Constructing collaborative pedagogical situations in classrooms : a scenario and role based approach

Christine Ferraris, Philippe Brunier and Christian Martel.
"Systèmes communicants" team - Université de Savoie, campus scientifique,
73376 Le Bourget du lac cedex, France
christine.ferraris@univ-savoie.fr, christian.martel@univ-savoie.fr.

ABSTRACT
Most CSCL works put forward the fact that learners working together would only need a means of communication. We feel this is not always sufficient. We have focussed on the collaborative activity itself and the way of enhancing collaboration. We have proposed a general framework which gives the teacher the possibility of defining and constructing pedagogical collaborative situations. It is based on regulation functions allowing the teacher to manage groups, to define the roles played by the participants in a group and to describe the way actions can be performed (by means of scenarios). This framework has been implemented as an independent software that can be plugged into any collaborative application. It has already been tested with a collaborative drawing software for young children.

Keywords
Regulation, roles, scenarios, collaborative drawing application, constructing collaborative situations.

INTRODUCTION
Most CSCL works put forward the fact that learners working together would only need a means of communication. We feel this is not always sufficient. We think that the focus of attention would be the collaborative learning situations themselves and the way of enhancing the collaborative process. In what follows we present our approach, which consists in giving the teachers the means of defining, constructing and modifying these collaborative situations. We will first describe some applications designed in order to create situations in which learners had to collaborate or could discover the benefits of collaboration. We will then explain our approach and illustrate it on the collaborative drawing software intended for young children we have developed within the "cartable électronique"® project. We will first present the drawing software before showing how the teacher can construct collaborative pedagogical scenarios and presenting the underlying theoretical model. We will then present the very first results of the experiments which have been conducted in three schools.

COLLABORATIVE LEARNING SITUATIONS

A communication oriented approach
Cooperative learning has frequently been seen as a stimulus for individual cognitive development, through its capacity to stimulate collaboration and discussion between learners. Two major theoretical approaches explain the role of social interaction in the causation of cognitive development. In the Piagetian approach, cooperative learning is effective because it promotes the emergence of socio-cognitive conflicts due to different opinions and strategies employed by the partners (Doise, 1984; Perret-Clermont, 1991). In the Vygotskian perspective (Vygotsky, 1978; Wertsch, 1991), individual change is presented as the result of an internalisation of regulatory activities, such as co-constructive processes, through the mediation of language. In the situation of learner(s)-computer interaction, the computer is seen as a mechanism to support social interaction and to modify the nature and the efficacy of this interaction (Blaye, 1991; Mandl, 1992). Several experiments report highlighting positive effects of computer-based peer interaction.

So CSCL seems to be an interesting paradigm for learners to learn. That's probably why lots of CSCL environments are currently being developed. Most of the time, collaboration just relies on the fact that teachers can construct material about courses and make it accessible to learners, generally via a web-based interface. Teachers and learners also have the possibility of communicating by means of commonly-used media : chats, forum or videoconferencing. The focus is thus put on communication and document sharing : there is no real study of what could and would be a collaborative learning situation and how the computer could be used to support it.

Enhancing collaboration between learners

Some works have begun to focus on this particular aspect of CSCL, no longer concentrating on communication but rather on the collaborative activity to be set up. The first example we want to present here is the T3 collaborative writing tool (Tewissen, 2001) developed within the Nimis European project (Nimis; Hoppe, 2000). This tool allows young children to "write" words or small sentences phonetically, by assembling phonemes they can pick up from a phoneme table. It has been used to create a collaborative situation between two children. The phoneme table was split up : one of the children had to work with the vowels while the other could only make use of the consonants. Therefore, to complete a word, both children had to work together.

Kidpad (Benford, 2000) is another example of software which was developed to enhance collaboration between children. It is a drawing tool with a shared drawing space. Children can draw together and they may not have at their disposal the same tools, for instance they may not have the same colored crayons. The originality of this software is that the colors of the crayons are mixed when the crayons are used on the same area. Children are thus invited to collaborate to create new colors and to enrich their drawings.

(George, 2001) and the European project NetPro (Markkanen, 2001) are also two other works in which a specific collaborative activity is considered and tools are developed to support it.

Constructing collaborative situations

The applications presented before have been designed in order to create situations in which learners had to collaborate or could discover the benefits of collaboration. They are based on predefined scenarios of collaboration that are encoded in software and that cannot be changed. Our approach is similar but goes one step forward : we want to give the teachers the means of defining, constructing and modifying these collaborative situations themselves by acting on the software. This will be done by means of what we call regulation functions. In what follows we will show how to construct these situations dynamically, through the example of a collaborative drawing application for young children we have developed.

