Use of graphical modality in a collaborative design distant setting

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Abstract. In this chapter, we are interested in studying the use of the graphical modality (digital sketch and document annotations) as a tool for collective design and remote communication. This study takes place in the framework of a 3 months long collaborative architectural design studio, gathering students from Belgium and France to remotely work together in 3 small groups. The study focuses on the role of the graphical modality inside synchronous remote meetings supported by the Distributed Collaborative Design Studio (DCDS). The DCDS enables multimodal real-time remote exchanges, and aims at remotely re-creating the conditions of co-present meetings. This environment associates a videoconference tool (supporting verbal and non-verbal communication) and an original real-time shared digital hand-drawn sketches system (supporting graphical communication). We identify the types of digital annotations made on the imported document (thanks to the electronic pen), as well as their role in the cognitive design processes and in the collaborative and communication processes. We also identify the different practices of digital sketching, in regard to each group and its collaborative strategies. We discuss the utility of the graphical modality as an efficient support for collaborative synchronous activities and show that the DCDS environment supports different strategies of collaborative design (co-design and distributed design). We conclude on recommendations for improving the system and for designing sketch-based collaborative environments.

Keywords: CSCL; architecture; multimodal collaboration; pen-based interaction

1. Introduction

In a wide range of activity sectors, collaboration has been intensified, notably in the design domains. Collective work is increasingly organized simultaneously (rather than sequentially as it used to be in the past [1]). Moreover, design teams are often geographically distributed, and the need for distant real-time interaction is consequently emerging.

While the best way of ensuring effective co-ordination and collaboration remains face-to-face meetings, convening all participants at the same time in the same

place can often be problematic: travel costs, ecological impacts and immobilization of human resources have to been considered. Moreover, complex activities such as design are characterized by the use of numerous documents, which are annotated or modified. In architecture, these documents are an integral part of the design process, translating existing perceptions and representations, then simulating and testing possible interventions: these documents include sketches, drafts, plans, specifications, etc. They are jointly produced by multi-disciplinary teams and are modified in real time (through annotation) to support the collective decision-making process. There is therefore a need to support rich distant interactions, helped by new means of communication made available, among which one can distinguish two categories:

- Asynchronous systems, which allows file sharing, such as emails, file servers or electronic document management systems. Although they may be very efficient, they are not sufficient: individually used, they force collaborators to construct information incrementally, by successively accumulating content ('versioning'), rather than incorporating it. Making decisions through successive interventions does not encourage connections to be made between different points of view nor the incorporation of all opinions into the final decision;
- Synchronous real-time communication tools such as telephone, videoconferencing or web chatting. Being more and more efficient, they however only convey partial interaction: voice and (to a certain extend) gestures. They are not designed to convey representations of content but only comments on them, i.e. they do not allow an evolving graphic representation to be shared.

In this context, some devices and environments are emerging, enabling rich distant interactions, and are increasingly used in professional but also in educational settings. In this study, we are interested in understanding the use of the graphical modality (digital sketches and annotations) as a tool for collective design and remote communication, through the observation of a remote collaborative architectural design studio using a multimodal real-time collaborative environment, the Distributed Collaborative Design Studio (DCDS). This environment has the particularity to convey in real-time several modalities of exchange: verbal and visual (via videoconferencing), but also graphical (with digital annotation and document sharing).

2. Collaborative design

Collaborative design requires three types of activities: task-oriented activities, process-oriented activities and interaction management activities [7].

Task-oriented activities are directly related to the content of the design. Usually, one can distinguish problem framing, solutions generation and solutions evaluations. Those activities occur in individual design, but also in collective de-

sign, through argumentation processes [5]. Communication is therefore an essential point for solving the design problem: a common understanding of the problem allows to structure it (e.g. suggesting goals), the ideas must be generated by the different actors and communicated to the group (e.g. propositions of design) and, to be efficient, the ideas must be collectively evaluated through communication processes (e.g. criticisms). Stempfle & Badke-Schaub [15] showed that those content-oriented activities account for about 2/3 of the interactions between group members.

