



# Configurations of activity : from the coupling of individual actions to the emergence of collective activity

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## ► To cite this version:

Philippe Veyrunes, Nathalie Gal-Petitfaux, Marc Durand. Configurations of activity : from the coupling of individual actions to the emergence of collective activity. *Research Papers in Education*, 2009, 24 (1), pp.95-113. hal-00848156

**HAL Id: hal-00848156**

**<https://hal.science/hal-00848156>**

Submitted on 25 Jul 2013

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1 Title: (research paper):

2 **Configurations of activity: From the coupling of individual actions to the emergence**  
3 **of collective activity. A study of mathematics teaching situation in primary school.**

4 Length: 9 846 words

5

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1 Abstract

2  
3 This paper presents and uses the notion of configuration of activity, which extends the  
4 Norbert Elias's original concept of social configuration (1966) based on the study and  
5 analysis of individual and collective activity. Although this concept embraces all types of  
6 social activities, in the present study we used it to describe and analyze various classroom  
7 activities during a primary school mathematics lesson. Individual action is described as  
8 being meaningful to the agent, according to semiological theory of course-of-action  
9 (Theureau, 2003).

10 The configuration of activity in the classroom is described as a collective activity with a  
11 global form embedded in a culture and emerging from the dynamics of points of  
12 articulation between individual actions. It presents the main characteristics of  
13 autonomous systems: (a) the emergence of an order, (b) the individuation of a form,  
14 (c) the existence of a unit with borders specified by the process of self-reproduction, and  
15 (d) the system sensibility to perturbation by outside events.

16 Using the concept of the classroom configuration of activity, this study allows for new  
17 insights in the emergence of a teacher-pupils collaborative activity in the classroom.

18  
19 Key words: activity, collective, emergence, classroom, mathematics, teaching

1           In the 6<sup>th</sup> grade classroom, pupils' desks are arranged to form four workgroups of  
2 four pupils each. The pupils are reading a duplicated text of a math problem that they  
3 have to solve. As the teacher moves from group to group she asks questions to make sure  
4 that the pupils understand the task. The pupils are involved in various activities: they  
5 mark up their problem sheets with highlighters, use their electronic calculators, answer  
6 questions, move around the classroom and talk to each other. The teacher monitors these  
7 activities observing group dynamics, confirms correct answers, helping some pupils and  
8 encouraging others, and confirming the correct answers. Although at first glance all these  
9 activities seem to be chaotic and spontaneous, a closer look will reveal a certain level of  
10 organization: the interaction between individuals forms a recognizable structure. These  
11 complex and dynamic forms of interaction have been termed "configurations of activity"  
12 (Durand, Saury & Sève, 2006), and their emergence in the classroom has become a focus  
13 of educational research (Durand, 2005).

14           This paper presents and uses a theoretical and methodological approach for  
15 studying these configurations of activity through the description and analysis of a  
16 classroom situation during a primary school mathematics lesson. We proceed in three  
17 steps: first, we introduce (a) the approach of "methodological situationism", the three  
18 presuppositions it is based on, and the notion of the intrinsic dynamics of activity. We  
19 then illustrate the concept of the configuration of activity through the case study of a  
20 typical classroom teaching situation. Finally, we provide a detailed examination of this  
21 concept and an assessment of its relevance for educational activity description.

22

## 1     **“Methodological situationism”**

2         Our approach is grounded in the following theories: (a) situated action (or cognition)  
3 theories (Kirshner & Whitson, 1997), (b) activity theory (e.g. Engeström, Miettinen &  
4 Punamäki, 1999), and (c) cognitive phenomenology (Varela, Thompson & Rosch, 1999).  
5 It focuses on the articulation of social and individual dimensions of activity, making a  
6 special emphasis on classroom activity. The approach differs from the current research  
7 trends based on the assumption that collective activity depends on individual actions and,  
8 for example, evolves from individual representations. From this perspective,  
9 representations determine or prescribe collective activity. Our approach also differs from  
10 those ones that assume the opposite, namely, that individual action depend on collective  
11 activity. This assumption implies that the organization determines or prescribes  
12 individual action.

