Supporting Learners' Self-organization: An Exploratory Study

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Abstract. Learners engaged in CSCL macro-scripts are involved in self-organization activities. We present an exploratory study that suggests that Bardram's theoretical model of collective work dynamics is a pertinent basis for both (1) designing interfaces providing a passive support that engages learners in an explicit organization activity, and (2) making learners' organization more easily detectable and analyzable within a perspective of active support.

Keywords: CSCL, Organization, Collective Challenge.

1 Introduction

CSCL macro-scripts are learning scenarios designed to enhance the probability of a group of learners engaging in knowledge-generative interactions such as conflict resolution, explanation or mutual regulation [1]. Such scripts define sequences of activities, create roles and constrain the mode of interaction among peers. Their basic principle is to structure learners' activity to make them engage in an effective collaboration whilst providing some flexibility and avoiding over-scripting (over-structuring), which could sterilize collaborative learning situations [2].

Macro-script settings are particular cases of collective work situations: learners are mutually dependent on their work [3]. CSCW emphasize that actors engaged in such interdependent processes must address an overhead activity, that of articulating (dividing, allocating, coordinating, scheduling, meshing, interrelating, etc.) their respective activities [4,5]. Organization is a meta-level activity that is not focused on the targeted output, but on setting the conditions of the production of this output.

In macro-script settings, taking organization into account is a core issue. First, organization impacts the overall process. If learners fail in building a more or less coherent organization, their engagement may diminish, and the pedagogical objective of promoting knowledge-generative interactions may not be reached. Second, consideration of organizational issues leads to interactions such as building a common ground, planning, resolving conflict resolution, or regulating processes.

By definition, macro-scripts provide learners with a certain degree of flexibility, i.e., let them decide on some aspects of the script enactment. Many experiments reported in the literature show that learners use this flexibility, e.g., in context, divide

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tasks into subtasks and adjust their division of labor, define some sub-strategies, or adopt alternative ways of using the technological means provided: they engage in *self-organization* activities [3]. Self-organization is "the meta-level activity that a group of learners engaged in a CSCL script may engage in so as to maintain, within the reference frame that is externally defined by the script, a more-or-less stable pattern of collective arrangement". In this definition, "self" is meant to highlight that, in such a context, part of the organization is externally set by the script, and part is related to emergent features of learners' enactment of the script at run-time.

From a general view point, an intelligent/adaptive CSCL framework addressing organization issues should be able to support self-organization by (1) passive features such as offering learners tools to share their plans, and (2) active support based on a certain understanding of learners' organization and its evolution. In the context of CSCL, active support can consist in individual or collective hints related to a lack of involvement or to the tackling of some tasks (using ITS techniques, see [6] for example). Other central issues are the dynamic adaptation of the scenario and/or of the technical framework offered to the learners [3], in particular in order to provide learners with means that continue to comply with the pedagogical objectives whilst not conflicting with their emergent activity [2,3].

Our general goal is to study how to support learners in their self-organization and prevent collaboration breakdowns. We use as a case study a pedagogical collective challenge, which is a type of macro-script that enhances the role of learners' motivation: the scenario is less detailed than in basic macro-scripts, and emphasis is rather on introducing a challenge to enhance motivation [7]. This type of setting is particularly prone to self-organization phenomena. We have designed and implemented a computer-based system that supports learners' self-organization. This system is based on Bardram's theoretical model of collective work dynamics [4]. We have conducted an exploratory study to analyze the impact of this system. This study suggests the adopted approach is relevant for (1) designing interfaces providing learners with passive support by engaging them in an explicit organization activity, and (2) making learners' organization more easily detectable and analyzable, which is a *sine qua non* condition for envisaging active support.

We first present Bardram's model and the way in which we use it, the application used as an experimental field, and the system principles. We then present the exploratory study (6 groups, 3 of which used the system) and the lessons learned.