Process-oriented activities are necessary to coordinate group actions. These activities are linked to the management of viewpoints, the synchronization and coordination tasks, the conflict management, and the building of a common knowledge [16]. Two modes of coordination can usually take place in collaborative design [6].

• Distributed design where the actors perform distinct but interrelated tasks, each one mobilizing its own resources and its own temporality to carry out specific objectives serving the joint project. The actions are simultaneous, but not joint. The key issue is the coordination of different partners' activities and their temporal articulation.

• Co-design where all the designers respond to the problem in an integrated way, share common goals, generate solutions and evaluate those together. The challenge of this type of collaborative design is the cognitive synchronization, i.e. the creation, through actions of communication, of a shared common context that enables the entire group to coordinate more efficient action.

In collaborative activities, primarily in distributed design activities taking place remotely and in the management of interdependencies between tasks and designers, actors need to have a collective consciousness of the situation, of the changes made on the design object, of the tasks, and of the partners' skills and activities. This mutual consciousness is called situation awareness [3]. While in face-to-face situations actors share a common context, remote interaction can be disrupted by many constraints: reduction of the richness of communication channels (e.g. reduced field of view) and difficulty in sharing information and objects (e.g. troubles communicating spatial reference). To achieve this mutual awareness, it is necessary to share a part of the context.

The different views on the object must be coordinated and integrated to build a common vision. This mechanism, called grounding, involves the construction of a common reference space consisting in all the knowledge that group members have in common and that they are aware to have in common. This space is called a shared common ground [4] or joint problem space [10]. This common ground is not just understanding which actor undertakes any action and how the task is globally conducted, but rather building a strong inter-understanding of each other and solve the problem together. The grounding affects both the problem (a framework for the generation and evaluation) but also the procedures, representations and the knowledge that partners have of each other. The construction of a common ground is a prerequisite for negotiating solutions.

Interaction management activities. These include all activities related to the process of communication. To communicate, one needs to develop a message, but also to check that this message has been understood. It is also necessary to provide clues and positive evidence to the partner(s) to show that the message has been understood: acquiescence, confirmations, start of next speaking turn, and so on [4]. These activities are simple in the case of face-to-face communication using everyday language, but are much more complicated in the case of remote communication, of asynchronous exchanges, and in case of high degree sophisticated or abstract messages.

The communication has therefore a “cost”. The different costs of communication are associated with the constraints of environments for sharing and supporting collaboration. The media of communication can be characterized by several properties that can facilitate exchanges and the construction of a shared common referent: possibility to see and hear each other, simultaneity of actions, sequentiality of the messages, reviewability, etc. [4].

3. DCDS

In order to support remote synchronous collaboration, the LUCID-ULg lab has developed the Digital Collaborative Design Studio (DCDS). The idea is to support real time exchanges with a complete approach, by associating a shared document space and a graphical modality interaction to the classical verbal and visual channels. The aim is to reinforce awareness of each other’s actions and to facilitate grounding and argumentation, by sharing the same contents.

This prototype is composed of two parts.

A hardware part, the Virtual Design Desktop (figure 1), consisting of an electronic A0 drawing table with a suspended ceiling equipped with a projection system offering a large working surface (approximately 150x70 cm). An electronic pen allows the drawing of virtual sketches on this surface. Manipulation widgets are specifically designed to interact only with the stylus in this environment.

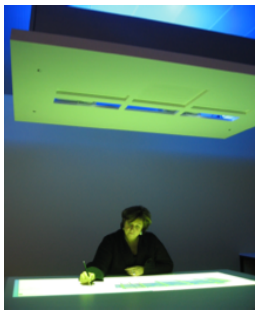

Fig 1 : Virtual Desktop.

