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## Changing face-to-face communication

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# 7 The Organization of Computer-mediated Communication

In chapters 7 and 8, we discuss two studies that have been carried at the beginning of the research project. We deliberately planned these studies at the start as part of an exploratory phase. The exploratory studies prevented us from making any premature decisions with regard to the requirements specification. First, we studied the basic properties of the envisioned collaborative tools. It helped us to get a grip on a relatively new topic of networked learning in face-to-face situations.

Chapter 7 discusses one of the initial guidelines – parallel access as floor-control mechanism – that aims to stimulate equal participation and the free exchange of ideas. We present a study that investigates the effects of *parallel access* on the coordination of the communicative actions in the shared digital workspace. The outcomes of that study provided the ground for the development of two additional design guidelines – i.e. design guidelines 5 and 6 – that aim to make the sequence of computer-mediated acts more coherent.

## 7.1 Problem Analysis: Parallel Access as Floor-control Mechanism

As mentioned in chapter 6, it is expected that parallel access as floor control mechanism counteracts the ineffective communication patterns “interruption” and “product blocking”. It is expected that parallel access leads to a more even participation because group members can express their ideas without any direct interference of other group members. Parallel access allows users to share their ideas directly with the group without any delay or interruption. Users can express their ideas more freely. In sum, this should result in a more balanced pattern of participation.

Parallel access opens up new possibilities for communication but it also creates new problems. Parallel access comes at some cost; it leads to new communication challenges for the group. These challenges have mainly to do with the coordination of the individual communicative actions.

Each floor control mechanism – turn taking and parallel access – has its own dynamics. They bring about their own specific opportunities and problems with regard to organization of interactions. Students in the parallel-access condition have more time available to perform actions, i.e. they do not have to wait for their turn but can put forward their contributions without any delay. This results in a sense of freedom to act, whereas working in the turn taking condition gives a feeling of being restricted. Parallel access as a permissive floor control mechanism leads to a greater number and a greater diversity of actions being performed in the shared workspace (Heeren, 1996). The group must manage this expansion and diversity of actions properly. They have to organize the constant flow of individual messages into a meaningful representation of their digital discussion.

Initial studies with parallel access as floor-control mechanism revealed that the number of contributions in the shared digital workspace expanded quickly. With parallel access, students hardly experienced any limitations with regard to the expression of their ideas. Students added many contributions in a relatively short period without any constraints. Consequently, the shared workspace of the collaborative tool became crowded with contributions and the students spent a lot of time organizing their contributions into a meaningful whole. The permanence of contributions even worsens the problems that students experience because all the contributions remained visible in the shared workspace.

The groups were faced with the challenge to organize their profusion of ideas into a meaningful whole. They must relate the individual contributions into a comprehensible representation that displays the line of reasoning of the group. The initial studies showed that the groups differed in respect to manner in which they achieved that task: some groups organized their interactions better than others did. These observations made it clear that the groups may benefit from some additional support that would guide their interactions in the shared digital workspace. In this chapter, we discuss the development of such kind of support. Therefore, we had to revisit research question three and four of chapter 1 that states:

*Q3: How do the structural features of the medium relate to the ineffective communication patterns?*

*Q4: Which structures makes the desired patterns of communication more likely?*

Research questions 3 and 4 were further specified by the following two questions:

1. What kind of principles do groups apply to organize their computer-mediated exchanges into a coherent and meaningful whole?
2. Could the insights, which we gained from answering the previous question, be used to improve the support? Moreover, how should such an improvement look like?

## **7.2 Study I: The Organization of Computer-mediated Communication**

We carried out a study at a secondary school with fourth level students who varied in age between 15 and 17 years. The study involved one class with 7 groups of three students. The aim of the exploratory study was to investigate the computer-mediated communication patterns associated with parallel access. The students in our study took part in a geography course. The topic that the students had to address was the social image of a certain geographical region, in their case the view that people have of Salou, a popular holiday destination in Spain.