13         Our approach is based on three presuppositions: (a) self-organization of individual  
14 action, (b) lack of opposition between the individual and social dimensions of activity,  
15 and (c) fundamental semiosis basis of activity. The first presupposition is that individual  
16 action emerge from the “activity – situation” coupling (Varela, 1979). This coupling  
17 embraces the fundamental property of living and social systems, regardless of their level  
18 of organization or complexity: living systems develop and maintain their structure  
19 through the exchange with the environment in a process of permanent self-organization  
20 (Fuchs, 2006; Luhmann, 1995). The changing forms of this coupling result from the  
21 dynamics of life and from the viability of the system to its environment. In other words,  
22 the organization of individual action is considered to be essentially autonomous, although  
23 extrinsic constraints on this coupling do occur (Theureau, 2002, 2003). The organization  
24 of action and the meaning attributed to them by their agents should be considered by the  
25 researchers thus need to be taken into account by modalities other than the outside  
26 “causes” of coupling (Andersen, Emmeche, Finnemann & Christiansen, 2000). From the  
27 same perspective, the organization and meaning of collective activity proceed from the  
28 articulation of individual action in accordance with the emerging dynamics that is  
29 different from but analogous to the dynamics that characterizes individual action. When  
30 individual situations allow it, global cooperation emerges spontaneously, regardless of  
31 precise rules or a central authority. Phenomena of this type have been described as “latent

1 organizations” by Starkey, Barnatt & Tempest (2000), or as “intelligent crowds” by  
2 Rafael (2003), in the context of new technology use.

3 The second presupposition is that the individual and the social are not two distinct  
4 entities or ontological realities. Individuals form groups: although separate as ontological  
5 entities, they are united by a common structure that distinguishes them from an “exterior”  
6 in a dynamic and labile manner. The individual and the social are thus intrinsically  
7 connected. Individuals attribute a meaning to the collective activity in which they are  
8 involved insofar as the latter allows for the accomplishment of individual action.  
9 According to Elias (1966, 1978, 1991), the concept of social configuration can be used to  
10 describe and explain the interdependency of relationships, the tensions between  
11 individual actions, and the relatively stable forms of this system of interdependence.  
12 Social configurations are constructed by individual agents as they interact collectively in  
13 a certain situation, yet these configurations are independent of both individual intentions  
14 and awareness. They are *gestalts* that stand out from the background. They are limited in  
15 space and time and can be described as emerging processes of distribution and dynamic  
16 balancing of tensions. Social configurations are “concrete” in that they are “no more and  
17 no less real than the individuals who make them up” (Elias, 1966, p.397). They are global  
18 forms with ever-changing dynamics produced by interaction. They offer a potential for  
19 action, imposing balance and thus facilitating the achievement of goals. They present  
20 opportunities both for addressing individual preoccupations and for achieving a social  
21 balance often based on individual goals that do not necessarily converge.

22 The last presupposition is that configurations of activity emerge from the meanings  
23 that individuals attribute to their action and environment, yet these configurations may  
24 never become meaningful in themselves. Each agent’s action is based on semiosis; that is,  
25 on processes of construction or attribution of meaning in direct and essential connection  
26 with the organization of their action (Theureau, 2002; Chaliès, Ria, Trohel & Durand,  
27 2004). Agents interact only with issues that are meaningful to them. In other words,  
28 agents are fundamentally and permanently engaged in the construction and reconstruction  
29 of an “*umwelt*” (Uexküll, 1992), i.e. a meaningful situation. Our study adopts a situated  
30 action approach in which the situation is defined as part of the objective environment  
31 whose meaning is constructed by the agent We insist that activity must be studied as a

1 whole, that not only does the agent's action carry the imprint of the environment in which  
2 it unfolds, but also that the agent "has a situation" in Dewey's sense (1938/1963). This  
3 means that the agent has an irreducible point of view at the environment that generates  
4 meaning, and that cognition is mainly culturally situated, i.e. that the culture offers  
5 possible actions which are or are not actualised in context.