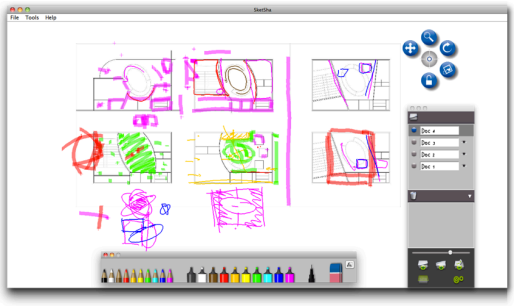

Fig. 2 : SketSha Interface.

A software called SketSha (for “sketch sharing” - figure 2) constitutes a shared drawing environment allowing several users to be connected to the same virtual drawing space. Various functionalities, such as a panel of colored pens (and an eraser) and a navigation tool (to zoom, translate, rotate), are available through intuitive graphical widgets. Some layout facilities also have been included in the prototype, such as the possibility of drawing and managing different sheets of virtual paper, of deleting or duplicating them, and of managing their transparency. The software also enables users to import Computer Assisted Design (CAD) plans and bitmap images. This software captures the strokes that compose the sketch, shares them between the different distant locations (through a standard internet connection) and transmits the complete information in real time onto the active boards through video-data projectors.

A 24-inch screen completes the system, with an integrated camera which enables the participants to talk to each other, and to see each other face, arms and hands during the real-time conference. Pointing, annotating and drawing are made possible due by the electronic pen. Social exchanges are transmitted through the external modules of video-conferencing in order to support the vocal, the visual and the gestural aspects of the collaboration.

Fig. 3 : meeting on the DCDS

In respect to the user-centered framework underlying the development of the DCDS, the system has already been tested in different short and long collaborative work settings with students and professionals [see 2,8,9,12,13].

4. Issues and setting

This study aims at understanding the role of multimodality and interactive annotations in the collaborative process of designing. In particular, we address two types of issue in this chapter.
First, we wish to know the impact of the document sharing on collaborative process. The system, by allowing the real-time sharing of documents and interactive

annotations, may support the awareness, the grounding and facilitate negotiation of solutions. We therefore expect its use to be associated with a strong quality of collaboration and to support "coupled" versions of collaboration (i.e. co-design, [6]). The second issue is related to the way the graphical modality is used to support the collaborative design process**.** We wish to understand how the designers use the graphical modality to support their design process (generating solutions, reframing the problem and evaluating solutions) and their remote collaborative process (awareness, grounding, interaction management). This study is a first attempt to identify and describe the role of interactive distant annotations in collaborative design.

To answer these questions, we observed a collaborative architectural design workshop, co-organized by the Nancy School of Architecture (France) and the Faculty of Applied Sciences of the University of Liège (Belgium). Three groups of 5 students (mix with French and Belgian students) worked during one term (3 months) on an architecture program. Each group had to design collaboratively and remotely a building (a cultural center), starting from a program completely defined. For this purpose, the groups had several tools at their disposal: asynchronous collaborative tools (mails, file exchange servers,…); usual synchronous collaborative tools (chat, videoconferencing…); and a one-hour meeting each week on the DCDS. They were allowed to upload their documents in the system, to annotate them during their discussion, and to save the edited documents.

This study focuses on the weekly synchronous meetings with the DCDS. We videotaped each session and recorded all the documents, digital drawings and digital annotations. The video data represents 8 one-hour meetings for each of the 3 groups, for a total of 24 hours of video. More than 700 documents were analyzed to identify types of annotation.

5. Method

Our method is a comparative descriptive approach. We compared three groups in the same specific setting, in order to identify similarities and differences on collaborative activity, that can inform us on the benefits provided by the system and its limits. The large corpus enables us to make a first identification of the different roles, types and functions of annotations.