The learning method that the teachers applied was collaborative learning. Students discussed the topic in small groups of three students. The pedagogical objective of these discussions was to address the students' (pre)conceptions with regard to Salou as a popular holiday destination for young people. The students had to formulate arguments in favor or against the claim that this region was mainly a holiday destination for youngsters. Such an argumentative discussion is an important pedagogical strategy for knowledge construction (Mason, 1998). When a learner argues he or she constructs and put forth an argument that another learner will interpret and criticize, after which the first learner will respond, perhaps by revising the argument (Hitchcock, 2002). The notion of 'winning' an argument is completely irrelevant – if both counterproductive – to the primary goal of clearly articulating ideas (Schrage, 1991).

## Learning Environment

As mentioned at the introduction, the studies of chapter 6 and 7 have been carried out at the beginning of the research project *before* any software prototype was available. It means that we used an existing collaborative tool – the Digalo tool – to study the dynamics of parallel access. The Digalo tool was developed by the DUNES project, initially to support online collaborative learning but the tool has also been applied in face-to-face learning situations (Schwarz & De Groot, 2007; Overdijk & van Diggelen, 2008). The Digalo offers two modes of floor control: turn-taking and parallel access. In our study, we used parallel access as a means to access the shared workspace.

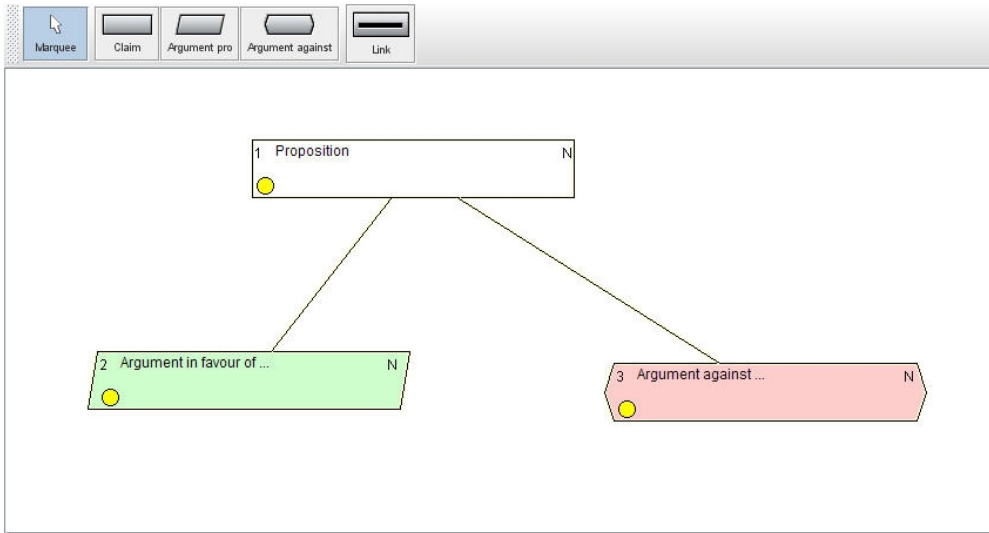
### *The Digalo Tool*

The Digalo is a Graphical tool that offers its users a two-dimensional shared workspace that is based on a concept-mapping interface. Such an interface allows users to construct a spatial representation of concepts and their interrelationships. Users put forward their ideas in the shared workspace as textual objects and they visualize a relationship between two concepts by drawing a line between the two (see Figure 7.1).

The Digalo supports collaborative argumentation. The tool has a pre-defined notation system that labels the textual contributions. A user selects a specific label from the menu at the top of the window and attaches that label to the textual contribution, for example an argument in favor or argument against a proposition. The shared workspace represents the contribution as a card that has a distinct shape and color. Shape and color represents the specific label attached to the contribution.

A contribution only becomes visible for the other users after the user types in a text and presses on the “submit” button. The text that is displayed in the card is called the “title”. Users can also add an additional text associated in a comment window. The comment text is not directly visible in the workspace but it appears on the screen when a user selects the card.

Another feature of the Digalo is the possibility to link contributions to indicate a relationship between the two. Users can link two contributions that, in their view, are related by drawing a line between the two contributions.