2 Theoretical Background: Bardram's Model

Bardram's model [4] (see Figure 1) introduces 3 basic notions: *co-ordination, co-operation* and *co-construction*. Co-ordination denotes the level where actors concentrate on the subtasks they have been assigned. Their work is related to a common goal, but their individual actions are only externally related to each other. They carry out the overall task from the point of view of their individual activity. Co-operation is a level where

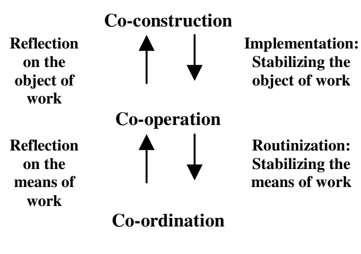


Fig. 1. Bardram's Model

actors are active in considering the shared objective. This enables them to relate to each other and make corrective adjustments to their own and others' actions according to the overall objective. Co-construction is the level where actors focus on conceptualizing or re-conceptualizing their organization in relation to their shared objects. These 3 levels correspond to analytic distinctions: activity takes place simultaneously at all levels.

Bardram's model highlights the importance of supporting the dynamic transitions that may occur from one level to another during activity. Bottom-up transitions are related to an analysis of the object or the means of the work, which can occur in relation to a breakdown or an explicit shift of focus. Top-down transitions are related to the solving of problems and contradictions, and lead to a stabilization of the object and means of the work. In a learning context, transitions may be induced by learners themselves or by regulation actions, e.g., drawing learners' attention to the fact that they should interact about another level feature in relation to a problem encountered by a learner or by the group, an anticipation of a breakdown, or a pedagogical opportunity. Bardram's model also stresses the fact that perceiving breakdowns is an important dimension of the understanding of collective work dynamics. Breakdowns must be regarded as natural and important events, which should (if the actors are aware of them) challenge the group, and cause a reflection on the means or the object of the work, i.e., a bottom-up transition. A breakdown is solved by a stabilization of the object or means of work, and should end in a top-down transition.

To analyze learners' organization, we have elaborated a structured coding grid (a set of indicators [8]) that allows analysis of learners' organization in terms of co-construction, co-operation, and co-ordination. As examples, co-construction phases are denoted by actions categorized as "understanding of the problem", "elaboration or revision of the general strategy" or "installation of a co-operative structure"; co-operation phases are denoted by actions categorized as "proposition, negotiation, or revision of a precise planning", "decision-making about the organization" or "agreement on how to work together"; co-ordination phases are denoted by actions categorized as "adjustment / application of the adopted organization". We define a breakdown as a difficulty or a contradiction related to an organization that could endanger the dynamics of the collective problem-solving if it were to persist. We use the negation of the criteria and sub-criteria of the coding grid, reformulated as necessary, to detect breakdowns. For example, at the co-construction level, we use as a breakdown criterion "problem not collectively understood" and the two sub-criteria "common representation not clearly established" and "common language not clearly elaborated/acknowledged." Such sub-criteria are not absolute indicators, but rather "symptoms" that may lead to diagnosing a breakdown. Indeed, when considering breakdowns, time is an important issue. When a breakdown is detected, data can be further analyzed to understand if it has been solved, and how, or not solved, and why.

3 The Setting: The "Race with No Winner" Challenge

A pedagogical collective challenge is a learning situation where: (1) the problem is designed to make learners practice some target domain-related or meta-cognitive competencies; (2) a group of learners is involved, as a team, in the solving of the problem; (3) solving requires the learners to pool their forces; (4) the problem and the setting are designed to create a positive tension that motivates learners [7].