5.1. Assessment of the collaboration

In order to understand and describe the collaborative process, we made video analysis supported by a grid to assess the quality of collaboration. This grid, in-

spired by Spada's works in the CSCL domain (see [15]), enables to quickly assess the collaborative process according to six dimensions, based on the observation of behavioral indicators (see table 1)

Dimensions	Definition	Indicators
1. Fluidity of collaboration	It assesses the management of verbal communication (verbal turns), of actions (tool use) and of attention orientation	• Fluidity of verbal turns • Fluidity of tools use (stylet, menu) • Coherency of attention orientation
2. Sustaining mutual understanding	It assesses the grounding processes concerning the design artefact (problem, solutions), the designers' actions and the state of the AR disposal (e.g. activated functions).	• Mutual understanding of the state of design problem/solutions • Mutual understanding of the actions in progress and next actions • Mutual understanding of the state of the system (active functions, open documents)
3. Information exchanges for problem solving	It assesses design ideas pooling, refinement of design ideas and coherency of ideas.	• Generation of design ideas (problem, solutions, past cases, constraints) • Refinement of design ideas • Coherency and follow up of ideas
4. Argumentation and reaching consensus	It assesses whether or not there is argumentation and decision taken on common consensus.	• Criticisms and argumentation • Checking solutions adequacy with design constraints • Common decision taking
5. Task and time management	It assesses the planning (e.g. task allocation) and time management.	• Work planning • Task division • Distribution and management of tasks interdependencies • Time management
6. Cooperative orientation	It assesses the balance of contribution of the actors in design, planning, and in verbal and graphical actions.	• Symmetry of verbal contributions • Symmetry of use of graphical tools • Symmetry in task management • Symmetry in design choices

Table 1. Dimensions and indicators of our method

These dimensions cover the task-related, group management and communication processes and enable to calculate both a score on each dimension and a global score on the collaboration quality. This grid has proven to have a strong inter-coder reliability (see [2] for details).

5.2. Graphical Activity analysis

We made video analysis of a sample of video extracts in each group. These videos have been analyzed together by an ergonomist and an architect. This sample has been made in order to have a representation of all kinds of drawings and annotation, in each group and in different moments in the design process.

We tried to identify the uses of the graphical modality, i.e. digital drawings and annotations, in the collaborative design process. Our observation focuses on the roles and functions of annotation in the communicative process, the graphical characteristics of the drawings and the difference between the groups, according to their modes of collaboration. Complementary to these we also analyzed all the documents used during the DCDS sessions.

6. Comparison of the groups' collaborative and graphic activity

Clearly, the three groups do not collaborate in the same way.

The **group 1** sets up a "distributed design" process: the members work individually asynchronously, take some decisions, and the propositions are presented to the group during the synchronous sessions. Specific issues are resolved collectively in those synchronous meetings and the work is divided. Each member leaves the session with specific tasks to be done for the next weekly synchronous meetings. Between two DCDS sessions, students exchange documents and questions by email. Intermediary scores on the collaboration quality scale characterize the group during their synchronous meetings. Comparatively to the other groups, they have a weak score for the "argumentation and consensus" dimension: solutions are chosen amongst the individuals' propositions, but are not clearly negotiated. But the group globally manages well the design process: the teachers judge the results of the design as excellent.

In general, the **group 1** uses graphical modality for presentation: the documents are brought into the workspace by the different designers, each in turn explains the contents of the documents, using the annotation as a medium of presentation. Designers highlight essential parts of the design, add pieces of information to explain the document or draw pointing annotation to identify the elements of design to which they refer. They mainly use annotation, which does not convey new information to the document, like pointing and especially highlighting (figure 4). Sets of questions and answers regularly take place between students and teachers (or between students themselves) and the graphical modality is used to identify the elements of design on which the discussion focuses. Most of the time in this group, the documents are only annotated by their authors and the teachers. Nevertheless, the frequent highlighting of documents elements seems more than just

communicating about the drawing. We have shown, in individual architectural design, the importance of highlighting for the decision making process [11].

The primarily purpose of annotations is communication, for building a shared vision of the project and for taking decisions. The generation of solutions therefore takes place outside the meeting sessions, and synchronous DCDS sessions are used to evaluate those solutions and to reframe the problem.

