who made the comment: a user or someone from the design group. In this way, we try to show the participation of the users in the design process of the DHS.

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design group members. This, may be related to the face-to-face meetings that the design
group had. However, it is important to emphasise that users suggested 10 different ideas
for the design of the DHS and reported 8 different errors.

9.3 Conclusions

These experiences suggest that the quality of user-designer communication is an important
aspect of successful design. User-participation in the design process of the DHS was in
fact very active. This might be because they sensed that their comments in the shared
space were going to be read, sooner or later. On the other hand, the public response from
the designer also might have contributed to increased users’ trust in the design group.
Including a common dialogue space inside the system that is being developed is a simple
way to increase users’ participation in the design process. Clearly, collecting other data
from users during the use of a system might be demanding or difficult for reasons of
integrity. Giving the possibility to users of reporting their impressions of the system in an
unobtrusive, voluntary way, and ensuring that what is said has been taken in account,
might increase users’ participation in the design, as well as promoting the ongoing
discussion among designers.
10 CONCLUSIONS

In this thesis, I have presented three Web-based tools for collaboration: the Domain Help System (DHS), Col·lecció and Col·laboració. A fourth system, DID, supports a single user in navigating in a domain and provides a better understanding of the interaction among the participants. The main research issue has been how small or middle size groups work collaboratively to discuss, annotate, or produce a document on the Web. Most of the case studies have been carried out in an educational setting. This means that we have also had the possibility to observe some aspects of introducing Web-based tools in the classroom, such as the public aspect of the Web. Also, as the DHS, Col·lecció, and Col·laboració have been developed from scratch, we have gained experience in, and insight into issues related to the design and development of Web-based collaborative systems.

10.1 The discussion experience

Web-based tools that support discussion are very common. Frequently, those discussions tools are text-based, topic-oriented, and embedded in virtual communities. Many of these forums are oriented for mass communication and support several topics at the same time, e.g. Usenet newsgroups. Others are oriented to supporting selected groups (as students from the same class) in their discussions, e.g. WebCT, FirstClass, and TopClass.

The DHS and Col·lecció can also be classified as discussion tools, but with the particularity that they place the main focus on a document that the users have included in the domain. The interface of the DHS and Col·lecció has intentionally been kept simple. Therefore it lacks advanced support such as administration features for moderators, support for rating and voting, and group calendars. The main reason for maintaining simplicity was that we wanted users to concentrate as much as possible on the given task: to discuss the content of the document.

Below we present some general conclusions about the use of these tools.

- Case studies show that DHS and Col·lecció support group discussion of a set of Web-documents.

The use of the Web for teamwork is becoming more and more frequent, and documents are an important entity in many forms of teamwork. The discussion about a set of documents might therefore be essential for the accomplishment of a collaborative task, as shown in our case studies. DHS and Col·lecció proved to be suitable tools to discuss a set of Web – documents in asynchronous mode by small or middle-sized groups. The systems give the Web-document a central role in the discussion. They also allow easy access to all of the documents and ensure that each member shares the same version of the documents.

- Text-based discussions in our studies focused both on the document content and on previous comments, presenting a dual context

Overall, the discussions focused on the content of the document, and rarely drifted to other, unrelated topics. Furthermore, the comments very often referred to a dual context,
Designing, evaluating and exploring Web-based tools for collaborative annotation of documents

consisting of previous comments and the document content. This might be partly because the system supports an overview of the document and its comments together, and the relation between the document content and its comments is always maintained. Having the document content visible and easy to access while making a comment on it, might help maintain the focus of the on-line discussion. How the dual context is exploited by participants is easy to explore using the Document Interactivity Chart (DIC) generated by the system DID. Otherwise, a demanding and time-consuming analysis of the comments by the members would be needed to find these relations.

- The structure of the flow in the dialogue should be clearly presented without disruption

Though users were provided with an overview of the comments as a whole and could navigate easily through them, they found it difficult to follow the discussion when a comment was a reply to an earlier comment that was not adjacent to it. The origin of the problem in our tools is the chronological order in which the comments are presented. This is in contrast to systems that use threading of messages, which requires a subject line of the message and the relation “reply-to” between messages. One solution might be to let users re-locate the comments using the number id of the comments. Users extensively employed this number when they replied to a comment that was not the very last one, in order to help readers find the context. Enabling users to re-locate a comment adjacent to its context, that is, adjacent to the comment it constitutes a response to, might help them to perceive the discussion as a dialogue. However, this possibility merits further investigation.

