

Design and evaluation of activity model-based groupware: methodological issues

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Abstract

This article presents methodological issues on evaluation related to the design process of the tool being evaluated. We emphasize the different variables which are important to take into account, and the links between them. We illustrate our approach with the presentation of a groupware for collective sensemaking (Sum'it Up) based on a theoretical activity model coming from social sciences, and a first evaluation of this groupware.

1. Introduction

Collaborative systems' evaluation raises many methodological issues, for example which metrics should be used [1], how to plan the evaluation in a firm [2], how to integrate evaluation in iterative design [3], etc. This paper deals with the link between methodological issues of evaluation and the design process used for building collaborative systems. Indeed, evaluation method depends on the purpose of the system and on the design approach [4]. The example which we are going to present relies on a design process based on a theoretical activity model coming from social sciences.

The first part of this paper clarifies our design approach with an example of a groupware for collective sensemaking. The second part places our evaluation approach in relation to other studies, and the third one analyses the methodological issues raised. An example of the application of our evaluation approach is presented in section 4, followed by a discussion.

2. The case of a groupware for collective sensemaking

2.1. The collective sensemaking issue

The issue of collective sensemaking by the actors of an organization from the work situations which they are confronted with has been treated by the early 80's. We follow an interactionist approach which stresses the sensemaking process, rather than a cognitive approach which would focus on a collective representation of sense. According to Karl Weick [5], collective sensemaking is a collective process of reducing the perceived ambiguity of a situation. Through exchanges and debates, members of the organization are going to clarify, and then share comprehensions of lived situations, which will build sense step by step. Sharing the sense will not correspond to the fact of having the same vision of the sense, nor to the fact of dividing the sense between each actor, but will correspond to the fact of taking part in its creation.

Following the interactionist approach, we are interested in the possibility to mediate the collective dynamics of sensemaking by computer tools.

Sharing stories or lived experience could be a framework to make sense collectively. Indeed, account of experience is a semiotic medium of a lived situation, which makes sense for an individual. Collective interpretation of these stories will make it possible to draw part of the experience while being able to leave the framework in which this experience was lived.

This choice of mediatizing interactions which support cooperative interpretation is justified as the same time by the will to provide contexts supporting the production of these interactions, and to design tools making it possible to structure these interactions, and by the same way to analyze them [6]. In addition, the fact of designing a computer-based tool leads us to

clarify our concepts, to formulate in a precise way the underlying activity models.

2.2. Proposition of a transdisciplinary design process to achieve our goal

The research project which we described above brings us to define new practices to be assisted, and of this fact a traditional design process based on a needs analysis, or on an analysis of an existing activity, in order to deduce primitives of design is not adapted.

We propose to adopt a resolutely transdisciplinary design step, in which social sciences researchers would not be limited to the analysis of the activity, the specification of the tool, and its evaluation, and the computer science researchers limited to the implementation of the tool, based on social sciences recommendations.

This integrated vision is the one recommended by many researchers in social sciences in the field of Computer Supported Cooperative Work (CSCW). They do not want just to describe cooperative activities to clarify the design process, but they want to take part in the system implementation process [7].

The step that we propose is inspired by the positioning of Baker in the field of computer supported human training [8]. This author distinguishes models as scientific tools of models for systems design. The firsts make it possible to use a theory to understand or predict a situation or an activity; the seconds translate the firsts into a model allowing the design and implementation of systems supporting the situation or the activity.

However, social sciences theories usually used when designing groupware (activity theory, communication theory ...) are difficult to exploit to deduce primitive of design, or it is difficult to transpose their definitions within a computer-mediated framework. Our design work thus consists in defining new models, with new concepts, in agreement with the theory, to describe the artifact assisting and tracing the interactions. The theory will then enable us to analyze the traces thus memorized.

We finally propose the following process: Within the framework of a theory in social sciences adapted to the phenomena which we wish to assist/observe, use or define a *description model* of these phenomena which puts into practice the theory and gives the bases of the definitions of situations in which these phenomena would be computer mediated. This reflection leads to the creation of the *mediated activity model*, creation bringing into play at the same time social sciences researchers, guarantor for the description model, and

the computer science researchers, understanding and controlling the properties on computer-based tools. This mediated activity model is then materialized in a *design model*, which is the specification of the tool which will at the same time assists interactions but also traces them. This tool will be thus the support of a memory of the interactions, and is thus a good mean to collect corpus. This corpus, analyzed using the mobilized theory, will enable us to make evolve our comprehension of the studied phenomena.