THE EXAMPLE OF A COLLABORATIVE DRAWING APPLICATION FOR YOUNG CHILDREN

The collaborative drawing software

We have developed a collaborative drawing software within the "cartable électronique"® project (see below) in collaboration with teachers and pupils. It is intended to be used mostly in classroom settings, by children aged 5-6 years and by their teachers. It provides children with the means of working together to produce graphical realisations : drawings and graphics. Graphics has to be distinguished from drawings. It is also a drawing activity but a very constrained and directed one. It is used as a pre-writing activity, to develop fine psychomotivity. Children are told what to draw, where and how; they usually draw curves or "bridges" or "scales", because this is a way of preparing them to acquire the physical abilities for writing.

We have chosen to install the application not on classical hardware (like personal computers) but on pen tablets. These tablets have an interactive pressure-sensitive touchscreen. Children can draw on the tablet with a sensitive pen as if they were drawing with a real pen on a sheet of paper. Tablets are so much more usable by young pupils. Furthermore, they present the advantage of being easily carried, which is an important feature to consider, as we want children to be able to use the application in classroom settings but also at home.

The "cartable électronique"® project

In an attempt to address the issues of teaching and learning with technologies, Syscom has established the "cartable électronique"® project. It was inspired by the main object children carry every day when they go to school : the "cartable" (satchel or schoolbag), which contains books and pens, toys and drawing tools. Technology gives us the opportunity to reduce the weight of the "cartable" without losing its content. SysCom is working on this project in collaboration with educational organisations in France (the French Ministry of Education and local authorities representing the Ministry) and the Department of Savoie local government (Conseil Général).

The long-term goal of the project is to give each people in the education sphere (pupil, student, teacher, family,…) the possibility to access to several educational services anywhere anytime and to collaborate. The "cartable électronique" has three main axes of development. The first concerns hardware: people involved in the project participate in the design of computers adapted to children, mostly wireless ones, as mobility has to be taken into account. The second is the creation of a support on which services and applications can be put and proposed to teachers, children and their families. An educational web portal has already been developed to play this role. It has been designed as a CSCW environment based on the possibility given to its users to create and manage groups (Martel, 2001; Portail). The third is the services and applications one. The collaborative drawing application refers to the first and third dimensions.

Tools for drawing

The drawing application is designed around a series of graphical tools that children pick up and apply using the sensitive pen. The tools are:

- crayons of different thickness,
- a palette to choose the colour of the crayon,
- an eraser to do fine erasure,
- a rag to do rough erasure,
- stamps of various forms (letters, numbers, geometrical forms),
- an album to arrange the drawings done,
- scissors to cut out parts of the drawing (a part can then be put in the album or moved around the drawing in order to be pasted on it),
- an "undo" function which makes the drawing go back one step.

These tools can be accessed via the graphical interface shown in figure 1, on which Eloïse and Laetitia have collaboratively drawn a submarine.