- Email notification about comments on users’ documents supports awareness. The email itself reminds users about the task.

The integration of email into the DHS system was generally accepted by the users. An explanation for this is that email is frequently used by the students so they did not have to learn how to use it. Many of the respondents considered that the email notification sent by the systems was a valuable function. It was used as a news control mechanism. The content of the comment was also sent as part of the body of the email. This saves the user the trouble of visiting the system just to see if something has changed in the domain. However, this approach has two basic problems. The first is that the user might find it more difficult to understand the content of the comment as it is read as an isolated unit of information. This problem is more severe if the comment refers to a dual context. The second problem is that users might decrease the frequency of their visits to the system, if they feel that they get the information they need for the collaborative task by email. This problem would presumably be greater if the user was able to reply to a comment using his/her email program, as was proposed by some users. Using email to reply would make the approach not only a news alert mechanism, but also a new channel of communication, which might create confusion about where a comment was sent from. Furthermore, a concern that the users expressed was the amount of emails received, which could be a problem if the number of postings in the domain was too high.

- Promoting written interaction between the students is a simple form of collaboration, which may benefit learning.
Traditionally in co-located courses, written interaction among students is less frequent than individual writing activities and oral communication in the group. Usually the students write for the teacher, which of course reflects the hierarchical social structure and the context. That is, a student writing a comment addressed to the teacher of the course might not elaborate his/her comment as if he/she were addressing another student in the class. In our case studies, the interaction among the students in written form was more frequent than in other courses in which the written activity is mainly performed between the student and the teacher.

The written interaction among the students can have several benefits. Today, collaborative activities among the students are planned in most courses (co-located or at a distance). Forming the groups is not always an easy task, because the students frequently do not know each other and have no idea of other students’ personalities or preferences. In the case in which Col·lecció was used, it emerged that when the students were asked to select another student to carry out a project with, they would select one of those with whom they had interacting during the task. A noteworthy point here is that the task mediated by Col·lecció was the very first lab of the course.

What we select to present to a group, what we write, and even the topic we select to write about can help others in the group to know each other and therefore foster collaboration. One student wrote in a comment “I think that I have learned to know some of the students a little bit better. It is interesting to see that one can know a person by the way they write and by the topic they select to comment”. Even more, the user might expect others to judge him/her through his/her comments and choices. This issue contradicts the common position that text-based communication is impersonal. Today we communicate more and more via text-based media. It is likely that we are developing a tacit knowledge, allowing us to learn to know more the person behind a text, even if we have never met that person in real life.

In a second-language course there can be supplementary benefits. Students may appreciate other students' speaking skills, but they usually have a fuzzy idea of their writing skills. Using our tools allowed the students to become familiar with other students' writing skills as well. This could give them additional criteria to compare themselves with the other students and in this way set up their personal goals.

Furthermore, the interaction on the Web helps to develop the use of electronic language in second-language courses. The language used in CMC uses a code that is specific to this form of communication and that is also particular to every language. For example, shortcuts like $U\ 2$ instead of you too in English, du e, oxå, är, instead of du är, också, och, in Swedish, ke instead of que in Spanish. Second-language students might find it useful to learn to communicate using not only that code but also the protocol that is established by the members that use that code. The expanded use of CMC might imply that learning to communicate using this code is as important as learning to use common expressions that are used only in spoken language.

The public aspect of the tool influenced the students' performance positively. The students in the second language course were accurate when writing and indicated that they
dedicated more time to planning their text. The reason appeared to be that others were going to read what they wrote. In other words, the public character of the system was acting as a mechanism to improve the learning process of the students. However, the use of these Web-based tools must be handled with care. Students could easily forget their homework because the awareness mechanism of the system is focused mainly on the author of the document. Furthermore, the most common task according to the log files was browsing the documents, an activity that was invisible for all the members. So it is possible that users perceive that “nothing has happened”, which is not the case if we include browsing the domain by the participants. But disclosing this information might be sensitive. Does the students want others e.g. the teacher whether he/she has been browsing the document, for how long?