### 6 *Classroom activity analysis*

7 The course of action approach is part of a wider research program aimed at analyzing  
8 teachers' and pupils' classroom activity in various subject matter contexts at different  
9 curriculum levels. These studies focus on the teaching process (Durand, 1999; Durand,  
10 Saury & Veyrunes, 2005), classroom preoccupations and emotions of the beginning  
11 teachers (Bertone, Méard, Ria, Euzet & Durand, 2003; Ria, Sève, Theureau, Saury &  
12 Durand, 2003), the interaction between beginning and cooperative teachers (Chaliès, Ria,  
13 Trohel & Durand, 2004), teacher-pupils classroom conflicts (Bertone, Meard, Flavier,  
14 Euzet & Durand, 2002; Flavier, Bertone, Hauw & Durand, 2002), and the distance  
15 learning process (Leblanc, Durand, Saury & Theureau, 2001). Although all these studies  
16 provide new insights into the teaching and learning process and interaction, none of them  
17 examine the collective activity in the classroom. This is the scope of the present study...

18 To understand configurations of activity, one must examine the construction  
19 processes of activity-situation coupling, focusing on the meaning attributed to the  
20 environment within which agents act. This approach emphasizes the importance of the  
21 agent's point of view. In the classroom, for example, an individual agent's action partly  
22 depends on the individual action of other agents: this interdependence can be termed  
23 "individual activity – situation" coupling. This coupling is at the origin of the  
24 configuration of activity within which it unfolds, and yet is also made possible by it.  
25 Individual actions of agents are meaningful to each of them inasmuch as they can  
26 articulate these actions among themselves and in accordance with the configuration of  
27 collective activity that emerges from these actions. However, each agent only considers  
28 configuration issues that are meaningful to him/her, but might not have the same meaning  
29 to another agent. This means that: (a) agents do not have a global and thorough  
30 understanding of the configuration of activity in which they are involved, and (b) the

1 configuration needs to be analyzed by the researcher from a dual point of view: (a) a  
2 point of view of an external observer, which can be metaphorically termed the “point of  
3 view of the configuration”; and (b) a point of view of an agent, termed the “point of view  
4 of the actor”, or the internal point of view. The researcher uses agents’ verbalisation to  
5 interpret their experience during action. These methods of observation, coupled with self-  
6 confrontation interviews where agents are invited to comment on their own action while  
7 being video recorded, give the researcher an opportunity to coordinate the two points of  
8 view on action.

9 In this study, we refer to collective configuration of activity and *not* to configuration  
10 of collective activities. Unlike both individualistic and collectivistic approaches, this  
11 approach focuses on the emerging activity-situation coupling and has been termed  
12 “methodological situationism” (Theureau, 2002, 2003).

13 Our approach to classroom activity has been influenced by (a) Doyle’s concept of  
14 classroom ecology (1986) that describes the classroom organization and management as a  
15 structured, singular, complex and interactive process, resulting from a set of processes  
16 and dispositions carried out by the teacher to assure a supportive classroom environment  
17 for pupils; (b) the interactionist approach that maintains the idea of “social construction  
18 of the reality” (Schütz, 1970) and considers the way that actor’s interpret the classroom  
19 reality (Allen, 1986; Mehan, 1979); and (c) the distributed cognition approach that  
20 emphasizes the collective and cultural aspects of action and interaction between actors  
21 and between them and the outer world, placing them within network sustaining  
22 trajectories of participation in which cognition is socially distributed (Barab & Kirshner,  
23 2001; Roth, 2001; Salomon, 1993) and supported by objects (Saxe, 2002).