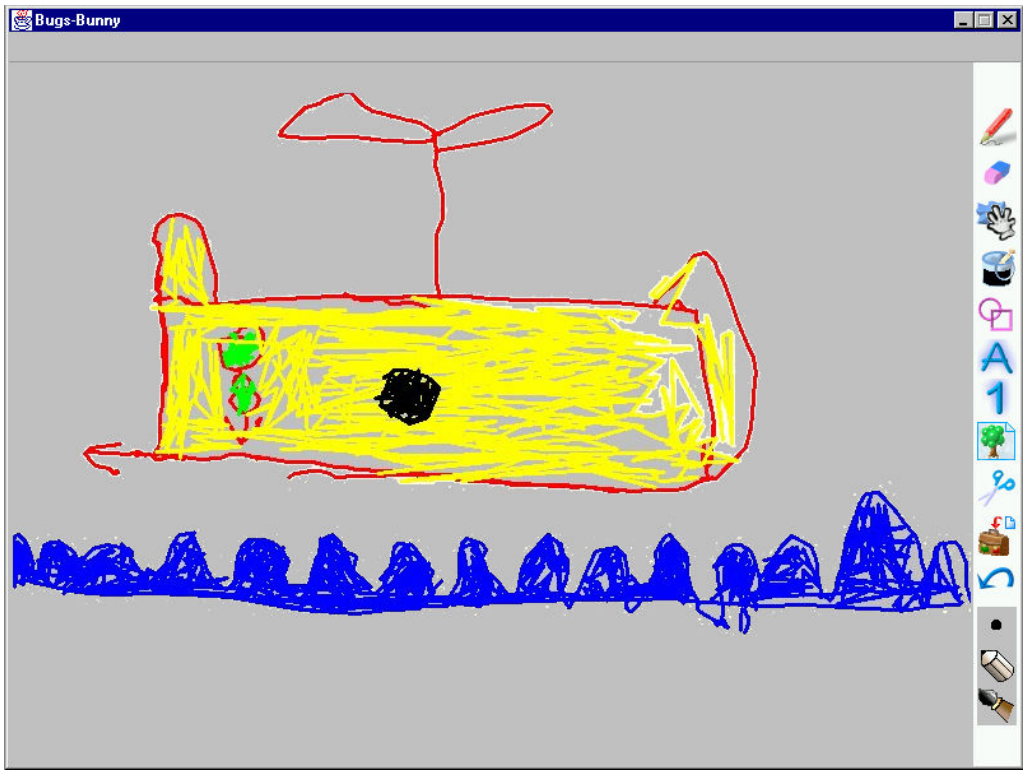

Figure 1: The interface of the collaborative drawing application

Drawing together

Children can choose to work together or on their own. When working together, each child belongs to one group. In a given group, each child has his/her own tablet and his/her tools. The children share the same drawing space but not the tools. When one child modifies something on the current drawing (by drawing, or erasing, or pasting, or cutting, …) on his/her pen tablet, the others immediately see what has been changed. It is a WYSIWIS approach, with strict synchronisation of the different children's views onto a shared workspace. Note that, as tools are not shared, the views onto the tools are not synchronised. Thus there is no problem of concurrent access to one tool. One child is either working alone, or as a member of a group. As soon as he/she becomes a member of a group, the drawing of the group appears on his/her tablet : he/she becomes immediately involved in the collaborative drawing process and can contribute to it. An individual drawing can thus be shared by the means of group definition.

Pedagogical challenges of the collaborative situation

When the teachers asked us to develop this software, they hoped that such a collaborative situation would be interesting for children to learn socialisation and develop oral expression, which are two important skills to acquire in primary education. The experiments we have conducted have actually shown that they were right. As was done in (Benford, 2000) or (Hoppe, 2000), the drawing software we have developed provides opportunities for children to discover the benefits of working together. They can choose with whom they want to draw and how to proceed: socialisation is thus encouraged by this means. Oral expression is encouraged by the fact that children, having to achieve a collective task, have the possibility of discussing and negotiating the way they are going to work (what are they going to draw ? on which part of the screen ? who does what ? etc.). They can also react to what is happening during the drawing process itself : for example one child can make suggestions about something new to draw; or they can discover together the need to define "rules" in their group ("hey ! you don't have the right to erase what I have drawn !"), which, once again, is a way of discovering life in a group.

Furthermore, they can be put in situations where one child can help and guide another. For example, in a situation where children have to make graphics (draw curves for example), one child having difficulties in drawing the curves and one who is quite a good "curves-drawer" can be members of the same group. So the second one will play the role of "assistant" for the first one : he will be able to help his friend, to show him how to make the right gesture, in the right direction, etc.

CONSTRUCTING VARIOUS PEDAGOGICAL SITUATIONS

The collaborative drawing software includes functions intended for the teachers allowing them to regulate the drawing activity. Regulation here resides in the possibility of defining pedagogical scenarios and submitting the collaborative activity to them. The teacher has the specific role of being in charge of the organisation and the management of the groups and, in a more general way, of all the mechanisms which regulate the group activity. He/she thus has at his/her disposal, through specific interfaces (see figures 2 and 3), functions allowing him/her:

- to create groups,
- to create roles and attributing roles to the participants,
- to manage scenarios.

All these functions can be activated dynamically, even when children are involved in drawing. It is thus a good way of giving the teacher the means to influence the way the activity will proceed. It is a way of achieving flexibility in groupware and co-constructing the activity (Bourguin, 2001).

Creating groups

Creating groups consists in creating an empty group, naming it and putting children in it. For example, in figure 2, the teacher has created the "rabbits" and "classroom" groups. He/she is currently working on the "rabbits" one, which is represented physically by a square in figure 2. Defining who is a member of that group is just a matter of selecting the icon representing the pupil, dragging it onto the "rabbits" square and dropping it into the square. This has been done in figure 2 with "Bart" and "Duffy-Duck".

Dealing with roles

The management of roles entails two steps : creating them and attributing them to the children in one group. To create a role, the teacher has first to name it and to define a set of drawing tools (crayon, eraser, rag, …) which will be attributed to the participant playing this role in the group. This may involve the children themselves : the teacher may ask a child the name of the role she/he wants to play, which tools she/he wants to have at her/his disposal, thus contributing to enhancing the imagination and creativity of the child. Associating tools to roles is done by means of "drag and drop" facilities. It is just a matter of picking up a tool and dragging it onto the role to whom the teacher wants to associate it. For example, in figure 2, the "big rabbit", "red rabbit" and "wizard" roles have been defined ; a "red rabbit" can only use the crayon and the scissors. The second step consists in attributing the roles thus defined to the children. This is done in the same way : just picking up a role and dragging it onto the pupil to whom the teacher wants to attribute it. In figure 2, Bart has the role of "big rabbit". So he will be able to use the tools associated with this role.