2.3. Application: the Sum'it Up groupware for collective sensemaking

As we already claimed in section 2.1, we are interested in the activity of collective negotiation of the sense of an event which is narrated in a story. We propose Sum'it Up, a groupware which allows the members of a group to agree on the structure of this event, as it is translated in a story. This groupware then assists the co-building of the sense of an event, by the means of a negotiated synthesis of the story of this event. According to us, this synthesis consists in retaining only significant information - within sight of the actors - and their relations. We also formulate the assumption that this task will be more effective if it is accomplished in a co-operative way, because it is in this condition that several points of view will be able to be confronted before obtaining a consensus.

To design Sum'it Up, we followed the process that we have described in section 2.2. In order to describe the collective synthesis activity, we took a classical theory in textual linguistic, in which a text synthesis is realized through an abstraction process, following rules defined by Van Dijk and Kintsh [9, 10]. In order to use this theory, which is not dedicated to system design, we propose an adaptation, the *description model*. This cognitive modeling describes how to build collectively a common interpretation of an individual experience. The description model leads then to the *model of mediated inter-comprehension activity*, which is the basis of the *design model* which specifies the Sum'it Up groupware which we are now going to describe.

We will go on the assumption of a group, having a story broken up in the shape of Narrative Atoms (in the sense of Van Dijk), and which must co-build an interpretation of this story. For that, they must select the most significant information, due to the structure of the story.

Sum'it Up will allow the actors firstly to visualize the Narrative Atoms, and then to select some of them in order to apply the synthesis rules (defined according

to the Van Dijk theory). We propose an asynchronous use of this groupware. Each actor can apply some rules, and then can comment the application of a rule. This “comment” function allows also actors to negotiate the application of the rules. Finally, Sum’it Up permits at the same time to assist the collective co-building, and to memorize this process.

As we see in figure 1, when a user is logged in, he/she visualizes in the left part of Sum’it Up the Narrative Atoms of the story which he/she is going to synthesize. In the right part, the elements selected in the left part appear with more details, with the same visualization logic of a files’ explorer. The user then selects the Narrative Atom(s) on which he/she wants to apply one of the rules which he/she selects in the « rules » menu. Depending on the rule that the user chooses, the system reacts differently: it could delete an Atom, integrate several Atoms in one of them, generalize several Atoms into a new Atom, or create a new Atom, not linked with the original ones. In every case, the rule application is followed by the display of a dialogue box in order to put a comment to justify the application of the rule. This function permits us to memorize the design rationale of the inter-comprehension process.

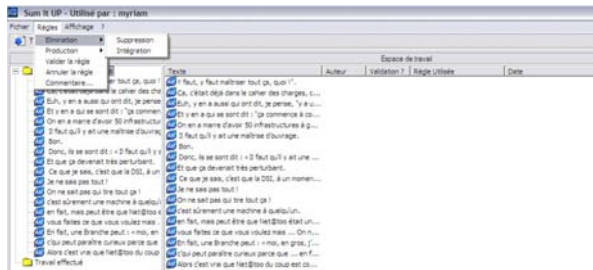


Figure 1. Sum’it Up interface

The design process which we have followed here is not a “classical” software design process in which the beginning would be a requirement analysis, translated into a computer-based model, implemented into software. The choice to follow this innovative process leads us to reflections on how to evaluate the type of tool which we have produced.

3. Groupware evaluation approaches

Two approaches could be distinguished to represent the goals of collaborative systems evaluation. The first one is focused on evaluating the system and the second one on evaluating the design process.

3.1. System-focused approaches

Most of the evaluations deal with the influence of the system on users’ behaviors. Several levels can be analyzed:

The *task level* concerns the effect of the system constraints on the task, for example, activity duration, ease of utilization of the system, satisfaction relating to the task goal, etc. [11]

At the *activity level*, the evaluation is about several socio-cognitive aspects of the activity realized to achieve the task, for example, group organization, problem solving procedures interpersonal communications, etc. [12] So, the variables used for these evaluations concern psychological processes and interaction between partners of the group.

The *result level* is about efficiency of the group production (innovation, benefits, etc) [13]. This kind of evaluation is important because the introduction of a groupware technology is associated with a cost for the firm [2]. It is well established that the evaluation of a system introduction involves an understanding of the organization [14, 15]. Thus, evaluation should include social and organizational variables.

This rapid review of the evaluation of system’s impact raises methodological issues. Evaluation deals with interdependent levels which are difficult to isolate. In fact, task, activity and result are dependant [16]. Moreover, evaluation is confronted with many variables implied in human interaction and the role of context.

This first category of evaluation approach is academic and recovers in part the distinction between usability, utility and usage [17]. In the other approach focusing on design process, the system emerges from a design process linked with specific questions on technology, methodology or theory. The system is somewhat an answer to these questions.