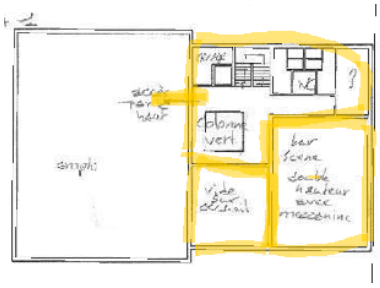

Figure 4 : highlighting annotations

Group 2 establishes a "co-design" process: key structural decisions are taken during DCDS sessions, a lot of collective propositions are done during those meetings. Between two sessions, students work locally in small groups to implement the decisions and propositions (by drawing plans and model). The formal exchange for explanation and presentation of the documents takes place by email before the synchronous sessions, to free up time during the DCDS sessions for collective decision-making. The group has excellent scores on the quality of collaboration scale all along the process. Especially, it surpasses the other groups in the “information exchanges”, “argumentation and consensus” and “cooperative orientation” dimensions. They are truly engaged in a collaborative design, where all members participate to all decisions. The teachers judge their design outcome as excellent.

This group is characterized by a very different mode of operation. Very quickly, the members choose a unique concept for the project and the meetings on the DCDS are used to solve important issues, to suggest ideas and take strategic decisions. The students spend much less time to present documents to each other, in benefit of the generation of solutions and collective decision-making. Here, the graphical activity is directed towards the design. Students use annotation to bring new information to previous representations: about 2/3 of the annotations conveys original piece of information to complete or modify the imported documents. In particular, this group uses a lot of complex drawings over the plans and images, which are mainly used to generate ideas. The various documents are annotated by all group members, which indicates a real sharing of representations. We may note that this group draws also more digital sketches than the others (on virtual white sheet).

This characterizes the common generation of solutions and a common decision process. The focus here is on the generation and criticism of novel ideas. The precise resolution of the generated ideas (i.e. increasing accuracy, reducing ambiguity, choosing one solution among the several possible solutions) is done asynchronously.

Group 3 is characterized by the establishment of a "distributed design" process and by the emergence of conflicts early in the workshop. Each student in this group makes his own propositions alone and the DCDS sessions are used to present each own work, to try to convince the others of one own ideas and to require teachers help and comments if necessary. Students present themselves each other's work, but there is little interaction within the group. Most of the discussions are held between the student presenting his own work and the teachers. These discussions are sometimes punctuated by questions and answers from other participants. The group obtains weak score on collaboration scale. In particular, they are globally weaker than the other groups in three dimensions: fluidity of collaboration, mutual understanding and information exchanges for problem solving. This functioning generates (or is generated by) a climate of conflict within the group. It is accompanied by an inability to agree on a unique concept or a common vision of the project. Thus, ambiguities and disagreements about the project persist until the end of the workshop. The synchronous collaboration sessions and the large number of emails exchanged between sessions fail to resolve the conflict. After 8 weeks, the conflict being too important, this mode of cooperation is interrupted by the teachers, who decide to impose a formal structure for sharing responsibilities and for distributing the tasks. Thanks to this external help, the group manages to finish the workshop decently. Their design outcome is nevertheless judged as weak.

In terms of graphic activity, this group mainly uses pointing annotation (see figure 5). Once again, this observation reflects the collaborative activity of the group. They take few or no decision together and use DCDS synchronous meetings to try to convince each other that their own solution is better. For this purpose, it seems that pointing is the most efficient way of using the graphical modality. Annotations are almost exclusively done by the authors of the documents, in order to convince their partners.

Here, the aim of the synchronous sessions is neither to generate all solutions, nor to collectively evaluate the propositions, but rather to convince the partners. The graphical modality is essentially used to support the presentation of documents, which explains the prevalence of pointing annotations. Errors are poorly detected and poorly recovered: in-depth analysis of the proposals rarely occurs.

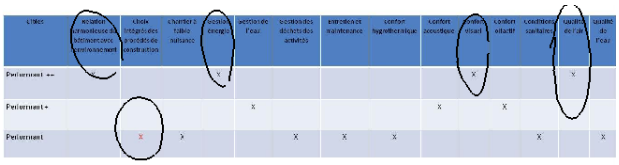

Figure 5 : pointing annotations on a document.