- Combining the Web annotation facility and the possibility for users to add the Web-document to a domain creates a collaborative bookmark tool with a social navigation approach.

Col·lecció is a simple way to present and maintain a collaborative bookmark facility, and does not need a complex system in which access rights need to be set up or analysis of the users' bookmark files be made. The Web annotations added by the users can contain relevant information about the web page that could acquaint users with the Web sites and prepare other users to better understand the information that is on the Web page. In the case studies in which Col·lecció was used, some comments would help to navigate on the Web site and also to focus on particularities that certain users might overlook. Furthermore, the interaction among the users influenced the information that the users selected to read. For example, one might choose to read the articles that were included by those who commented “my” article, or to read the articles of those who made an interesting comment. That is, the interaction of the group can influence members' navigation patterns in the shared space as well as on the Web in general. As a consequence, users might find it important to organize the index of contents in two different ways: one in which the content of the document determines the order (e.g. by title) and another one in which the pages are grouped by who added the page to the domain.

**10.2 The annotations experience**

The DHS was used as an annotation tool in four successive academic writing courses. In general, readers and authors use annotation for different purposes. When planning, the author might annotate the bibliography that will be needed. These annotations are very common during the revision process and can be used as a form of communication that relates the author, the reviewer, and the text. During the reviewing process, the reviewer role can be played by the author or by a third party. Clearly, an annotation by a third-party reviewer demands more elaboration than if the author-reviewer is one and the same person. Annotations made by third-party reviewers can also have distinct purposes. They could be used to advise on reading material, or to schedule a meeting with the author. Some annotations can be classified as corrective.
The limitations of the annotation experiences become evident if one considers that in these studies only corrective annotations were encouraged. However, this does not mean that the study was not valuable. From the experience of the DHS used as a corrective-type annotation tool, we can draw several conclusions:

- **Reviewers need access to the original text on the screen, when making annotations.**

The teacher and the students from the A-case studies appreciated the layout of the Add Comment Window (ACW) in which the document to be commented on was aligned to the input area. Also, they often used the paste button that attaches the original text into the input area. The unit of the paste function is the whole original text. However, if the original text is too long, the use of the paste function can be a problem because the user might want to comment on a specific fragment of the text. A similar problem is presented in email programs. The email system could paste the original text of the email to which the users intend to reply. This is mainly used to preserve the context of the dialogue. For both the email program and the paste function of the AWC, the user might be forced to delete the unwanted text that was pasted. A possible solution to this might be to use different units for the paste functions (e.g. paragraph, sentence). The need for this solution is borne out by the fact that the reviewers referred to the position of the paragraph and the sentence in these case studies.

- **Private posting of corrective annotations should be available.**

The public space in which comments are presented in the DHS might inhibit reviewers from pointing out shortcomings or errors in the document. We observed that most of the comments were positive and did not pinpoint any problem. This, of course, might be caused by the lack of experience that the students have when commenting on this kind of topic. Nevertheless, comments made by the teacher of the course were also in most of the cases positive. Having the possibility to send private e-mail messages, the reviewer might not feel the pressure that a criticism would harm students’ confidence.

- **A common mark-up system or change representation needs to be created among reviewers and writers before they engage in a collaborative writing task.**

These conventions should not only be defined but also available during the whole revision process so that reviewers and writers could easily retrieve them when needed. In our system, the conventions that were defined, though far from optimal, were always available for the students through the system. Most of the students used these conventions and according to the log file they often retrieved them during the whole course.

When using plain text to make a corrective annotation, the parenthesis seems to be the most frequently used symbol mark for representing recommended changes. It could be a good idea to avoid this, however, since parentheses could also occur in the text and might be confusing. If parentheses are used, the suggestion has to be explicit, so that the action is verbalized.

Furthermore, the ordinal position of the paragraph and sentence in the text was often used by reviewers to help writers to find the correction context. This suggests that the reviewer
might appreciate a mechanism that automatically numbers paragraphs and sentences. At least this might be useful in the context of a writing course. (as is customary in textbooks)

10.3 The collaborative document production experience

Communication plays a crucial role in any collaborative writing task, and is used for many purposes. Participants need to co-ordinate their actions and for the sake of general understanding they have to motivate them to the rest of the participants. In addition, they might ask for clarification of other participants' actions. It is particularly important for co-authors to be aware of changes to the document and to maintain a common understanding about them.