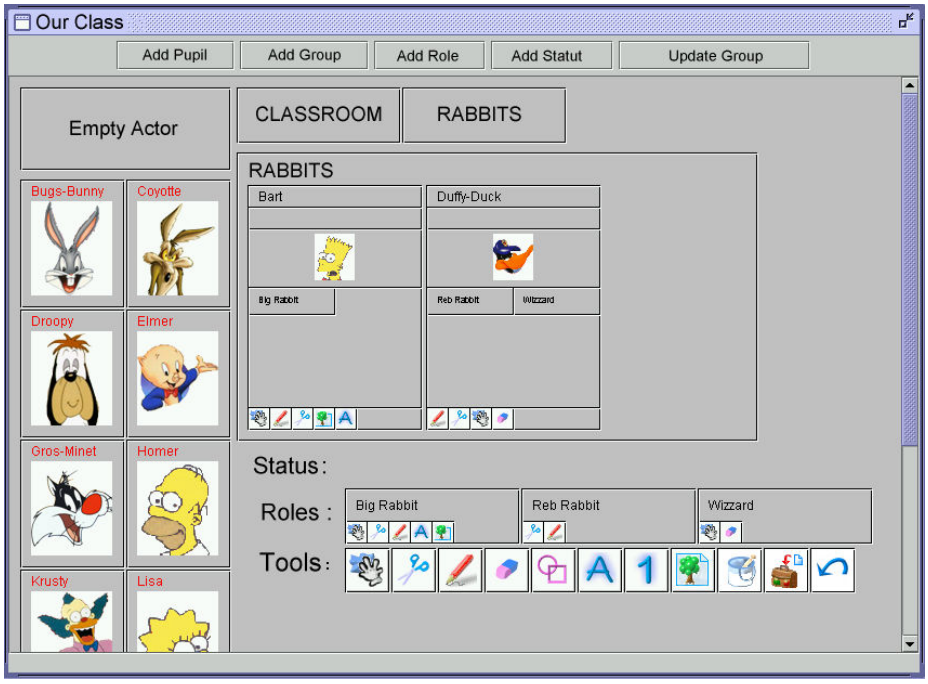

Figure 2 : The teacher regulation interface.

Dealing with scenarios

A *scenario* may be considered as a way of describing the laws, rules and effective uses of a group. It's a kind of story which describes how an interaction will be performed. It may be used to modify the way an action will occur in a group. It involves the members of one group through their roles. *"We can exchange tools"* is an example of a scenario. The teacher can "play" with scenarios in order to modify the collaborative situation. He/she can select the scenarios which will become active in a group from a set of predefined ones. This is also done by means of "drag and drop" interface facilities. For example, in figure 3, the scenario "before erasing, ask the big rabbit" has been chosen and put in the "rabbits" group. This will entail a change in the way the erasing tools can be used.

Note that defining scenarios (constructing them) is a particular function which, at the present time, cannot be handled by the teacher, as it supposes being finely aware of the theoretical model underlying the regulation process (see below). So it is handled by a person whose role is "administrator" (currently the designers of the software). We have developed a separate interface allowing the administrator to define scenarios and to link them to the methods invocation in the application code (Ferraris, 2000).

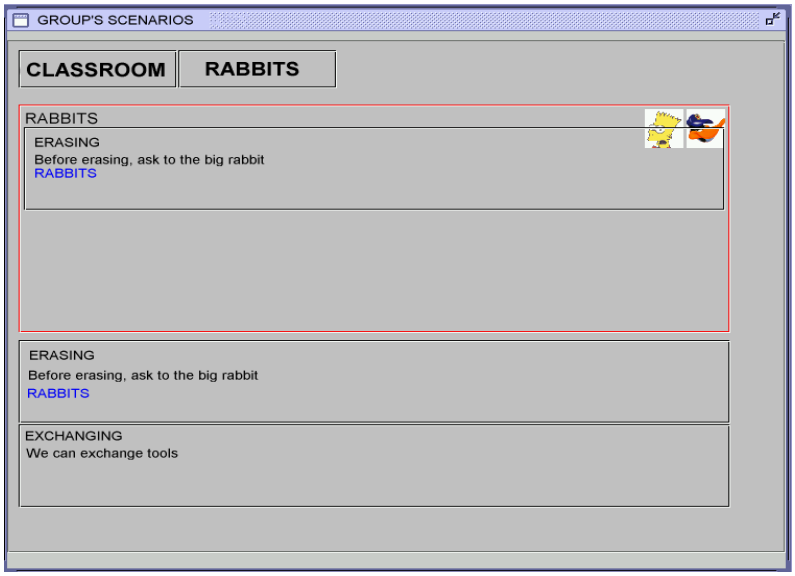

Figure 3: The interface for managing scenarios.