*Figure 7.1: The user-interface of the Digalo tool.*

### *The Learning Task*

The study took place during two lessons of 45 minutes each. During the first lesson, the students received their task instructions, studied information that has to do with the task and they became familiar with the basic functions of the Digalo. In the second lesson, the students performed a role-play discussion. Role-play is one of the tasks that incorporate authentic activities based on a real-life situation (see chapter 5). The three roles that were defined beforehand are: 1) a youngster, 2) a parent with young children, and 3) an elderly person. As a preparation, the students received role-specific information about the popular holiday destination Salou.

The discussion in the Digalo focused on the central claim: “Salou means discos, beaches, parties and flirtation”. The argumentative diagrams that the students constructed with support of the Digalo visualized the students’ argumentation. During their discussion in the Digalo, students could choose between three types of contributions: 1) arguments pro, 2) arguments contra, and 3) information source.

### **The Analysis of Student's Actions within the Shared Workspace**

The analysis of the collaborative activity focused on students’ ongoing actions within the shared digital workspace of the Digalo. The Digalo tool makes certain actions available for the students. We identified 10 different kinds of actions that the students

Action	Description
Add shape	Add a shape in the drawing area.
Add title	Add a title in the shape.
Add comment	Add a comment with a title (the comment is not directly visible. After one double click on a shape a comment window will appear).
Add link	Draw a line between two shapes that are associated together.
Move shape	Move a shape within the drawing area.
Change title	Change the title of the shape.
Change shape	Change the shape, i.e. change the type of contribution.
Delete shape	Delete a shape.
Delete link	Delete a link.
Resize shape	Change the size of the shape. For example, the user can enlarge the shape when a title is a few sentences long to make the whole title visible.

*Table 7.1: Actions that can be performed in the shared environment.*

could perform with the support of the Digalo (Table 7.1). These 10 different actions enable the students to put forward contributions and to organize them into an argumentative diagram that represents their line of argumentation.

A sequential analysis of the students' actions in the Digalo showed a typical pattern. Students put forward their ideas with the actions "Add shape" and "Add title". When the students placed 4 or 5 shapes in the shared workspace, they began to organize the diagrams with the action 'Moved shape' that moves a contributions to a different location in the shared workspace. Students also linked contributions to indicate relatedness. In general, all groups added links between cards when the shared workspace contained approximately 9 shapes. As mentioned before, synchronous action in a shared workspace quickly resulted in a crowded diagram. When three group members submit contributions more or less simultaneously, it is hard to keep track of all entries, let alone to get an overview of the discussion. This is why most groups organized their diagrams when complexity increased.

## Three Organization principles

Students used a lot of time organizing their contributions into a comprehensible diagram. Some groups managed to coordinate their actions into a clear direction; they applied a clear principle that guided the actions in the shared workspace. The diagrams of these groups looked organized. They came up with more rigidly structured diagrams. Other groups failed to do this, their diagrams remained scattered. These groups constructed less structured, extensive diagrams that may look chaotic for an outsider. An analysis of the structure of diagrams revealed that the students applied three principles to organize the contributions that were placed in the shared workspace (van Diggelen, Overdijk & Andriessen, 2004). These principles are (Figure 7.2):

- type of contribution,
- a link between two contributions,
- the spatial position of the contributions.

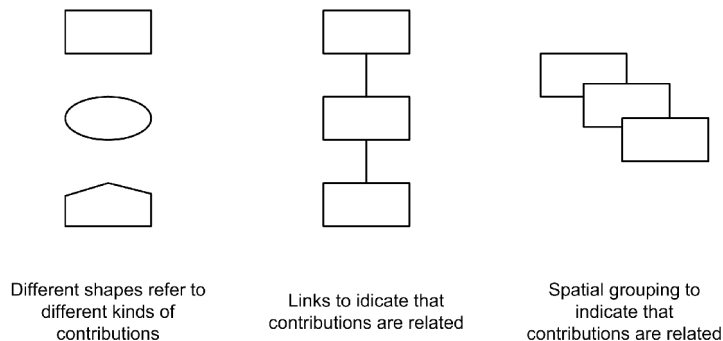


Figure 7.2: Three principles for organizing a Digalo diagram.

### *Type of Contribution*

First, users can organize a diagram with the support of a notation system that attaches a label to a contribution. These labels are visualized in the shared workspace by their shape and color. They give additional meaning to a contribution. For example, the notation system that we applied made a distinction in shape and color between arguments in favor or against. These different types of arguments are clearly recognized in the shared workspace. For example, one can see at first glance if an argumentative diagram contains many arguments against (a red color) or in favor (a green color).