Col·laboració has been used in our case studies to perform different collaborative writing tasks in which mainly small groups (2-9 members) had to produce a document. The documents were authentic ones that the co-author had to present in formal situations (e.g. a conference paper, annual report of a project). Col·laboració is a working prototype for collaborative writing, although there are points that need to be expanded, improved and examined more closely. The weakest part is related to the translation phase from ideas to text, as editing the document text directly in the system is a rather clumsy and laborious process. Version management is also limited in the system.

Some of the features that Col·laboració presents can be regarded as potential tools to reduce the complexity of collaborative writing activities. We describe them in the following points:

• Supporting a dialogue in a collaborative writing task is a simple and natural tool that co-authors can use to communicate and coordinate their tasks.

From our case studies we observed that the document to be produced was discussed on two levels. One level was a clear-cut discussion of the document content. In Col·laboració the document content is treated separately for every section of the document. McCarthy, Miles and Monk (1991) argue that providing a common report space, significantly reduces the problem of achieving a common ground. The second level is a more general discussion for the co-ordination of co-authors' efforts. This level is treated in the space that is called “Ideas for this paper”, which has been utilized by users to organize the document and to coordinate their tasks of the whole document. User studies made on Col·laboració show that this section was extensively used, and in many cases acted as a coordination center for the task. Not surprisingly, in those case studies in which interactivity among co-authors was expected to be low, this space was not used very much. For example, in the “Masters’ thesis proposal” in which one of the co-authors played only the role of reviewer, this section received merely 16% of the words of comments. If the collaborative system supports the discussion of the document sections, keeping them interrelated but separate, co-authors may not only decide where to place their comments but also speed up a search of one specific topic. For example, suppose that all co-authors have been discussing the Introduction section of a scientific paper. If one of the co-authors wants to recall that conversation later, he/she will probably first explore the space that has been designated to communicate about the Introduction. As a result, the search process is speeded up.
Co-authors coordinated many of their activities using the commenting function. Even face-to-face meetings were organized using this medium. On several occasions we found that a co-author was asking the rest of the group to comment on his/her contribution. Later, the text was revised on the basis of the written comments posted by co-authors to the shared space. Communication of the activities that the co-authors were involved in was also broadcasted using the commenting function.

- **Considering a document as a set of independent section files can support both coupled and uncoupled awareness in a collaborative writing task.**

Co-authors can be involved in the document's sections in different ways. For example, the leader of the writing team might be interested in the discussion and the work progress of all the sections of the document while a particular co-author might be interested in, say, only the section that he/she is responsible for. In Col·laboració, a section and comments on the section are saved in a file of their own. Therefore, they can be handled as modules. Users can select the modules (sections and comments on sections) and form a view of the document and its comments if needed. This approach, of perceiving the document and its comments as individual files treated as a module by Col·laboració can be used as a filter mechanism both to afford an overview of the document and to create a version of the document. Co-authors can select a sub-set of sections including or not including comments to provide an overview of the common document. This subset does not necessarily have to include several contiguous sections. For example, one co-author can be interested only in two sections that could be separated in the structure by other sections, say, the introduction and the conclusion of a document. The system furnishes the user with a view of the document that includes only those sections, breaking the linearity that ordinary word processors impose on document structure.

- **The Web commenting space can be seen as a potential exhibit space for text-to-be-included, and as a window to the Web from which relevant information for the writing task can be viewed.**

Co-authors used the commenting space mainly for communication. However, they also exploited that space in a novel and profitable way. For example, co-authors might feel the need to discuss the text before they make it part of a section. They sometimes submitted the potential text as part of their comment, that is, this potential text was exhibited first in the comment-frame and discussed. If approved, it was made part of the relevant section. Another possible reason for using the system in this way might be that the translation phase of the writing is poorly supported by the system. Users might want to minimize the amount of editing, avoiding insertion of a text that will probably change later. It might be better to discuss it first in the comment space and later make it part of the section.