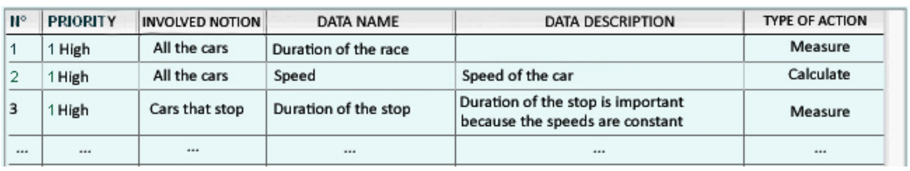
The challenge we use, entitled “the race with no winner”, has been defined by a community of practice dedicated to the use of simulations in mathematics and physics [9]. It is based on a Flash simulation. 10 cars can be put on a track. The cars have different behaviors (e.g., speed or dynamics: some of them stop at one place and re-start after a few seconds, while others do not). Learners must first test all the cars (using the simulation) to collect the data necessary to establish a relation between the departure position of every single car and its arrival on the finishing line. This requires solving equations to determine speed, duration and distance. When learners are ready, the tutor chooses 3 cars, and places one of these cars somewhere on the track (can be anywhere). The learners have to place the 2 other cars on the track so that the 3 cars cross the finishing line at the same time. The simulation is then run to check their solution. There are thus 3 phases: (1) preparing data (measuring and calculating the data for the 10 cars; car behavior does not change from one race to another); (2) calculating where to place the 2 cars after the tutor has placed his car on the track, on the basis of car behavior as calculated at the previous step (to be completed in 30 minutes); (3) running the simulation to check whether the cars have all arrived at the same time. The amount of calculations, the required accuracy and the limited time mean that phases 1 and 2 require a collective organized effort.

Preliminary experiments showed that, although learners are aware of the necessarily collective nature of the work, they do not naturally engage in elaborating an explicit organization and, if any, adopt a very poor organization. This leads them not only to fail (failing is not necessarily an issue: learners learn through their interactions during phases 1 and 2, success in phase 3 is nice but not a *sine qua non* condition for learning) but, more importantly, to feel “in front of a wall”, lose motivation, and not engage in collaboration and knowledge-generative interactions.

4 The System: Supporting Learners’ Organization

The system (named Albatros) is designed to allow a group of distant learners to collectively build a solution (phases 1 & 2). It integrates 2 dedicated shared editors designed to support learners’ self-organization, classical communication (chat) and voting tools, and the simulation. A comprehensive description can be found in [2].

A first editor (see Figure 2), related to the co-construction level, allows the elaboration (and, in case of breakdown, the revision) of a common view and vocabulary (grounding). It allows learners (and supports them, providing a set of predefined items



N°	PRIORITY	INVOLVED NOTION	DATA NAME	DATA DESCRIPTION	TYPE OF ACTION
1	1 High	All the cars	Duration of the race		Measure
2	1 High	All the cars	Speed	Speed of the car	Calculate
3	1 High	Cars that stop	Duration of the stop	Duration of the stop is important because the speeds are constant	Measure
...	...	...	...	...	...

Fig. 2. Data definition and actions editor (from the experiment, translated from French)

they can use or be inspired by) to collectively define the data and actions they will need as a list of *actions to be processed*. Each action mentions the involved notion (e.g., "cars that stop"), the name adopted by the group to denote the data (e.g., "duration of the stop"), a textual description, and what is to be carried out in relation to this data (e.g., "measure"). As each action corresponds to a line in the interface, the result is a kind of general problem-solving plan. Learners' activity, as shown by the experiments, is as hoped: definition of a set of lines denoting the way they intend to act and the involved notions (which is of course not necessarily what will happen!), using the suggested items and/or creating some others, each line being elaborated, discussed and negotiated (via the chat). The interface requires each line to be collectively acknowledged via the voting tool. Any learner can come back at any time to what has been defined previously.

Learner #1	Learner #2	Learner #3	No.	PRIORITY	INVOLVED NOTION	DATA NAME	TYPE OF ACTION	CAR # 1			CAR # 2			L
								Learner #1	Learner #2	Learner #3	Learner #1	Learner #2	Learner #3	
?	OK	OK	1	1 High	All the cars	Duration of the race	Measure	5,5	5.5	5.5	27,9	27.9	27.9	
OK	?	OK	2	1 High	All the cars	Speed	Calculate	27,45	?	27,5	5,41	?	5,41	
OK	OK	?	3	1 High	Cars that stop	Duration of the stop	Measure	OK	0	OK	OK	0	OK	
?	?	?	...	...	...	...	...	?	?	?	?	?	?	