24 Our approach is aimed at explaining collective activity in an educational setting by:  
25 (a) giving similar importance to individual action and collective activity; (b) adopting the  
26 actors’ point of view; (c) taking into account the meaning they construct about their  
27 action; (d) adopting a qualitative methodology that provides a detailed description of  
28 global interactions in the classroom (and not only dyadic interactions); (e) focusing on  
29 phenomenon that are not pre-defined.

### 30 *The intrinsic dynamics of action*



We describe individual action and its articulation within the semiological theory of the course of action (Theureau, 2003). This theory models the level of individual action that is meaningful to the agent, i.e., the level that can be shown, told and commented on by him or her. Course-of-action theory presupposes that this level of organization is relatively autonomous in relation to other levels of analysis, but that it represents the agent's global action (Theureau, 2003).

The individual course-of-action consists of a flux of action which includes three main components: (a) preoccupations, (b) perceived meaningful aspects of the situation and (c) cognitive elements of generality (i.e., knowledge). The preoccupations correspond to all the possibilities of action, relatively indeterminable and limited in time, that are open to the agent in a given situation (i.e. "*Help pupils*"). They emerge from the possibilities linked to the agent's past. These preoccupations are blurred, indeterminate (Ex.: "*Help the pupils establish links between important numbers*" or "*Get the pupils back on task*"). At the same time, these preoccupations are specified in the action by the aspects of the situation which the agent perceives and which are meaningful to him (Ex.: "*The pupils haven't noticed the important indications*" and "*The pupils are becoming discouraged*"). This refers to the knowledge present in cognition in the unfolding situation but arising from past courses-of-action (Ex.: "*Highlighting helps the pupils to find the key information*" and "*Finding the key information helps to solve a problem*").

# **Table 1: Example of action unit components**

## Actions and verbalizations in the classroom and self-confrontation interviews

[A pupil makes a sigh of discouragement]

Teacher (in the classroom): Give me a highlighter!

Teacher (during a self-confrontation interview): OK, let's do it again! So, here I'm going to highlight, because they haven't done it: This annoys me, and I want them to see it! I want them to see that it's over here — it's over here that it counts... There you go, here's one, and then the other!

---

**Preoccupations:** Help the pupils

- Help the pupils to establish links between important numbers

- 1       – Get the pupils back on task

---

2       **Perceived meaningful aspects of the situation**

- 3       – The pupils haven't noticed the important information
- 4       – The pupils are becoming discouraged

---

5       **Elements of Generality (Knowledge)**

- 6       – Finding key information helps to solve a problem
- 7       – Highlighting helps the pupils to find key information
- 

8

9       Collective activity results from the synchronic and diachronic coupling of several

10 agents' courses-of-action. This coupling results from multiple points of articulation

11 between two courses-of-action, that is, local relations of interdependence (mutual

12 dependence). Points of articulation occur between two (or more) courses-of-action when

13 one or more components of one agent's course-of-action correspond to one or more

14 components of the other agent's course-of-action. This articulation is produced by the

15 convergence or divergence of preoccupations and actions, like, for example, in a situation

16 of supervision in a teacher education program (Chaliès, Ria, Bertone, Trohel & Durand,

17 2004).

18       Our research approach extends beyond the interaction between two agents, focusing

19 on the collective activity of several agents. The configuration of activity in its changing

20 dynamics is studied based on collective articulation of preoccupations and actions of the

21 participating agents at a given moment.

22

23       **A case of collectively solving a mathematics problem**

24

25       This case study is an excerpt from a considerably more extensive research program

26 (Durand, Saury & Veyrunes, 2005). We have chosen it because it perfectly illustrates

27 some typical situations observed during mathematics lessons.