The other novel use that co-author gave to the commenting space stemmed from the possibility to support HTML tags in the comments. Users could use the tags for two purposes: 1- for formatting reasons; and 2- for including information that was found on the Web by the co-authors. Including information from the Web directly (by inserting the information as a comment) or indirectly (by including a link to the information) was a way to create a window to the huge amount of information that can be found in the Web. Our
studies show that co-authors included in their comments fragments of text they found on the Web and that they shared web links that are relevant to their writing.

- *Keeping the history of the comments could create confusion as it does not always reflect the changes that the document has gone through.*

One problem that we observed was that after the revision based on the comments that the section had received, co-authors that were not involved directly in the process might not understand the nature of the comment. This is what Cadiz et al. (2000) has called “orphaned” annotations. The problem in our system is due to the fact that the whole dialogue is presented in a linear structure. One way to alleviate this problem would be to allow users to indicate in the dialogue which was the last comment that was received before the section was updated. In this way, co-authors will know which comments relate to the current version of the document. Regardless of this issue, we consider that the whole dialogue should be presented, for two reasons. The first is that it gives a design rationale perspective to the document that is produced. This could be of help when a new member later joins the writing team. The other reason is that in a comment, two or more topics could be mentioned and the revision might have taken into account only some of them, leaving others for a later revision.

### 10.4 The use of a web-based tool in the classroom

Many students welcomed the idea of using our tools in the course as a complement to their activities in the classroom. The most frequent aspects that the students mentioned in favour of our tools were flexibility of time to do homework, not having to “chase” others to ask for the document that they were going to work on, the possibility to go through many examples in an easy way, and the possibility to interact with many others in the same class. For the teacher of the course, it was also valuable to have access to all the students' homework from one place and to have a flexible time to work with the students. The teacher in the A-case studies indicated that the students are often not aware that besides themselves there are other students that the teacher has to attend to. This is mainly due to the fact that when working on paper, the comments made on a particular homework by the teacher are commonly given directly to the author and kept by him or her (one student). Using the DHS, students could “see” that the teacher has indeed been working, even when she has not commented on their homework. This also has a second effect: students are usually interested in reading the teacher’s comments that he/she might have made on other students’ work and to share them with all the other students.

However, the flexibility of time that the students experience can also be a problem, since it allows them to postpone the task indefinitely. Also, the teacher might not have the knowledge to deal with the technology for using our system. For example, the teacher of the Spanish course found it difficult to set up his email program to organize the emails that were sent by the system.
10.5 Identity, privacy, and legal aspects

Users’ activities on the Web are easy to record using information provided by the server. The log files that were kept by our system can mirror the user's navigation pattern step by step. However, the type of information thus provided is limited: for example, it is not possible to know whether the user was indeed reading the document content or the comments, or talking on the phone. When our tools were introduced, the users were informed that log files were generated. The system kept information about whether or not a student used the system, what they read, when, for how long, how many times a document was visited, and so on. This raises a general question: how much information should the system provide the teacher with about the students' activities with the tools? In our case, the log files were not at all used for this purpose, but the question raises integrity issues that should be acknowledged.

On the other hand, this kind of data in the log files could be used for design purposes. For example, through the log file we noted that in one of the first versions, after sending a comment, the user clicked again on the link to the document that he/she just commented. This was probably because the system did not provide the right feedback to the users. After sending the comment, the system showed the very first comment instead of showing the comment just added, and thus confirming the users' action. The user therefore “revisited” the document because the comment frame showed the very last comment first.

Sharing information on the Web has, as we have seen, many benefits for our users. However, sharing also means disclosing information to others. Our tools can be run in a Web-browser and no special settings to run them are needed. Users did not install any special software to run our system and therefore they were aware that any person using a Web-browser could use our system. Thus, sharing using our tools could mean disclosing information to outsiders. Disclosing information is always a sensitive question that depends on every individual and the context. Confidentiality is, of course, an important issue when disclosing information. However, in our case studies, we observed that other factors such as authorship, administrative (e.g. copyright), and knowledge about the Web played a crucial role when deciding the degree of security for disclosing information.