Fig. 3. Planning definition/execution editor (from the experiment, translated from French)

The second editor (see Figure 3), related to the co-operation and co-ordination levels, allows definition and enactment of a more precise plan. The interface is generated from the collective result of the preceding phase. For every line data/action, 3 columns by car are generated. All cells are initialized with "?".When used in the "definition" mode, the editor allows learners to declare who will carry out each action: if "Learner #1" clicks on a cell, he/she declares he/she will carry out this task for this car; the "?" is replaced by an "OK" in "Learner #1" column. As the interface is shared, the other learners are aware of this. As each car/action pair is associated with one column per learner, learners can decide to delegate each action to just one, two or three of them. A chat allows synchronous interactions, and learners have to vote on the result to skip to the next phase, using the editor in "execution" mode: the cells marked as "OK" for a learner become editable, i.e., he/she can edit the value. Now that tasks and roles have been fixed, each learner is confronted with his/her tasks. In accordance with Bardram's model, the experiments show that learners concentrate on the task they have been assigned (learners are individually measuring, calculating, etc.), their individual actions being externally related to each other, but related to a common goal (co-ordination level). The shared interface allows every learner to know what he/she is supposed to do and what the others are doing. Solving evolution is denoted by the fact that the "OKs" are gradually replaced by values.

The way learners can use the editors is very flexible, e.g., they can always come back to previous declarations, start editing values although tasks allocation is not complete (i.e., some "?" remain, see Figure 3), or come back to this allocation. The notion of "plan" (i.e., the succession of lines) is here to be thought of as a resource (and not a constraint) adaptable in context, see Bardram's work on the non-contradiction between planning seen from this view point and Suchman's situated-action views. With respect to these editors, four important issues directly related to intertwinement of Bardram's levels can be noticed: (1) the organization/execution interfaces are similar, (2) if something is modified in the organization the execution interface is automatically adapted, (3) only the items that have been changed in the organization are modified in the execution interface (modifying the organization does not mean re-starting from scratch or changing everything), and (4) learners can move from the organization to the execution interface and *vice versa*.

With respect to usability, the coherence organization level / execution level appears to make the interface easily understandable and usable by learners (the design has benefited from exploratory experiments). During action, learners do come back on what they had "planned" (in some cases in an explicit way, i.e., changing their declarations via the editors, in other cases by agreeing to do so more or less explicitly via the chat or *de facto*), and also enact partial plans.

5 Exploratory Study

The exploratory study aimed at suggesting if and how the system impacts the learners' organization and motivation, and helps detect learners' organization. We present hereafter the data and comments (due to a limited number of individuals and groups, no statistically significant results were to be expected).

Experimental setting
Participants. 18 learners (9 females, 9 males, 11th grade science) were randomly assigned to 6 groups of 3 learners.

Materials. Each learner was connected via an individual computer to the system Website. Computers were equipped with software (Camstasia) to record the learners' screens (video file). The chat and the different tools were logged in an XML format.

Protocol. 3 groups used the system before and during the challenge: specific editors (to fix the data to be collected, define the organization and collect the data) and the voting tool to acknowledge decisions (plan, change of mode), simulation, calculator and chat to discuss at all stages. 3 other groups didn't use the system and had only access to the basic tools: chat, simulation, text zone for individual edition, and calculator. The 6 groups worked in the same place, in the presence of the experimenter. They exclusively used the computer-based system to exchange within the group. The proposed scenario was as described previously, identical for the 6 groups: introduction screens explaining the problem and the tools (this part being different for the two groups); phase to prepare the data; launch of the final phase of the challenge when the experimenter perceived the group to be ready (approximately after 2 or 3 hours of preparation, depending on the group).