### *A Link between Two Contributions*

Secondly, the use of a link helps students to indicate coherence and meaning. A user adds a link between two cards to visualize relatedness. Links make it possible to organize the sequence of messages differently; it exceeds the temporal order associated with verbal exchanges where coherence is based on turn taking and adjacency pairs (see Chapter 5, design guideline 7). The principle of linking cards enables users to go beyond the limits of a temporal sequence of ordering. Users organize their contributions based on related meanings so that they create a logical order that reflects their line of reasoning.

### *The Spatial Position or Grouping of a Contribution*

Users do not always use a link to indicate a relationship between two contributions. Sometimes they position contributions near each other to indicate relatedness. In that case, users fully use the spatial characteristics of the two-dimensional workspace. As a result, they create meaningful areas that contain cards that belong to each other. Cards that are in close proximity suggest similarity, association, inferences or causality. This principle for organizing the contributions based on closeness is called 'spatial grouping'.

## **Organization Principles and the Appearance of the Diagrams**

During the first studies, students worked within the two-dimensional workspace of the Digalo without hardly any restrictions. They could access the shared workspace simultaneously without any temporal or spatial constraints. Furthermore, students did not receive any specific instruction with regard to the organization of the diagram. This led to diversity in appearances of the argumentative diagrams: the patterns and number of contributions differed to a large extent.

Some groups constructed more rigidly structured diagrams with a clear pattern. However, the leading pattern differed between groups. We observed, for example, that one group constructed a diagram that represents one line of reasoning (diagram 1, Figure 7.3). Contributions were placed beneath and next to each other in a logical order. A second group constructed a diagram that emphasized opposing standpoints (diagram 2, Figure 7.3). Arguments in favor and arguments against were separately grouped together in the left side and the right side of the workspace. The maps that displayed a more rigid structure can be characterized by the fact that all the