28       The teacher conducted a mathematics lesson in Year 6 class (the highest level of

29 primary school in France) in a small rural school with only three classes. There were

1 eight 11-year-olds in the classroom. Six lessons were video-recorded and analyzed  
2 based on the notion of proportionality. One of these lessons was selected as  
3 representative of a configuration of math problem solving activity. Two types of data  
4 were collected and analyzed: (a) data of pupils' and teachers actions' observation:  
5 recordings of classroom actions with a video camera; (b) data from self-confrontation  
6 interviews held immediately after the lesson. After the teacher and the researcher had  
7 closely examined the video recording, the teacher was invited to comment on her actions,  
8 i.e. to explain what she was doing, what she was thinking about, what she perceived and  
9 what she felt at a particular moment. The researcher's role was to identify specific events  
10 and to encourage the teacher to comment on her own action while avoiding *a posteriori*  
11 interpretations, generalizations, or explanations that were not directly connected with  
12 these actions.

13 Data processing was carried out in five stages:

14 **Stage 1:** Chronological presentation of collected data. For this purpose, a three-  
15 column table was created. Column 1 comprises the traces of the activity in the classroom:  
16 *verbatim* transcription of participants' verbalizations, pupils' work, and schemas made by  
17 the teacher. Column 2 comprises the video file of pupils' and teachers' behaviours and  
18 interactions along with their full description. Column 3 comprises the *verbatim*  
19 transcription of self-confrontation interviews corresponding to the teacher-related data in  
20 Column 1.

21 **Stage 2:** Identification of components. Detailed examination of participants'  
22 behaviours and communications in the classroom and during the self-confrontation  
23 interview. Preoccupations were identified and categorized. Based on the responses to the  
24 following questions: What are the agent's preoccupations at the time under study? Pupils'  
25 preoccupations were identified by inferences performed during self-confrontation  
26 interviews and based on pupils' behaviour and verbalizations, on researchers' experience  
27 of the classroom (all of them have been teachers), and on their expertise in the course-of-  
28 action theory. Inferences made by the researchers in a blind procedure achieved a 92%-  
29 level of agreement; disagreements were resolved through follow-up discussions between  
30 the researchers". Perceived meaningful aspects of the situation were identified and  
31 categorized using the responses to the following question: what perceived or remembered

elements of the situation were meaningful to the agent at a moment of study?

**Stage 3:** Linking the teacher's and pupils preoccupations with those of the students by noting the convergence and divergence between them.

**Stage 4:** Study of the points of articulation in the configuration of activity. The points of articulation were determined based on what elements of the situation are meaningful to agents in the situation: if a certain element of the situation (in this case, for example, the math problem) is meaningful to two or more agents, it is considered to be an articulation point in the configuration of activity.

**Stage 5:** Description of the dynamics of the configuration of activity, i.e., the tensions and the balance resulting from the coupling of courses-of-action in the classroom.

During a follow-up discussion between two researchers, they resolved any existing disagreement about the decomposition of courses-of-action, the component categorization, and the convergence/divergence of preoccupations, achieving 97% of agreement. After consulting with the third researcher, they achieved a full agreement (100%).

During the lesson, the pupils were asked to solve a proportion problem using a scale (see Figure 1).

**YEAR 6 PROBLEM SITUATION (1)**

A boy wants to build a model car.

He can choose between two sizes:

– a 1:45 scale model (9 cm long and 3.2 cm wide)

– a 1:20 scale model (22 cm long and 7 cm wide)

He wants to build the one that is really bigger, the one that would be bigger if he saw them both in the street.

Which one should he choose?

Tips:

1) – Think about the scales presented in the text

(Relationships between units) cm-cm

2) – Think about the tables that show the real car-model relationship

**Figure 1.** Facsimile of the problem given to the pupils

***Individual actions during math problem-solving***

**Teachers' individual actions.** The class was divided into groups of four or five pupils in four work areas; in each area, pupils' desks were put together. Once the problem sheets were handed out and the problem was read out loud, the pupils started searching for the solution. The first responses given by Gerald, Gregory, Justine, and Charlotte<sup>1</sup> were invalidated by the teacher. In the 25<sup>th</sup> minute, Gerald suggested a solution that involved dividing one scale by another one. The teacher invalidated this suggestion with a simple "no".