Data. Every action (mouse click) and message typed by the participants was recorded and associated with an author, a time-stamp, a duration, a type (e.g., "measure"), the tool used, and complementary data such as the numerical value or the tool's mode when pertinent (e.g., organization or execution). The result is a chronological reconstruction of each collective session as a 3-column table displaying the messages and actions of the three learners of the group. Then, we used the coding grid [8] to identify the co-construction, co-operation and co-ordination phases. To analyze the evolution of motivation, we used the SAL instrument [10].

Results and discussion related to learners' organization

Engaging learners in constructing an explicit organization could represent an obstacle for them: it is a meta-level additional activity they are not used to, they are not naturally convinced of its interest, and the system may have appeared difficult to use. The SAL questionnaire (Table 1) and the fact that groups using the system engage in longer sessions (Table 2: learners decide themselves when to face the final simulation, and groups using the system asked for additional preparation time) suggest this is not the case. Learners' motivation seems to increase. However, this needs to be confirmed statistically using SAL with more subjects. As a matter of fact, learners using the system seem to come closer to the result (Table 4). It can be thought that feeling the group has good chances of success impacts motivation and engagement.

Table 1. Scores, SAL questionnaire

Motivation scores, 6 questions (24 points max.)																		
	Groups using the system									Groups not using the system								
	GR1			GR3			GR5			GR2			GR4			GR6		
	# 1	# 2	# 3	# 1	# 2	# 3	# 1	# 2	# 3	# 1	# 2	# 3	# 1	# 2	# 3	# 1	# 2	# 3
Pré	21	17	17	10	18	19	22	16	17	19	20	20	15	16	10	13	N/A	20
Post	20	20	12	11	19	21	24	15	23	15	19	17	14	12	16	12	N/A	21

Table 2. Duration (and % / total session) at each Bardram's model activity level

Duration / level	Groups using the system			Groups not using the system		
	GR1	GR3	GR5	GR2	GR4	GR6
Co-construction breakdowns	0' (0%)	57'30'' (23%)	0' (0%)	105' (62%)	25' (14%)	100' (64%)
Co-construction with no breakdowns	45' (20%)	50' (20%)	72'30'' (30%)	27'30 (16%)	30'00 (16%)	0' (0%)
Co-operation breakdowns	5'00'' (2%)	10'00'' (4%)	2'30'' (1%)	0' (0%)	2'30'' (1%)	0' (0%)
Co-operation with no breakdowns	10'00'' (5%)	32'30'' (13%)	7'30'' (3%)	5'00'' (3%)	25'00'' (14%)	12'30'' (8%)
Co-ordination breakdowns	77'30'' (34%)	50'00'' (20%)	37'30'' (15%)	12'30'' (7%)	0' (0%)	27'30'' (18%)
Co-ordination with no breakdowns	77'30'' (34%)	32'30'' (13%)	37'30'' (15%)	0' (0%)	67'30'' (36%)	7'30'' (5%)
Individual activity	10'00'' (5%)	17'30'' (7%)	90'00'' (36%)	20'00'' (12%)	35'00'' (19%)	7'30'' (5%)
Total session and %	225' (100%)	250' (100%)	245' (100%)	170' (100%)	185' (100%)	155' (100%)

Table 3. Number of chat messages by learner

Messages	Groups using the system									Groups not using the system								
	GR1			GR3			GR5			GR2			GR4			GR6		
Learners	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Messages	66	70	49	100	116	116	56	52	67	110	90	78	61	141	47	47	39	8
Average	61,7			110,7			58,3			92,7			83,0			31,3		
Std Dev	11,2			9,2			7,8			16,2			50,7			20,6		

Table 4. Distance to the solution

Delta/solution	Groups using the system			Groups not using the system		
	GR1	GR3	GR5	GR2	GR4	GR6
Delay car #1	0,5	1,1	0	14,3	6,9	0
Delay car #2	2,2	8,2	0	5,2	0,2	0
Total	2,7	9,3	0	19,5	7,1	0
Total (3 groups)		12			26,6	
Average		4			8,9	

Delay groups' cars / tutor's car on the arrival line (success is denoted by delay = 0)