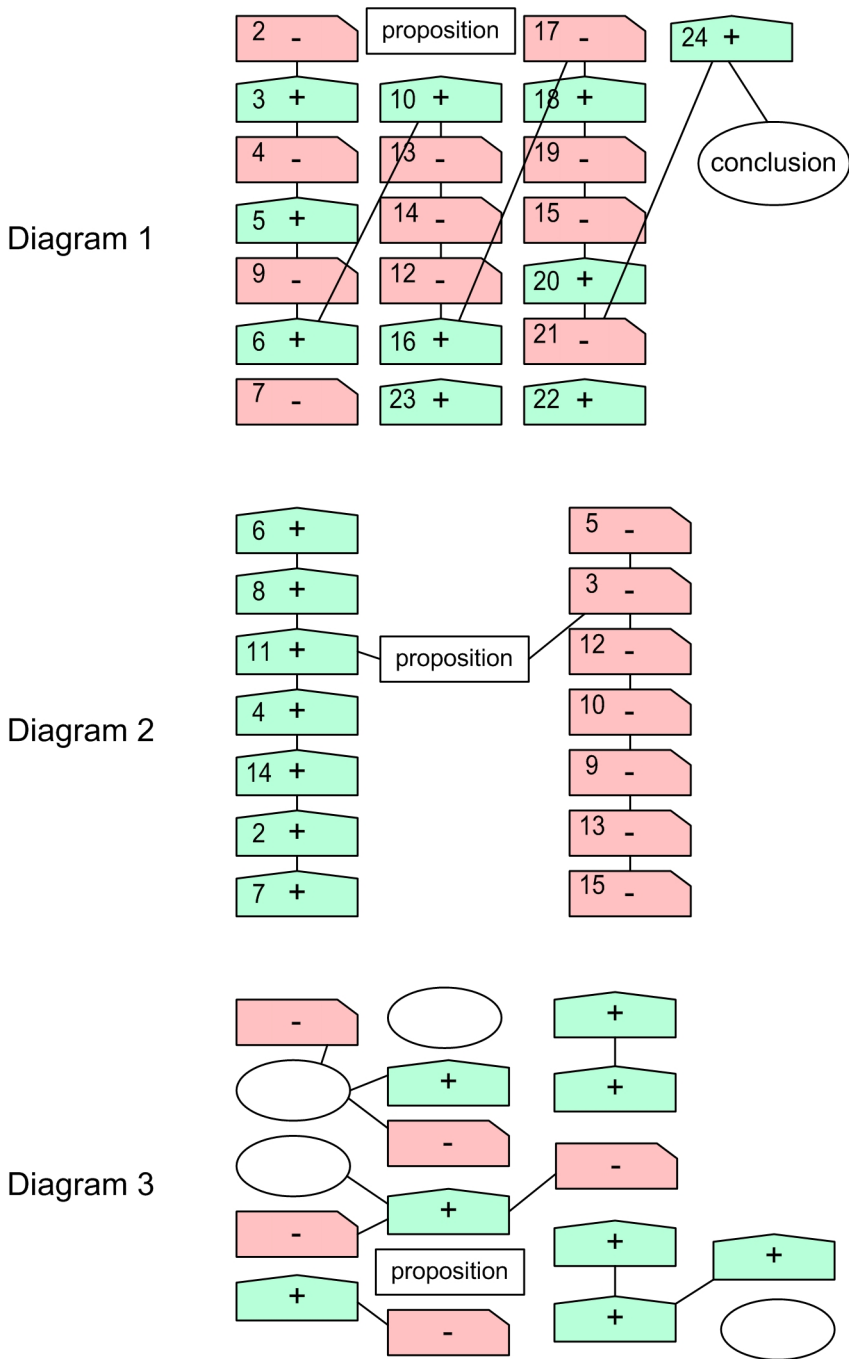


Figure 7.3: Schematic examples of Digalo diagrams.

organization principles strengthen the representation of one leading pattern. For example, in diagram 2 the arguments in favor and against were: 1) linked, 2) grouped together spatially, and 3) recognizable by their shape and color.

The more unstructured diagrams lacked one clear leading pattern. From diagram 3 (Figure 7.3) one can see that the students used two of the organizing principles: 1) different types of contributions, and 2) links between the contributions. What the diagram lacked was the use of the third organization principle: the spatial grouping of contributions. It resulted in rather complex diagrams. This became even more apparent when the number of contributions increased.

## Conclusion

To summarize, observations suggest that the diagrams became crowded and scattered if the groups did not use the third organizing principle of spatial grouping. By far the most common method for indicating relatedness was to position contributions that are related close to each other. This observation is consistent with the studies about functional spaces that were discussed in chapter 6. Dwyer and Suthers (2006), for example, observed that spatial proximity was used to group contributions into meaningful threads. If the groups did not appropriate the spatial dimensions of the shared workspace, it became less like that they could organize their interactions into a coherent whole. This insight served as inspiration for the development of design guidelines 5 and 6 (Table 7.2). Table 7.2 describes the two design guidelines in the form of the pattern language (Alexander, 1979) that has been introduced in chapter 2. The description makes a distinction between problems, solutions and the context within which the problems and solutions emerge.

## 7.3 Study II: A Refinement of the Design

Design guideline 5 and 6 aim to solve the coordination problem that users experience when they can access the workspace simultaneously. Design guideline 5 assumes that students are better able to coordinate their actions when the shared workspace is divided into functional spaces. Design guideline 6 states that these functional spaces should have a distinct meaning. The guidelines assume that it will be less likely that students act arbitrary when the workspace is divided into functional spaces relevant for their task performance. The tool must offer the students a meaningful structure that is

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Design pattern for guidelines 5 and 6	
Problem	A diagram becomes crowded in a relatively short time when users put forward contributions simultaneously. As a consequence, users spend a lot of time organizing their contributions in the shared workspace into a coherent whole.
Solution	It is hypothesized that a structure that divides the workspace into functional spaces helps users to organize the diagram into a coherent whole. It makes the users aware of the spatial properties of the shared workspace as a means to the structure their shared representation. These functional spaces have a meaning relevant for the problem or task at hand. They display basic aspects of the problem space.
Context	The implementation of the two design guidelines depends on the learning task. These functional spaces have a meaning relevant for the problem or task at hand. They display some basic properties of the problem space. This may vary from situation to situation.