3.2. Design process-focused approaches

We have noticed three questions about design (this review is not exhaustive):

Design addresses sometimes *technical problems* like interoperability, reliability of systems, etc. The evaluation of the proposed solutions implies verification at a computational level. The utilization of the system by end users is not necessary. Mathematical analysis, formal demonstration and scenario utilization could be here relevant methods for evaluation [18].

The *design method* could also be evaluated (user-centered design, iterative design, etc.). The issue is to determine if the innovative method produces a more

relevant, adapted, accepted, system. The focus is more on the method than on the final system. In this case, evaluation could then be based on an analysis of the design process (for example, the participation of end users for a user-centered design [19]) and/or the influence of the groupware system on users' behaviors. If the system has an impact, as expected by designers, the design method is thus validated in an indirect way.

Some design approaches are based on analysis of the activity which is going to be assisted by the system. This *activity analysis* could come on one hand from an analysis of a lived situation, or on the other hand from a theoretical analysis (as we have presented before for Sum'it Up design). In this latter case, several models are proposed in order to go from a theoretical, descriptive model to a design model. We first need a reflection on activity's mediatization (which results is the *mediated activity model*), and then on the functions of the groupware (*design model*).

In this kind of design process, the role of models is crucial, and then the model's evaluation becomes a key issue. It raises methodological questions evoked before, and some specific problems. In fact, it is difficult to differentiate the effect of the model from the effect of the system on the users' behaviors. Thus, we need to propose evaluation methods which permit the identification of the different variables and their interactions.

4. Evaluation variables

Research relating to the mediatized interactions is usually complex, complexity which is inherent in our situation, which combines several levels of analysis. It is particularly difficult to evaluate some results without elaborating evaluation models taking into account the various variables in question.

If many researches classically evaluate the impact of a tool on an activity (cf. 3.1), they produced very general results or which can be slightly applied generally. The issue is the complex interactions between the variables. Our alternative strategy then consists in isolating intermediate variables in order to take in account the intrinsic complexity of the causal relation.

In our case, three groups of variables are implied: the model of mediated inter-comprehension activity, the collaborative tool Sum'it Up and finally the quality of the effective collaboration. For obvious reasons, we do not take into account the role of the organization and/or the instructions in the effective collaboration of the people who took part in it. In an ecological situation, this organization variable should of course be

reinstated, probably beside other groups of variables. In the same way, the variable "use of the tool" was not taken into account, since the users were constrained to use the tool, and more of that, in a certain way.

We are now going to specify precisely the concepts and the variables of the evaluation, and then the relations between them.

In our case, the collective construction of sense takes the form of the variable *quality of collaboration*. If there is no collaboration, we will considerer indeed that there is no collective sensemaking in the studied interaction. This variable thus holds place of a *dependent variable*, also called variable to explain or endogenous. The two other variables, the *collaboration model* and the *tool* (which implements the collaboration model) hold place of *independent variables*, also called explanatory variables or exogenic. Usually, an independent variable represents the cause, which effect is measured on a dependent variable. However, in our case, the studied phenomenon is composed of more than one simple independent variable and one dependent variable. In fact, we are faced to two independent variables to explain the same dependent variable. In the same time, there is a link to specify between the two independent variables.

In an intuitive way, we identify several types of effects related to the introduction of the variable "collaboration model" into the causal relation between the other two variables tool and quality of collaboration (figure 2).

The first type of effect is the *additive effect*: the collaboration model constitutes an independent variable added to the basic model binding the tool to collaboration.

A second type of effect is the *interactive effect*: there is a significant interactive effect between, firstly, on one hand, a collaborative model and a tool which does not implement it explicitly and on the other hand a collaborative model and a tool which implements it explicitly and secondly on the perception of a better collaboration.

Other types of effect can be defined; the *mediator effect* and the *regulating effect*. In the first case, the effect of the independent variable on the dependent variable is measured via the third variable, called mediating variable. In the second case, the regulator variable modifies the intensity (increases or decreases) and/or the sign of the relation between the independent variable and the dependent variable.

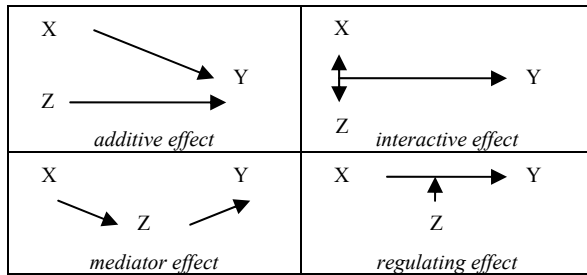


Figure 2. Various types of effects between dependent and independent variables in a causal relation.

Relations between two variables of a phenomenon are themselves plural. We could find a *simple causal* relation between two variables (X influences Y, but Y does not influence X), a *reciprocal* influence between two variables (X influences Y which in return influences X), or finally an *association* between two variables without being possible to determine which one is the cause of the other one (X is in relation to Y and Y with X).