In the 29<sup>th</sup> minute, the teacher confirmed Justine's response pointing out that she had spotted an important piece of information, that is, that the two models were of different size. The teacher's preoccupations were: (a) *to confirm Justine's response*, (b) *to stimulate Justine's involvement in the given task so that she would continue working*, and (c) *to prevent the pupils in Charlotte's group from confusing the numerical data of the two models*.

The teacher's preoccupation with helping the pupils to understand the reduction ratio was expressed by a reference to "their life outside school". The teacher thus commented on her own action: "So, now I am trying to help Justine because I know she goes walking with her uncle... [...]. So I say: OK, who has ever run a kilometre? And I am waiting for Justine to say...: I do, every Saturday I go walking with my uncle. We take the model diagram, we look at it, and... When you put your foot on the diagram, you can see that it goes over the edge?" The teacher's preoccupations at that moment were: (a) *to help Justine by evoking a meaningful experience outside school*, (b) *to help Justine understand the reduced scale presented on the diagram*, and (c) *to keep Justine focused on the prescribed task*.

In the 38<sup>th</sup> minute, Justine came up with a new suggestion. Although the girl had figured out the relationship between the width of the first model and its scale, she had divided instead of multiplying. The teacher asked her to encircle a different answer on a worksheet than the 3.2 that Justine was focused on. She wanted the pupils to compare the

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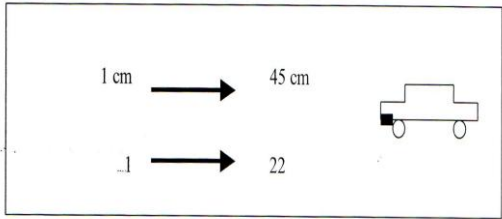
<sup>1</sup> This group of pupils is thereafter called Charlotte's group.

length and width of the cars in relation to their respective scales by multiplying the dimensions of each model by its scale, and then to compare the results. For Model one:  $9 \times 45 = 405$  and  $3.2 \times 45 = 144$  and for model two:  $22 \times 20 = 440$  and  $7 \times 20 = 140$ . Her preoccupation was: *to invalidate incorrect suggestions*.

Because two of the four groups could not find the right solution, the teacher decided to help them. In the 42<sup>nd</sup> minute, she went to the blackboard and gave additional explanations. She focused her attention on the pupils who experienced difficulties in the two groups. Using drawing, she illustrated the scale ratio, pointing out that 1 cm on the scale corresponds to 20 cm or 45 cm (depending on the scale) of a real car. Her preoccupations were: (a) *to help the pupils find and perform the multiplications to be carried out*, (b) *to help the pupils understand the problem using an example from a real-life situation*, and (c) *to keep the pupils involved in a given task*. The teacher Justine's answer with a big smile and an exclamation of satisfaction". Her preoccupation was to *validate on Justine's suggestion*.

15

16 **Table 2.** Excerpt from classroom verbalizations (Minute 42)

Classroom verbalizations	Video and Behaviours description
<p><u>Teacher</u>: ...1 cm on the model...</p> <p><u>Justine</u>: I know!</p> <p><u>Teacher</u>: Means, in real life, 45 cm...</p> <p><u>Justine</u>: ... 1 cm on the model is just 1 cm, but on a normal big car that will be 40 cm ... uh, 45 cm.</p> <p><u>Teacher</u>: Yes, that's right! So, think about this: if you have 2 cm?</p> <p><u>Pupil</u>: You have to multiply!</p> <p><u>Justine</u>: 45 multiplied by 2!</p> <p><u>Teacher</u>: Ahhhh!</p> <p><u>Pupil</u>: 45 multiplied by 22!</p> <p><u>Teacher</u>: Ahhhh!</p>	 <p>Facsimile of the schema drawn on the blackboard by the teacher (Minute 42)</p>

17

1        In the 54<sup>th</sup> minute of the lesson, having realized that the pupils were not on the right  
2 track, the teacher returned to Charlotte' group and repeated her explanation. During the  
3 self-confrontation interview, the teacher said that the period of time between the 54<sup>th</sup> and  
4 58<sup>th</sup> minutes was quite difficult. She reviewed and marked up the text of the problem in  
5 order to help the pupils identify the important information using a highlighter.