These descriptions highlight three clearly different modes of collaboration and three different annotation practices. The possibility to use shared representations and to annotate them interactively does not seem to produce strong collaboration. Rather, the groups' collaborative practices seem to determine the graphical behaviors.

7. Graphical activity analysis

We identified several functions of annotation as well as differences in the uses by groups and individuals. According to our observations, digital annotations serve different roles during the collective activities.

Draw attention to one element of the design. This function aims at supporting communication by spatially contextualizing the discourse on the documents. It is the deictic role of annotations. This role is carried on by pointing annotations but also by some highlighting annotations. These annotations are similar to pointing gestures and can spatially locate a question or comment. This feature of the annotation is temporary: once made, the trace is no longer necessary.

A second function, close to the previous one but however distinct, consists in **putting in correspondence elements present in several documents**. Thus, the annotations do not only support the speech, but also help to make connections between multiple representations, on a graphical mode. In the illustration below (Figure 6), the designer, explaining to its partners the principles underlying its construction, explicitly shows on five drawings where is the "heart of the project." This function is supported by highlighting or pointing annotations. No new information is specifically added to the document, but this mapping can convey a specific message, namely the identification of several drawings of a common concept.

Designers also use annotations to **contextualize the document** on which they are drawn. They may typically indicate North or elements of surrounding context (road, buildings neighborhood, etc.). This contextualization is important in the course of communication, but does not create new information to be conserved. These annotations are explicitly intended to reduce ambiguity and synchronize the different viewpoints.

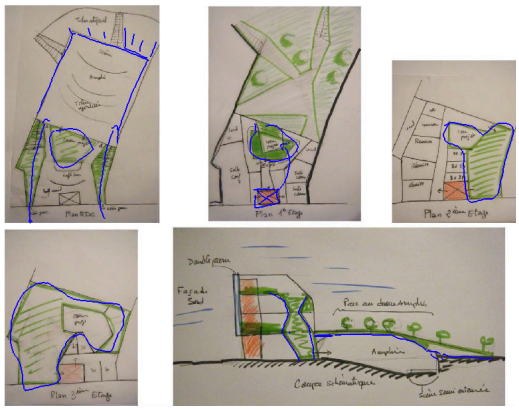

Fig. 4 : identification of the “heart of the project” (in blue) with digital annotations on previous documents (scanned pen-and-paper sketches).

Another function is **to complete the document** with information not present explicitly, relative to the "functioning", the use or the atmosphere in the building. These are elements that traditional architectural representation does not contain, such as circulation information, ambiance, luminosity, etc. Indeed, plans adopt a strictly geometric perspective on the architectural object. This added information explains how to interpret the plan. The digital annotation, accompanied by speech, can compensate the weaknesses of other representations (models, plans, images, etc.). Some complementary digital sketches can also be made next to the document, such as perspective drawing, detailed design or synthetic cross-section.

Graphical annotations are also used to **“synthesize” the document**. In this case, the designers highlight specific parts of the plans or models to emphasize the main elements of the building. The design is synthesized into "functional areas" which make up the premises of the building. This function is performed with highlight annotations and no new information is brought to the document. This synthesis reduces the complexity of the design and some of the uncertainty, but it does not add precision to the design, the underlying document being often more accurate than the annotation.

Sketches and annotations are obviously also used to **come up with ideas**. These generations of solutions, acts of conception, are supported by drawings and elements such as annotations as well as digital sketches. The group members and teachers can directly visually and graphically assess these new ideas.

Annotations sometimes meet several of these functions, and it is not easy to establish a strict correspondence between the form of annotation and its function. Note that all these functions have been identified in all groups.

In the groups, we moreover observe that each group member usually uses a specific color to annotate the document. This may allow the group to identify the

annotations' authors and to trace the argumentation process. But this behavior is not systematic. Participants change pen color when they have to make several sketches or annotations, not when they just have to make a quick note.

Our observations show that graphical modality is a flexible tool for collaborative design, which can serve three main purposes.