The number of chat messages by learner tends to be balanced for groups using the system, which is not the case for the other groups (Table 3). A "co-construction coherent phase with some subsequent minor revisions" pattern appears within groups using the system: a continuous phase (average duration: 46'40') when preparing the challenge and then during the challenge (average duration: 8'20''), with short adjustment phases (average: 5 phases and 3'50'' *per* phase). In the other groups co-construction is not a proper phase. This is an important point given the underlying learning assumptions (learning through interaction). This quantitative indication does not imply that these interactions are knowledge-generative. However, other indications appear positive by suggesting learners are also more "in line" (see *infra*).

The system appears to encourage learners to act as experts and not as beginners. Groups not using the system engage in individual problem-solving, and attempt to explain or share the work episodically, when necessary (typically: suddenly understanding there are discrepancies in the measurements or calculations). At the end of the preparation phase, they tend to have individual solutions written in different conceptual languages. Groups using the system engage in a collective definition of the data to be acquired. The analysis shows it corresponds to (and is later used as) a common language, and acts as the premises of a general solving strategy. The system is the center of the activity (average: 84% of the session duration), which makes learners constantly aware of each other's actions and progress, and naturally engage in comparisons, discussions, revisions of their results, etc. They have no difficulty communicating on data and actions as they use a jointly established language. At the end of the phase preceding the final challenge, the 3 groups had a common solution with negligible variations, and written in a common language.

We have defined "breakdown periods" (Table 2) as periods where learners are no longer in-line: they are individually tackling issues that are not related to each other or conflicting (co-ordination issue), a learner is left on the side, etc. Such periods are not independent from each other, and characterizing them is an issue. A key descriptive feature that can be noted is the total period of time groups remain organized: 51% of total problem-solving time for the groups using the system, and 35% for the others. For instance, considering the key issue of co-construction, groups using the system are involved in a total of 167'30'' (average 55'50'') of co-construction with no breakdowns, and a total of 57'30'' (average 19'10'') of co-construction breakdowns, while for the groups not using the system the figures are 57'30'' (average 19'10'') and 230' (average 76'40'').The qualitative analysis shows that the process of the groups using the system is collective right from the beginning, while the others engage first in individual measures and solving for an average of 15 minutes.

The number of breakdowns made explicit and tackled by the learners using the system is greater (22 *vs.* 14). Qualitative analysis shows this is not correlated to a larger number of problems, but to the fact that these problems are made more easily detectable, and earlier on in the process. Furthermore, as soon as the learners detect a breakdown, they tackle it (11 out of 22 were explicitly solved). For groups not using the system, breakdowns are less explicit, less detectable, and less considered as issues. Unresolved breakdowns are located at the co-operation and co-ordination levels for the groups using the system, and at the co-construction level for the others; they are consequently much more difficult to manage (in particular, because detected very late). As a matter of fact, groups using the system face breakdowns at the co-operation and co-ordination levels because they succeeded in having a common ground, and are effectively working together. 2 of these groups failed in the final challenge, although they remained collective right through to the end (failure was due to learners not succeeding in completing a task, and not to collective-work issues). On the other hand, 2 groups not using the system came to collective-work deadlocks, i.e., lost the collective dimension.

The system does not enforce a particular organization: all groups vary in the strategy they adopt (co-operation and co-ordination levels). As an example, 2 of the groups using the system distributed the measurement and calculation tasks among the various individuals, while the 3rd group built a common ground (co-construction phase), but decided that a single (brilliant) learner would carry out all the calculations, only using the editor in execution mode (the other learners continue to be active, however). This is an important point as our objective is to support learners in making explicit their organization, not to impose one. However, from another point of view, this means that system use does not necessarily result in a balanced organization.

Results and discussion related to learners' organization detection

From a general point of view, analyzing the process of learners not using the system is much more difficult. Level qualification and level-change detection are made difficult because organization and resolution of the problem are heavily intertwined. Learners often change level according to their own process, without noticing or taking into account the opinion or the progress of the other members. Changes are often only understandable *a posteriori*, later on, by re-interpreting actions and chats. The system features (in particular, definition of common ground and alternation of organization and execution modes) facilitate learners' activity characterization.