A more general model : the « participation model »

The interfaces offered to the teacher to regulate the collaborative drawing activity are just customized views of a general model of regulation that we call "the participation model" (Martel, 1998). This model is a proposition to take into account the social aspects of collaborative work, which most of the time are rarely supported in GroupWare. It proposes to consider the persons involved in a joint activity as active participants who can organise their activities, define the conditions under which they will be exercised and negotiate their commitment to these activities. It can enable compromise between the interests of the group and those of the individuals, between the dependencies that stem from relationships among individuals and their autonomy.

The objective of the participation model is to organise the shared space, the rules and agreements, the users and their actions or interactions. It is a conceptual model that describes, formalises and builds the context of the joint activity, the relationships of dependence and the structure of exchanges within the group. It proposes to describe the *arenas* (locations) where the activity will take place, the *interactive scenarios* guiding the interactions and the actions of the participants, and the participants themselves. They shall be represented in the arenas by means of computer entities which we call *actors* and are socially situated in the arenas by the *roles* they can play in them. They will acquire the possibility of acting and contributing to the joint activity through these roles.

The *interactive scenarios* describe the social protocols in effect in the group. They were inspired by the dialogue models of the University of Geneva (Roulet, 1985) that attempt to explain the succession and the interweaving of conversational exchanges. In the same manner, the scenarios will describe the possible exchanges between participants and define the possible sequence of these exchanges. This does not entail a rigid and deterministic description of the interactions between participants (which does not seem possible to us for most joint activities) but rather the furnishing of guides to help the participants govern their exchanges, such as is proposed by (Bider, 2000) for workflow. From a social point of view, the interactive scenario constitutes a means of subordinating the activity to the context (cultural, educational, commercial, technical, etc) in which it occurs and explains the typical sequences for each of these contexts.

Like many works in CSCW, we have been inspired by ethnomethodology and linguistics (Dourish, 1998; Goffman, 1981; Garfinkel, 1972; Rastier, 1989). We aim to give groupware users the means of co-constructing their environment. We share here the same approach as (Bardram, 1998; Bourguin, 2001; Fitzpatrick, 1995; Tolone, 1996).

Pedagogical challenges.

The regulation functions appear to be a good way of giving the teacher the means of creating various pedagogical situations. He/she can focus on the collaborative activity and imagine as many situations as possible to enhance collaboration. He/she can also involved the children in the definition of these situations and make them react to scenarios that were used or lead them to discover the need for rules.

Regulation is teacher-centered in this application. The teacher builds situations in which the children simultaneously play with tools and talk about them. The activity needs not only to be explained to the children but also to be negotiated with them, step by step. That’s why we aim to move towards pupil-centered regulation, which will allow the children to take the activity in hand and to organize the framework of cooperation. This will take advantage of the reflexive feature of the regulation model.

TECHNICAL FEATURES

Concerning the drawing application

The application has been developed with the JAVA language and can thus be installed on various operating systems (we have already tried successfully to make it run on heterogeneous OS machines including Linux, windows NT and windows 95). We used the SWING package for the design of the interfaces and the RMI mechanism for communication between the tablets. In order to synchronize the updates on the shared drawing space, a server for each group has been implemented. It centralizes the events corresponding to the new pieces of drawing coming from the different tablets and redistributes them.

The Regulation level

The participation model has been implemented in JAVA as an independent software that can be plugged into any collaborative application, providing that the application has an API which allows the events generated by the users to be intercepted and to modify the methods invocation. The API must specify at least who is involved in the collaborative process and what actions can be performed (what tools are at the participants' disposal).

How the regulation level operates

In a non-regulated collaborative application, when a user activates a tool by acting upon the interface, the event generated by the interface modifies the application model directly. Our approach is to reroute the events and to send them to a specific regulation component called a *filter* that will be able to know if the actions

corresponding to the events have to be regulated or not. If this is the case, the events will be transferred to the *decision center* which will treat them. This component is in charge of the management of the scenarios : it uses a *regulation motor* to select and activate them. The last regulation component is the *"execution mechanism*" which makes the connection between the actions in the scenarios and the method calls in the collaborative application.