We experimented with different access modes to enter the systems. It appears that because the tools were not oriented to mass communication or stranger-to-stranger communication, the degree of security could be lowered, providing users with access modes that were simpler that the traditional ones (e.g. login/password based). Rocco (1998) argues in a study on the impact of electronic versus face-to-face communication on trust development, that trust can be achieved when team members have an initial face-to-face contact. All our users had had initial face-to-face contact and therefore it is likely that the alternative access modes that we offered were accepted.

10.6 Designing from inside

From my perspective, any collaborative tool should support communication to some degree. The Web-based systems that we developed kept “inside” the system a
communication space where the designer and users could communicate. When entering the system, the first information shown to the users was the commenting space that was reserved for the designer and the users. Thus, any user could be aware of the issues that were discussed. The designer received notification in an email message about the new comment and therefore could promptly reply to the users' questions. This reply was made using the commenting space of the tool and therefore available to all the users. The fact that users could see that other users' requests had received a response from the designer might have stimulated them to post further comments related to the interface. Moreover, comments supported HTML tags and therefore the designer could present high quality prototypes to the users and discuss them interactively.

Also, in this way we could collect information from the users in an unobtrusive way as the users sent their comments on a voluntary basis. It is possible that, just after encountering a problem in the system, the users would want to notify about this problem. Furthermore, having the possibility to express the problem “in context” might be easier for the user than waiting for a post-questionnaire that the designer might have planned for testing the system. In fact, the mere fact that the user can express his/her frustration to the designer might be of benefit for the relation between the designer and the users.

For the designer of a Web-based tool it is difficult to simulate all the possible environments in which the users might run the system because they depend very much on preferences set by every user. Users often reported errors that would have been difficult to detect by the designer as they were determined by the particular environment in which the user was running the system.

The users did not only report problems but also suggested features and enhancement to the system. However, we also observed that the interaction among the designer and the users was less in those contexts in which the users were not interested in the design of computer systems, as in the case of the A-case studies.

In general, the most interesting aspect of this approach seems to be that users, while using our system, could perceive that behind the system there is a designer taking care of their comments. Further, the communication is carried out in a dialogue mode, and the users do not have to face questionnaires or interviews that they might find difficult to answer. I do not claim that this method would be enough for the development of collaborative systems but it can be an interesting alternative to involve users in the design of collaborative tools.

10.7 Final words

The use of Web annotations offers a great possibility for collaborative work. More and more people use the Web as infrastructure for collaboration and documents are an important entity in many collaborative activities. The Web itself can be used as a shared space in which co-workers exchange documents, communicate, and co-ordinate their efforts, but are also made aware of the changes that have been made in the documents to be produced. The studies made here have shown that such communication, co-ordination, and awareness can be successfully maintained through text-based dialogue among co-
workers, and that this dialogue is also a valuable instrument for developing collaborative systems “from inside.”
11 REFERENCES

All the URLs were last visited the 8th of May 2003 unless indicated.


Malone, T., and Crowston, K. (1990) What is Coordination Theory and how can it help
design cooperative work systems?, Proc. of ACM CSCW’90, ACM Press, Los
Angeles, California.

Marshall, C. (1997) Annotation: from paper books to the digital library; Proceedings of
the 2nd ACM international conference on Digital libraries, pp. 131-140.

McCarthy, J. Miles, V., Monk, A. (1991) An Experimental Study of Common Ground in


589-607.

for a synchronous-asynchronous group editing environment In: Sharples, M. (ed) -
Computer Supported Collaborative Writing. Published by: Springer-Verlag, 1993
ISBN: 3-540-19782-6

Muller, M., Hasllewell, J., and Dayton, T. (1997) Participatory practices in the software
lifecycle, In handbook of human-computer interaction, Helander, M., Landauer, P.,

Approaches to Teaching Writing, Timothy R. Donovan and Ben W. McClelland, eds.
Urbana, IL: NCTE.

Factors, vol. 40, no. 2, pp. 311-323. URL: http://wearables.gatech.edu/papers/
larry.html

collaborative writing: a comparison of spoken and written modalities for reviewing

Neuwirth, C., Kaufer, D., Chandhok, R. and Morris, J. (1990) Issues in the design of
computer support for co-authoring and commenting, In Proc. of ACM CSCW’90, pp.
183-195.

distributed collaborative writing: defining parameters of interaction, In Proc. of ACM
CSCW’94, 145 -152.