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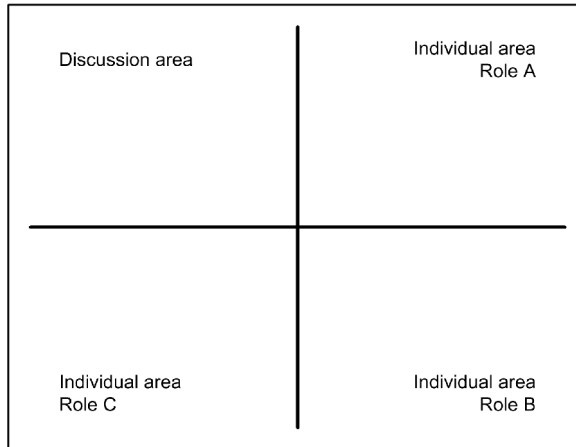
Table 7.2: Design guidelines 5 and 6.

related to the task that the students have to carry out. Such a structure or representational aid guides the joint actions of the group members.

## The Implementation of the New Design Guidelines

Design guideline 5 states that functional spaces provide the users with a predefined structure that facilitates the coordination of their actions in the shared workspace. Design guideline 5 was implemented in the graphical tool as a *grid* that divided the shared workspace into four areas (Figure 7.4). As indicated by design guideline 6 these areas should have a meaning in relation to the learning task. Actually, this design guideline makes design guideline 5 suitable for a specific context of use.

As mentioned in the previous paragraph, the students had to discuss the social image of Salou from three different perspectives, i.e. of 1) a youngster, 2) a parent with young children, and 3) an elderly person. They should formulate arguments in favor or against the claim that “Salou means discos, beaches, parties and flirtation” from the perspectives of those three roles. The three student roles were taken as a reference; they were associated with a meaningful area that we called the “individual role areas”. All students could access these areas; however, the students received the instruction to start



*Figure 7.4: The shared workspace divided into four functional spaces.*

working in the area associated with their role. The fourth quadrant was appointed for a general discussion.

The use of a grid provided the students with clear directions how to organize their joint actions in the shared workspace. It was expected that the students should spend less time organizing their communicative exchanges into a coherent whole because they were provided with a structure relevant for their learning task. We used a semi-experimental design to study the effects of design guideline 5 and 6. Two conditions were created: one condition where a grid was displayed as a representation aid and one condition where the shared workspace did not contain a grid.

### **The Analyzing of Students' Actions with and without a Grid**

The groups that participated in the study were divided over two conditions (Table 7.3). The groups in both conditions received the same learning task and preparation. All the groups used the Digalo to share and organize their arguments in favor or against the claim. The groups differed with regard to the appearance of the shared workspace. In condition one (H4a) the students used the shared workspace without a grid as representation aid. The students in this condition discussed the topic in a 'default' shared workspace with no additional structure. In condition two (H4b) design guideline 5 and 6 were applied: the shared digital workspace was divided into four functional areas with a distinct meaning attached to them. The shared workspace had a grid structure that divided the shared workspace into 4 meaningful areas (Figure 7.4).

	Condition 1 (H4a)	Condition 2 (H4b)
Lesson 1	Students became familiar with the basic functions of the tool	Students became familiar with the basic functions of the tool
Lesson 2	One 'default' shared graphical workspace with no additional structures	A shared graphical workspace divided into four meaningful areas

Table 7.3: Two conditions to study the effects of design guideline 5.

Each condition involved one class: a class with 21 students (H4a) and a class with 22 students (H4b). Students were randomly appointed to groups of three persons. It is hypothesized that the coordination of the joint actions would differ for the two conditions. The division of the shared workspace into function spaces would help the students to organize their contributions into a meaningful way. The grid structure makes the students aware of the spatial dimensions of the workspace. It is expected that students use this knowledge to coordinate their actions and locate contributions in the appropriate area.