ONGOING EXPERIMENTS

In order to validate our approach and the regulation functions, experiments were conducted in collaboration with a researcher from the department of psychology of the University of Savoie. They involved 43 children coming from three classes of three schools in the neighborhood of Chambéry (Savoie - France). The children were given in turn two collaborative tasks of drawing: a free one, which consisted in drawing what they wanted, and a constrained one, which consisted in reproducing a model of a drawing (a car, a house, …) in which various colors and thickness of crayon were used. Groups of two or three children were constructed to manage these tasks. As one of the pedagogical challenges is to develop oral expression, the experiments were conducted in face to face settings. The children were thus able to see and speak with each other.

There were mainly two situations in the experiments : the first one during which traditional material was used (sheets of paper and real crayons), and the computer-mediated situation. For the latter, the drawing software was used with the interactive pen tablets in a regulated way and without regulation. The idea here was to compare a classical situation with the computer-mediated one, and a regulated situation with a non-regulated one.

The materials used to analyze the results of the experiments are the drawings done by the children and their verbalizations during the collaborative process. They are currently being analyzed, the drawings regarding their conformity to the given instruction, the verbalizations regarding the fact that they enhance collaboration or not. At the present time, we have only partial results, so we are not able to present full results in this paper (we will do it in a future publication). However, the initial results have already led us to establish the fact that regulation is useful in learning collaborative behavior. We expect the final results to confirm this conclusion. Meanwhile, we present in what follows the methodology defined to conduct the analyses. We are going to describe the way regulation can be analysed, the variables introduced to compare regulated situations and non-regulated ones, the outcome expected and the way collaboration can be measured.

How to analyze regulation: variables considered.

Two ideal models enabled us to explain the mechanism of regulation and to isolate relevant variables to experiment it with respect to the expected teaching considerations.

The instrumental theory, on the one hand (Rabardel, 1995), makes it possible to consider the tool not according to the uses prescribed or envisaged, but according to its capacity to be integrated by the subjects like a means to achieve their goals. This theory allowed us to isolate the conditions under which regulation should be effective before evaluating how it could support collaborative processes between two partners. The variation of the type of task (free task or constrained task) enabled us to show the importance of the specification of the conditions of learning. In the free situation of drawing, the children carry out the drawing of their choice. The only constraint is to manage prior agreement to the production of the drawing. In the situation of constrained drawing, the children must reproduce a model of drawing.

These two tasks do not refer to the same field of learning. The free situation of drawing refers to the field of creativity, whereas the situation of constrained drawing refers to the field of collaborative learning. The goal of regulation is mainly to support collaborative processes in the interaction between two partners, and not to support creative processes. It thus appears obvious that a facilitator effect of regulation will be expected in the situation of constrained drawing: regulation increasing the interdependence of the subjects in interaction and leading them to build a joint definition of the situation of training. In free situations of drawing, the model of learning implemented is creativity. However, constraining the activity of the subjects interacting does not appear relevant to support this type of creative learning. This variation of the conditions of learning thus enables us to expose the expected teaching considerations clearly, according to the adequacy of the characteristics of regulation with the characteristics of the task.

The goal of regulation is to support collaborative activity: the teaching situations will have to be defined according to this goal, and not in a general way, without consideration of the field of learning of reference. Eventually, this variation should make it possible for the teachers to use regulation in a relevant way, while enabling them to take into account the conditions necessary for the emergence of a collaborative process.

The theory of the activity, in addition, explains the effectiveness of the tool according to whether it is or not in the proximal zone of development of the subject, i.e. between what the subject is able to achieve alone and what it cannot do without external assistance (Kaptelinin, 1996). It will enable us to answer the question of the adequacy of the tool to the cognitive capacities of the children.

Practically, we thus chose to limit in this first phase of experiment the use of regulation to its simplest application, but also most fundamental: the fact of forcing the activity of the subjects or not, in allotting them turns at roles. When the activity is controlled, the tools are distributed between the two partners. Subject 1 does not have the same tools as subject 2. The idea is then to generate a complementarity between the two partners, a need for taking account of the actions of the other in the realisation of the task. When the activity is not controlled, the subjects have the same tools. They can thus carry out the task in an isolated way, without dialogue necessary with the partner before any action on the system.

The comparison of these two situations appeared necessary to us to validate the effectiveness of the mechanism of regulation on children of this age. Indeed, it is not so easy for children of that age to be decentred from their own point of view to take account of the point of view of their partner. We thus postulate a facilitator effect of regulation on the collaborative learning only if the situation of training generated is in the proximal zone of development of the child. The comparison of these two types of situations should enable us to account for the adequacy of the tool to the cognitive capacities of children of that age.

Expectations for the outcome of the investigations

The characteristics of the free task of drawing should promote processes of learning such as creativity, less compatible with the expected learning objective, which is collaboration. The characteristics of the task of constrained drawing should support processes of collaborative learning.