To understand to what extent the system could support automated analysis, we re-examined the data to simulate an automated analysis for the transition notion. We defined an analysis grid restricted to computational events, i.e., identified what usage of the system (e.g., use of a given tool or change of mode) could be used as transition indicators. We then compared the first analysis (human analyst + general grid) and the second analysis (system-based indicators only), see Table 5. The result shows that 66% of the transitions can correctly be identified by basic automated analysis. The other transitions are not found because they can only be detected by the chat Natural Language (NL) analysis. They typically correspond to learners involved in a task related to a given level (building the plan, enacting planned actions) and using some corresponding tools but, via the chat, episodically coming back to a feature and interacting to enhance their common understanding (co-construction to co-ordination: 5; co-ordination to co-construction: 7). Other transitions are related to emergent tasks that are not envisaged in the current system (e.g., learner organizing a kind of rehearsal before the final challenge). Erroneous detections (15%) are essentially anticipations: learners shift to a tool associated with co-operation or co-ordination and then chat (or continue chatting) about their organization or their problem-solving. A possible explanation could be that the fact that they engage in a subsequent phase (via the system) leads them to additional organization-related interactions.

Table 5. Automated *vs.* human analysis of transitions

Transitions		Human analysis				Automated detection (simulation)											
						correct				not detected				incorrect			
Groups		GR1	GR3	GR5	∑	GR1	GR3	GR5	∑	GR1	GR3	GR5	∑	GR1	GR3	GR5	∑
Top-down	co-con. / co-op.	1	3	1	**5**	1	3	1	**5**	0	0	0	**0**	0	0	2	**2**
	co-con. / co-ord.	6	4	6	**16**	3	4	4	**11**	3	0	2	**5**	0	0	0	**0**
	co-op. / co-ord.	2	4	1	**7**	2	4	0	**6**	0	0	1	**1**	0	2	1	**3**
Bottom-up	co-op. / co-con.	0	2	1	**3**	0	0	0	**0**	0	2	1	**3**	0	0	0	**0**
	co-or. / co-op.	1	3	1	**5**	1	3	0	**4**	0	0	1	**1**	0	1	0	**1**
	co-or. / co-con.	6	4	5	**15**	3	2	3	**8**	3	2	2	**7**	0	0	0	**0**
Total		**16**	**20**	**15**	**51**	**10**	**16**	**8**	**34**	**6**	**4**	**7**	**17**	**0**	**3**	**3**	**6**

6 Conclusions

Providing organizational support has necessarily an impact on learners' activity. Results so far suggest that our system (1) supports learners' self-organization whilst not imposing a given strategy, (2) promotes knowledge-generative interactions (co-construction of a common ground and strategies; mutual regulation; resolution of conflicts such as breakdowns), and (3) does not negatively impact motivation (although making learners engage in a meta-level additional activity, whose interest is not obvious for them), and (to be confirmed) seems rather to enhance motivation.

Regarding intelligent support, a core result is that the system does not disrupt learners in their problem-solving (on the contrary, it seems to support them). Given this usability result, it makes sense to make learners use the system, and thus to benefit from the major advantage of the adopted approach: the structural correspondence between the theoretical background, the system, and the analysis grid. This correspondence allows the system traces to be interpretable (to a certain extent) in the terms of the model. Preliminary results for transitions, however, show that a basic automated analysis can support a human tutor by drawing his attention, but remains insufficient for automated monitoring retroactions (66%) and must be completed by NL analysis techniques. The next steps in this research are to enhance the system to increase the percentage of transitions detectable by basic trace analysis, envisage the use of NL analysis techniques, address the issue of breakdown detection (which is likely to request more NL analysis capacities than transitions), and to model active support (hints to individuals and/or the group, etc.) based on these analyses.

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