## Analysis

Table 7.4 and Table 7.5 give the frequencies of the different actions (see Table 7.1) that the students can perform in the shared workspace of the Digalo. The actions “Move

	Actions in the shared digital workspace H4a (condition 1)										
	Add shape	Add title	Add link	Comment	Move shape	Change title	Change shape	Delete link	Delete shape	Resize shape	Organize
<b>Group 1</b>	15	15	23	0	42	2	0	0	0	2	65
<b>Group 2</b>	19	13	5	0	50	2	0	0	2	10	55
<b>Group 3</b>	12	11	7	1	55	2	0	0	1	11	62
<b>Group 4</b>	21	21	2	0	40	2	0	0	0	13	42
<b>Group 5</b>	10	9	9	7	60	1	0	0	0	1	69
<b>Group 6</b>	17	16	15	0	48	0	1	1	1	2	63
<b>Mean</b>	16	14	10	1	49	2	1	0	1	7	59
<b>St. dev.</b>	4.2	4.2	7.7	2.8	7.6	0.8	1.2	0.4	0.8	5.4	9.6

Table 7.4: Frequencies of Digalo-mediated actions (Condition 1).

Actions in the shared digital workspace H4b (condition 2)											
	Add shape	Add title	Add link	Comment	Move shape	Change title	Change shape	Delete link	Delete shape	Resize shape	Organize
<b>Group 1</b>	31	28	26	1	11	0	0	0	2	2	37
<b>Group 2</b>	30	22	12	0	18	6	0	0	4	8	30
<b>Group 3</b>	41	21	7	0	21	0	2	1	2	4	28
<b>Group 4</b>	29	20	8	0	35	0	0	0	7	0	43
<b>Group 5</b>	20	14	5	8	42	2	0	1	5	2	47
<b>Mean</b>	30	21	21	2	25	20	0	0	4	3	37
<b>St. dev.</b>	7.5	5	5	3.5	12.7	2.6	0.9	0.5	2.1	3	8.2

Table 7.5: Frequencies of Digalo mediated actions (Condition 2).

shape” and “Add link” were added up and labeled “Organize”. Organize refers to the actions of students aimed at arranging the diagram into a coherent and meaningful whole.

A large part of the students’ actions dealt with organization of the contributions (59% of the actions for H4a and 37% of the actions for H4b). Parallel access in the shared digital workspace quickly filled up the workspace with a large number of contributions. That is why most groups started to organize the diagram when the number of cards increased; and they kept on doing this. On average, the groups in condition 1 who did not worked with functional spaces ( $M=59$ ,  $SE=3.9$ ) spent significantly more time organizing the diagram then students who worked in condition 2 with a workspace divided into meaningful areas ( $M=37$ ,  $SE=3.6$ ,  $t(9)=4$ ,  $p<.05$ ). On the average, 59 actions in conditions 1 had to do with the organization of the

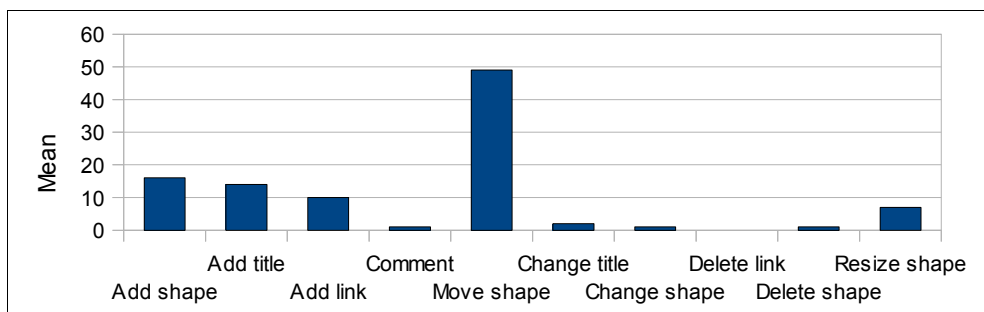


Figure 7.5: Digalo-mediated actions (Condition 1).