6

7    **Table 3.** Classroom and self-confrontation verbalizations (Minute 54)

<b>Classroom verbalizations</b>	<b>Video        and        Behaviours description</b>	<b>Self-confrontation verbalizations</b>
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Teacher: Give me a highlighter!

Justine gives her a highlighter

Teacher: So, let's have another look! So, I'm going to highlight, because it hasn't been done: It's annoying me, and I want them to see!

Do we agree that this and this are the measurements of the little car?

Grégory  
Gérald



Justine

Charlott

Researcher: What are you highlighting, the numbers?

Gérald: Yes!

Charlotte in-knee, leans over the document and watches how the teacher is highlighting the text.

Teacher: The numbers which are... boom! That one with that one, and this one with this one, that's all.

Justine: Yes!

Teacher: And that this and this are the measurements of the other little car? OK?

Gérald also leans forward and does the same.

Researcher: Are you highlighting the four numbers on the photocopy?

Gérald (in a whisper):

I see!

At this time, Gérald leans over his copybook and sets to write.

Teacher: And I want them to see that it's over here, over here, and that makes, there... There is one and then there is another one!

Charlotte (in a loud voice): I see!

Charlotte sits up clapping her hands

Researcher: You separate the two of them, why? What do you expect?

Teacher: I want her to say: 'but, the two others, then, and the two others, but look: here's one that goes with this one!'



1

2       The teacher used a highlighter to mark up relevant information. By highlighting the  
3 model dimensions, she drew the pupils' attention to essential data. But she also wanted  
4 the pupils to detect a relationship between a scale drawing and an actual object.  
5 According to her, understanding this relationship should have helped them realize that the  
6 length and width of the two models were of the same measurement domain, and that the  
7 non-highlighted numbers represented scale factors (1:45 and 1:20). She wanted the pupils  
8 to establish a relationship between the two scales and their respective groups of  
9 measurement data. Her preoccupations were: (a) *to help the pupils from Charlotte's*  
10 *group find the right equation*, (b) *to help the pupils from Charlotte's group to see the*  
11 *relevant relationship between the numbers*, and (c) *to keep the pupils involved in a given*  
12 *task*.

13       The teacher was interrupted by Charlotte and Gerald, each of whom came up with a  
14 solution. First, Gerald suggested multiplying the length of the model by its width, thus  
15 getting what he erroneously named "perimeter" (in fact, the surface area). Gerald seemed  
16 to have interpreted the act of highlighting two pairs of numbers (3.2 and 9 and 22 and 7)  
17 as an evidence of a relationship between the two numbers of each set, and not as an  
18 indication of a link between a set of two numbers and a corresponding scale. So, he  
19 simply chose to multiply the two numbers of each set. Gerald's suggestion was perceived  
20 by the teacher as wrong, and her preoccupation was: *to invalidate Gerald's suggestion*.

21

22 **Table 4.** Verbalizations in the classroom and the self-confrontation interview (Minutes  
23 55-56)

Classroom verbalizations	Video and Behaviours descriptions	Self-confrontation verbalizations
<u>Gerald</u> : So, there, in fact, we did 3.2 times 9 and get 28.8.	Gerald speaks to the teacher ; Charlotte, in-	<u>Researcher</u> : So, when he says that... what do you say?
<u>Teacher</u> : Why did you do 3.2 times 9?	knee on her chair, looks at the teacher	<u>Teacher</u> : I say to myself: but he hasn't understood yet,
<u>Gerald</u> : Because that's the width and that's the length.	Gerald points to the	because in my mind, there is this plan that I am waiting

Teacher: And what does that mean, when you've done this?