In our case, for example, if it is usual to consider that a collaborative tool supports collaboration, we could just as easily say that a good collaboration is a preliminary favourable factor for the adoption of the collaborative tool (reciprocal effect). There is also an association between the model and the effective collaboration, or between the collaborative tool and the collaborative model.

Once the nature of the relation is defined, it remains to specify the sign of the relation: *positive* if X and Y vary in the same direction, or *negative* if X and Y vary in an opposite direction.

We can represent the variables of our causal model of evaluation as follows (figure 3):

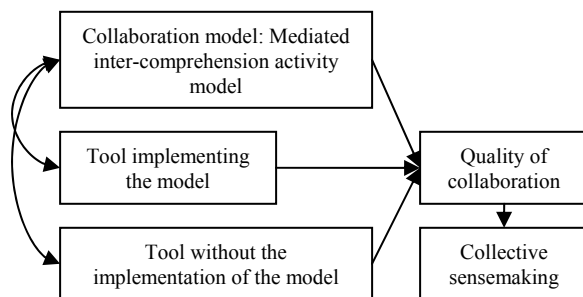


Figure 3. Causal model of evaluation

Specification variables and the definitions of the relations between variables can follow a qualitative and inductive method or a quantitative and more deductive method. For our part, we chose here to adopt an experimental approach, which we detail hereafter.

5. Sum'it Up experimental plan of action

A first evaluation of Sum'it Up is in progress. For the first step of the evaluation process, we have chosen to focus on the *mediated activity model* and thus the mediation of the *description model*. We evaluate the instrumentation of the description model in a tool (several mediated activity models could be created for the same description model). The goal is to determinate to what extent the mediated activity model represented in Sum'it Up is relevant (compared with a tool containing no/another mediated activity model).

The dependant variable is the coordination quality and the independent variables are the model mediation and instrumentation. The “procedure” and “use of the tool” variables are not taken in account here (cf. section 4).

Sixteen students took part in the study. One half of them used Sum'it Up and the other half used MSWord. They had to build together an interpretation of a story in group of 2 or 3 persons, asynchronously. The procedure was the same for the two situations. They were trained to use the tool and apply the model (during two hours). They tried the tool and applied the model with a practice story during a week. Then, they build together an interpretation of the target stories during two weeks. There were real stories about professional experiences of consultants. Participants should send by e-mail the work realized on the story to the next partner and so on. They had to decide when the work was over. After that, the participants were interviewed in order to collect their opinions. They were asked several questions about rules understanding, ease of tool use, effectiveness of collective work, satisfaction. Results' analysis is in progress.

6. Discussion

As part of our design approach, it seems relevant to relate the evaluation to the three kinds of model which we used during the design process.

The goal of the *description model* evaluation would be to examine if the theory's principles are valid for the practices to be assisted. For Sum'it Up, an evaluation would compare one group fulfilling the task face to face without specific tools, and a second group fulfilling the same task, but following the description model (specific instructions).

The *mediated activity model* evaluation would determinate if the instrumentation of the activity model is relevant compared with other possible

instrumentations (cf. section 5). Complexity of tools usage should also be introduced in the evaluation process. Analysis of the organizational context and evidences from users would allow modifying the *mediated activity model* to adapt it to a particular organization (changing/ adding new functionalities). For Sum'it Up, we could compare groups in an experimental situation with groups in professional context and/or during a long period.

The *design model* evaluation corresponds to analysis like verification at a computational level [19] and would be crucial (security requirements ...).

It would be of course difficult to realize all these kinds of evaluation for a single tool (time, cost, etc.). But we think that this framework is a good way to help us positioning an experiment in order to better understand the evaluation results.

7. Conclusion

Our design approach based on a theoretical modeling of activity emphasizes the importance of evaluating the model underlying the tool. Three models are distinguished: description model, mediated activity model and design model. Each one can be the focus of an evaluation. We emphasize the difficulty of isolating the effect of the model from the effect of the tool. In fact, we consider that it is important to construct evaluation settings implying several variables related to the inherent complexity of collaborative situations, in order to better understand, interpret user's behaviors.

To illustrate our approach, we presented the first evaluation step of Sum'it Up, a groupware for collective sensemaking. This study relies on an experimental approach but other methods could be used (correlations for example). The weak number of participants is of course a limit for our first evaluation. Moreover, the comparison with MSWord may be problematic because people are familiar with this tool, contrary to Sum'it Up. We are thinking about others evaluations like we listed in section 6.

The framework presented here links design process and evaluation process. We assume this approach could be heuristic at the methodological level.

8. References

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