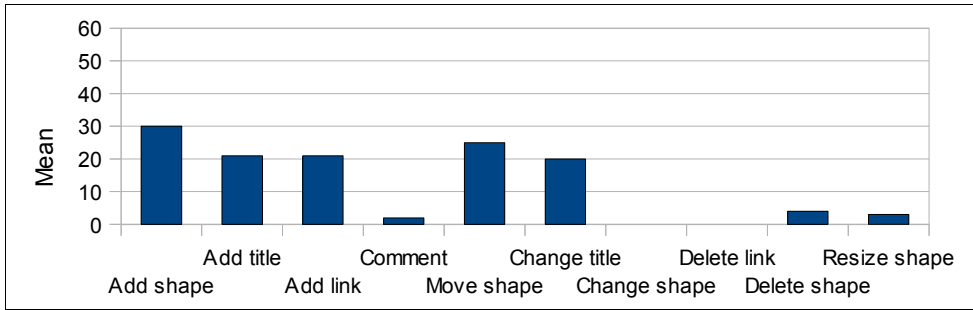


Figure 7.6: Digalo-mediated actions (Condition 2).

contributions into a meaningful representation. The groups in condition 2 only used 37 actions for the organization of the diagram. Moreover, the students in condition 1 ( $M=14$ ,  $SE=4.2$ ) put forward significantly less contributions than the students in condition 2 ( $M=21$ ,  $SE=5.0$ ,  $t(9)=4$ ,  $p<.05$ ). Figure 7.5 and Figure 7.6 graphically represents the average frequencies of the different Digalo-mediated actions for both conditions. It clearly shows how the dominant course of actions moves from organizing the diagram in condition 1 towards putting forward contributions in condition 2.

## 7.4 Discussion

In this chapter, we studied three design guidelines – design guidelines 4, 5 and 6 – that were developed during two successive cycles of problem identification, abstraction, theory formulation, implementation and evaluation (Figure 7.7).

First, we identified interpersonal dominance as a group behavior that leads to unequal participation during a group discussion. Dominance as an ineffective communication pattern was associated with turn taking as floor-control mechanism. We hypothesized that parallel access as an alternative model for access leads to a more balanced participation because group members express their ideas without any hindrances. We lay down this hypothesis as design guidelines 4, which rounded off the first research cycle. The implementation of guideline 4 led to a second research cycle that focused on the coordination problem that students faced when their communication is based on parallel access.

Students found it difficult to coordinate their joint actions and to come up with a diagram that represents their contributions into a meaningful whole. An analysis of the diagrams indicated that the spatial grouping of contributions made the digital



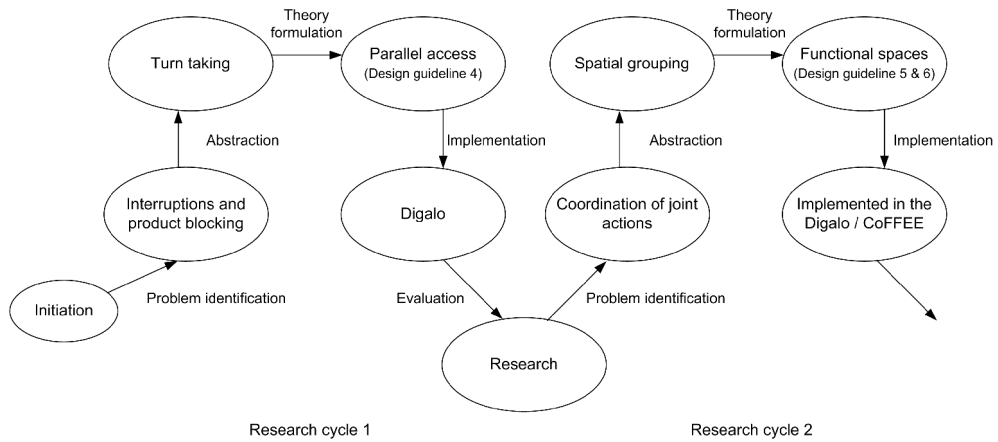


Figure 7.7: Two successive cycles of design.

interactions more coherent. This led to the development of two additional design guidelines: guideline 5 and 6. These guidelines state that meaningful areas help users to organize their contributions into a coherent and meaningful whole. We evaluated this hypothesis in a study where the groups were divided over two conditions. In one condition, the use of meaningful areas was implemented as a grid, while in the other condition the groups did not use such a representational aid. Results indicated that the use of the grid significantly reduced the coordination problem that groups experienced in the shared digital workspace. This reduction had a positive effect on the discussion: students put forward substantial more contributions.