Regulation should increase the level of interaction of the subjects in the task of constrained drawing, by allowing the partners greater discussion and greater negotiation before any machine response. It should decrease their level of interaction in the free task of drawing, by supporting conflicts over resources and ideas.

Measures used

The measures used enabled us to analyze the two levels of interaction of a subject with his/her partner and the device. It relates to the cognitive aspects of the work of the subject in the course of action. The analysis of the course of action is carried out through the study of the interpersonal functioning communication. All the interactions were filmed and tape-recorded to allow this evaluation of the cognitive child work in the course of action. The method of analysis of the course of action consists of a synthetic-progressive method, which makes it possible to explain how the subject includes/understands new information on the basis of its knowledge. The chronicle of the course of action thus released makes it possible to account for the various stages of the inferential process of (1) proposition, (2) explanation, (3) execution and (4) control (Gilly, 1984; Saint-Pierre, 1998). This analysis of verbalizations also makes it possible to categorize the various cognitive acts according to whether they support the interaction or not. For example, the fact of proposing a joint action and of awaiting the answer of his/her partner is an action considered as supporting the interaction ("I draw the circle and you the square, ok?") whereas an isolated execution without preliminary dialogue with the partner is regarded as a negative cognitive act for the interaction.

A percentage of reduction in the initial actions of the subjects in particular units of language was also calculated, making it possible to account for the sequences of the actions, a long sequence being regarded as favourable to the interaction.

A percentage of stages in the correct sequence's inferential processes was also produced, making it possible to account for the respect of the actions and entries of language which respect the process of speech development. According to this process, a proposal must always be preliminary to an explanation or simultaneous with an execution, an explanation must be preliminary to an execution, an execution must follow a proposal or must be simultaneous with an explanation, a control must follow an execution.

A positive effect of regulation on the task of constrained drawing should be translated by a strong percentage of cognitive acts preliminary to the action (proposal, explanation) and a small percentage of concomitant or consecutive cognitive acts to the action (execution, control), a high percentage of cognitive acts supporting the interaction, an extreme percentage of reduction in the initial actions in particular units of language, a significant percentage of stages of the correct sequence's inferential processes. The effect of regulation on the free task of drawing should be translated by the effects opposite to those observed during the task of constrained drawing.

ASSESSMENT AND FUTURE WORK

The experiments are now finished and we are waiting for more detailed results. They have mainly focussed on the children at work and on the pertinence of regulation, as this have seemed to be the prerequisite of more complex ones. We think that we have now to pursue them by involving the teachers more. Actually, as one of the reviewers of this paper has noticed, it is probably a very new task for the teachers to design or to facilitate the designing of the scenarios and the cooperative situations. We thus particularly have to give them more time

to think up pertinent and richer scenarios. We will work with them on the construction of those scenarios. Then we will have to enter the second and maybe most important phase of experimentation with the model: a learning situation intended no more for the children but for the teacher to manage scenarios.

We also have to work on a formalism that they would be able to manipulate via an appropriate interface in order to give them the possibility of constructing the scenarios themselves. We have actually noticed that this is done by the designers of the software as the formalism used to express the scenarios strongly relies on the participation model.

Finally, we will soon be focussing on the reflexive feature of the participation model. Actually, regulation can be considered as a collaborative activity which can itself be regulated. Within this activity, the teacher has the special role of "regulator". This role allows him/her to use the specific tools of regulation. It could be played by a pupil.

CONCLUSION

We have presented, through the example of a collaborative drawing application designed for young children, a generic framework of regulation intended for teachers to create original collaborative situations. Teachers can modify the way the drawing application operates by means of this framework. It is based on a theoretical model called "the participation model", which aims to take into account the social aspects of collaborative work.

ACKNOWLEDGMENTS

We want to thank very much Laurence FOUBERT-GAGNIERE who had led the experiments with the children in the schools, with the point of view of a psychologist. She is currently analyzing their results in a detailed way.

REFERENCES

Bardram J. (1998) Designing for the Dynamics of Cooperative Work Activities. *Proceedings of the ACM CSCW'98 conference*, ACM Press.

Benford S., and al. (2000) Designing Storytelling Technologies to Encourage Collaboration between Young Children. *Proceedings of the ACM DIS'2000 conference.*

Bider I., and Khomyakov M. (2000) Is it possible to Make Workflow Management Systems Flexible ? Dynamic Systems Approach to Business Processes. *Proceedings of CRIWG'2000, 6th international workshop on groupware* (Madeira, Portugal, October 2000), 138-141

Blaye A., Light P., Joiner R., and Sheldon S. (1991) Collaboration as a facilitator of planning and problem solving on a computer-based task. *British Journal of Developmental Psychology*, **9**, 471-483.