Novák O., Eisenstadt, M., Slavik, P. (2002); Visualization of the dynamic chat communication, KMI-TR-121. URL: http://www.kmi.open.ac.uk/papers/kmi-t-121-pdf


Palme, J. (1999) Support for decisions by E-mail, URL: http://dsv.su.se/jpalme/ietf/JPMADS.html


Smith, C (1997) Vocabulary Instruction and Reading Comprehension, ERIC Clearinghouse on Reading, English, and Communication Digest #126.


APPENDIX

Some of the questions in the Web-survey

Please read the instructions to fill out this survey

You will find several questions, most of them can be answered just by a click of your mouse. You will find the following form elements that allow you to answer the survey.

- Radio buttons You can select only one option of the given ones
- Check box buttons. You can select all the options that apply in your case.
- Text field__________ or
- text area _______________

Skriv på svenska om du vill

Your name:_________________

3. How long have you used the Web?

<table>
<thead>
<tr>
<th>Less than six months</th>
<th>O</th>
<th>from six months to one year</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>from one year to two years</td>
<td>O</td>
<td>More than two years</td>
<td>O</td>
</tr>
</tbody>
</table>

4. Have you ever used any Web based tool in a course for communication with the other members in your class. Please do not consider E-mail as a Web-based tool.

   Yes | O | No | O

5. Have you ever used a Web-based tool before to discuss the content of a document

   Yes | O | No | O

   If Yes, which ones (use “;” to separate)________________________

6. What do you think in general about the discussion?

   it was interesting and useful O
   it was not that interesting O
   Not that much discussed really O
   there was no discussion at all O

   Why?

   ______________________________________________________________
   ______________________________________________________________
7. How many comments have you read?

I read everything O
I read most of the comments O
I read only a few comments O
I skimmed through the comments O
I did not read any comments O

8. How did you react when you received comments from other students? How did you react when students didn’t answer your comments on your postings

9. When, inside THE SYSTEM, you were reading the document others included and the comments made on them,

How easy/difficult did you find it to relate the comments with the content (text) in the document in question

<table>
<thead>
<tr>
<th>Very easy</th>
<th>Easy</th>
<th>Neither easy nor difficult</th>
<th>Difficult</th>
<th>Very difficult</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Why?

Was it difficult to relate a particular comment with past comments?

<table>
<thead>
<tr>
<th>Very easy</th>
<th>Easy</th>
<th>Neither easy nor difficult</th>
<th>Difficult</th>
<th>Very difficult</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
10. A notification e-mail was sent when a comment was added.

Did you find this approach appropriate, why?
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

11. Describe the advantages and disadvantages you found with sharing URLs/comments through THE SYSTEM:

Advantages
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Disadvantages
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

12. While interacting with THE SYSTEM

<table>
<thead>
<tr>
<th>Did you feel the need to print out the comments made on a contribution?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How often did you really print the comments made on a contribution?</th>
<th>Never</th>
<th>Seldom</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
13. Entering THE SYSTEM was done by selecting your name and then pressing enter. Would you prefer to have to use a password to enter the system?  

| Yes, I would rather have a password | No, I am happy with how it is now |

Why?
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

14. How would you classify your awareness of what happened in the system since the last time you visited it

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Good</th>
<th>Poor</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>For the whole system</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>For the articles you were most interested in</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

15. Using the system you had to navigate inside a shared space. How would you classify this navigation:

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Good</th>
<th>Poor</th>
<th>Very bad</th>
<th>Not relevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through the articles (using the index frame; on the left)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Through the comments (using the comment frame)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

16. In THE SYSTEM in every comment there is a navigation bar that looks like this: First-Previous-Next-Latest

<table>
<thead>
<tr>
<th>Never</th>
<th>Seldom</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often did you use it?</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

17. What problems, if not mentioned before, have you faced while using THE SYSTEM?
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

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18. What improvements of THE SYSTEM would you suggest?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

19. What is your opinion on this tool being utilized for the educational field

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

20. During this lab, did you use any other communication channel than the system to discuss the articles with members of your group.

<table>
<thead>
<tr>
<th>E-mail</th>
<th>Face-to-face</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other (use “,” to separate)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Designing, evaluating and exploring Web-based tools for collaborative annotation of documents