Support the communication. This is primarily to support the speech and the argumentation, by highlighting the spatial elements to which the designer refers to when he explains the documents. It is also a way to convey gestures, weakly supported in our remote environment. The graphical modality and digital sketching provides a "cheap" and quick way to perform temporary pointing gestures.

Support the design (idea generation, questions and answers). The graphical modality enables to express ideas, to complete plans and models, to ask and answer questions, to share reflections by expressing them geometrically, etc. One can thus observe sequences of questions and answers with pointing, verbal criticism with drawn counter-proposals, etc. The graphical modality therefore supports the argumentative episodes, typically observed in co-presence activities.

Support the construction of a common ground. By adding information not explicitly present on the documents, by adding elements of context and by graphically comparing several documents, the group ensures that everyone understand the architectural object being designed in the same way, and share a common vision of the project.

A striking element emerging from our observation is the differentiation between two attitudes regarding the annotation practices. In particular, these attitudes concern the link between annotations and underlying documents.

- The first approach is to perform many annotations in a very spontaneous way, directly on the drawings (no matter who is the author) without erasing them. It seems that for some individuals the annotation is by nature ephemeral, and therefore it can be used flexibly and intensely. This is using the environment as a **temporary workspace**, allowing all compositions, simulations and graphic gestures. Here, it seems that the process is more important than the result.
- In the second approach, the annotations appear to have an informative and durable role. This is using the environment as a **document editor**. The authorship of the document is an important matter: users annotate much less the documents created by the others, use the eraser and make drawings more accurate. From this perspective, users 'respect' documents and draw on them only to add relevant information. This information is used after the synchronous meeting. The focus here is on the content of the annotation, rather than on the process.

Both of these attitudes depend on three factors:

- The group collaborative process: group 2 is clearly more engaged in using the DCDS as a temporary workspace, to generate ideas without constraints. The group 1 and 3 use the DCDS rather to edit their documents quite cleanly.
- The authorship: students tend to use their own documents (i.e. the documents they produced personally between two DCDS sessions) as a temporary workspace, whereas they tend to draw much less annotations, and do it in a more cleaner way, when on others' documents.
- We also observed some personal preferences. For example, one of the two observed teachers is always annotating intensely all documents (workspace) whereas the other one is always more accurate and tends to erase his graphical comments if they are no more necessary.

8. Conclusion

This study aims at understanding the role of the graphical modality in remote collaborative design. We followed three groups of students during a 3-months workshop and observed their annotations practices during weekly synchronous distant collaborative sessions. These meetings are supported by the DCDS, a multimodal collaborative environment, which enables to communicate by speech, to see each other, and to draw and annotate on a shared space thanks to an electronic pen.

This first study, specifically focusing on the use of the graphical modality during distant collaboration, brings 3 types of results.

- The graphics behaviors are largely dependent upon the group collaborative process. Although the digital drawings and annotations enable to support very "strong" versions of collaboration (in which group members share ideas and resources and in which solutions are collectively elaborated and evaluated), the availability of the graphical modality does not seem to generate those kind of collaborative processes. Rather, our observation shows a flexible use of the digital drawings.
- There are several functions of digital annotations, which support communicative processes, design content and the construction of a common ground. Those are three essential processes in collaborative design.
- We identified two attitudes towards the interactive annotation of documents.

Our future work will be to extend these results by examining them in a more systematic way: by the mean of experimental studies allowing to change the conditions of distant sharing, and by the development of proper methods to address the role of graphical modality and its complementarities with other modalities (gestural and verbal).

To enhance our system, and in general to design sketch-based communication tools, we suggest two main recommendations according to this study.

- Support communication and design activities by specific means. The idea is to reconcile the two attitudes: “document edition” (which necessitate lasting annotations) and “workspace” (in whom a lot of annotations are temporary). To convey this last type of information, using gesture recognition or temporary traces tools may be an efficient solution.
- Support seamless integration with other tools. The vast majority of collaborative activity takes place on previously made document. The system should favor an easy import and export of the documents, to enhance possibilities and allow more flexible organization.

9. Aknowledgements

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