Bourguin G., and Derycke A. (2001) Integrating the CSCL Activities into Virtual Campuses : Foundations of a new Infrastructure for Distributed Collective Activities. *Proceedings of Euro-Cscl 2001*, (Maastricht, Netherlands, March 2001).

Doise W., and Mugny G. (1984) *The social development of the intellect*. Pergamon Press, Oxford.

Dourish P., and Button G. (1998) On "technomethodology": Foundational Relationship between Ethnomethodology and System Design. *Human Computer Interaction*, **13**, N°4, 1998.

Ferraris C., and Martel C. (2000) Regulation in groupware: the Example of a Collaborative Drawing Tool for Young Children. *Proceedings of CRIWG'2000, 6th international workshop on groupware* (Madeira, Portugal, October 2000), 119-127.

Fitzpatrick G., Tolone W. J., and Kaplan S. M. (1995) Work, Locales and Distributed Social Worlds. *Proceedings of the ECSCW'95*, (Stockholm, Sweden, September 1995), 1-16.

Garfinkel H., and Sacks H. (1972) *Contributions in Ethnomethodology*, Bloomington, Indiana University Press.

George S., and Leroux p; (2001) Project-based Learning as a Basis for a CSCL Environment : An Example in Educational Robotics. *Proceedings of Euro-Cscl 2001*, (Maastricht, Netherlands, March 2001).

Gilly M., and Roux J.P. (1984). Efficacité comparative du travail individual et du travail en interaction socio-cognitive dans l'appropriation et la mise en oeuvre d'une procédure de résolution chez les enfants de 11 à 12 ans. *Cahiers de Psychologie Cognitive*, **4**, 171-188.

Goffman E (1981) *Forms of Talk*. Philadelphia, Univ. of Pennsylvania Press.

Hoppe U., and al. (2000) Supporting collaborative activities in Computer integrated Classrooms - the NIMIS approach. *Proceedings of CRIWG'2000, 6th international workshop on groupware* (Madeira, Portugal, October 2000), 94-101.

Kaptelinin, V. (1996). Activity Theory : Implications for Human-Computer Interaction. In Nardi, B.A. (Eds), *Context and Consciousness: activity theory and Human-Computer Interaction*, Cambridge, Ma: MIT Press, 103-116.

Mandl H., and Renkl A. (1992) A plea for more local theories of cooperative learning. *Learning and Instruction*, **2**, 281-285.

Markkanen H. (2001) NetPro : methodologies and tools for Project Based Learning in Internet. *Proceedings of Ed-Media 2001, World Conference On Educational Multimedia, Hypermedia & Telecommunication,* (Tampere, Finland, June 2001).

Martel C. (1998) La modélisation des activités conjointes. Rôles, places et positions des participants. *Thesis of the University of Savoie*, September 1998.

Martel C., and Vignollet L. (2001) Educational Web Portal based on personalized and collaborative services. *Proceedings of ICALT (International Conference on Advanced Learning Technologies*), (Madison, USA, August 2001).

Nimis Project. http://collide.infomatik.uni-duisburg.de/Projects/nimis.

Perret-Clermont A-N., Perret J. F., and Bell N. (1991) The social construction of meaning and cognitive activity in elementary school children. L. B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), *Perspectives on socially shared cognition,* Washington, D.C.: American Psychological Association.

Portail. http://portail.univ-savoie.fr:8080/cellule.

Rabardel, P. (1995). *Les Hommes et Les Technologies; approche cognitive des instruments contemporains*. Paris : A.Colin.

Rastier F (1989) *Sens et textualité*. Hachette, Paris.

Roulet E., Auchlin A., Moeschler J., Rubattel C. and Schelling M. (1985) *L'articulation du discours en français contemporain.* Peter Lang, Berne.

Saint-Pierre, M. (1998). Une approche pragmatique cognitive de l'interaction personne/système informatisé. *ALSIC*, **1**, 1, 27-36.

Tewissen F., Lingnau A., Hoppe U., Mannhaupt G., and Nischk D. (2001) Collaborative Writing in a Computer-integrated Classroom for Early Learning. *Proceedings of Euro-Cscl 2001*, (Maastricht, Netherlands, March 2001).

Tolone W. J. (1996*) Introspect: a Meta-level Specification Framework for Dynamic, Evolvable Collaboration Support.* Ph.D. Thesis. University of Illinois at Urbana-Champaign.

Vygotsky L. S. (1978) *Mind in society: The development of higher psychological processes*. Harvard University Press, Cambridge.

Wertsch J. V. (1991) A sociocultural approach to socially shared cognition. L. B. Resnick, J. M. Levine,, & S. D. Teasley (Eds.), *Perspectives on socially shared cognition,* Washington, D.C.: American Psychological Association.