Charlotte: Oh no! Teacher! I've found it! That!

Gerald: (At the same time) Well, the perimeter, and after we're going to do 22 times 7!

Teacher: You're going too fast, Gerald, you're panicking! Calm down!

Gerald: 22 times 7, and here we get 28.8 for 3.2 times 9, here, so we'll get ...

Teacher: What will you get with that? Explain it to me, you...

Gerald: The perimeter!

Teacher: The perimeter?

Gerald: Yes, of the car, of course...

Teacher: The perimeter!

Charlotte: Teacher, I understood!

Gerald: Yes... but no, but... And then we'll do 22 times 7, we'll get the result and we'll do 3.2 times 9... 28.8 so, look, and then we will do a ...

Charlotte: Teacher ...

numbers on the problem sheet.

Charlotte hits on the table, then points out the text of the problem with her pen.



Charlotte looks at the teacher

Gerald points out alternately the numbers in the problem sheet and in his copybook

The teacher is staring at Gerald for an instant

The teacher turns to

for. And it's true that I didn't consider that there might be others, and then, when he said: "we only need to multiply this by this and it gives that", I say to myself: OK, he says he has understood, but that's not what I expected! [...]

Teacher: On top of that, he's talking about the perimeter, and I say to myself, he's talking to me about the perimeter—but he's going to work out the area, yes... OK: he's really... lost it!

Teacher: When he talked about the perimeter, I said to myself: OK, he hasn't understood... and that's precisely it, because there is some vocabulary which is for me, well... when he's talking to me, for me it's revealing... There we are, I say to myself, he's talking about the perimeter, he hasn't understood anything!

Researcher: You've understood, but you stop him....

Teacher : Oh yes, I get it ... Gregory ; Gerald leans Teacher: Yes, I understood over his copybook ; what he wanted to say, but I Charlotte looks at the stop him because for me, its' teacher\_ not the right plan!

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The teacher invalidated Gerald's suggestion in three stages: (a) she asked him to explain the equation, (b) she expected him to "talk about the surface area" of the model, while Gerald insisted on using the term "perimeter", and (c) she asked him about his use of this word. For her, Gerald's second mistake was to talk about perimeter instead of area. She expected him to correct his error, which seemed to her to reveal a wider lack of understanding of the situation. She asked him to explain his reasoning, leaving alone the wrong use of terminology. As soon as she realized that Gerald's explanation was not getting him closer to the right answer she briskly interrupted him. Her preoccupations during this exchange were: (a) *to have Gerald explain his reasoning*, and (b) *to invalidate Gerald's suggestion*.

Charlotte's suggestion started at the same moment as Gerald's. The teacher let Charlotte talk after having listened to Gerald. Charlotte used her pen to successively point to relevant pairs of numbers, indicating the model measurements and the scales. She pointed to number 9, then to the scale 1:45, then to number 3.2, and again to 1:45. She did the same for the other model, indicating 22 and 1:20, and then 7 and 1:20. Charlotte emphasized her actions with deictics (repetition of "*that and that*").

The validation of Charlotte's suggestion was direct. The following conversation shows how the teacher was interpreting the solution offered by Charlotte while confirming it at the same time (see Table 5). The text of the problem mediated the two protagonists' actions because it was physically at the centre of the interaction. A sequence of gestures accompanying Charlotte's explanation, coupled with her discourse, was interpreted by the teacher as a sign of comprehension of the scale ratio multiplicative nature. She assumed that Charlotte had realized that to make a scale model bigger, she had to perform multiplication. The teacher therefore did not insist that Charlotte demonstrate her equation. Her preoccupation in that case was *to validate Charlotte's suggestion*.

1

2 **Table 5.** Classroom and self-confrontation verbalizations (Minute 57)

Classroom verbalizations	Video and Behaviours description	Self-confrontation verbalizations
<u>Charlotte</u> : Look, Teacher, I think I got it!	Charlotte points out the numbers in the problem sheet.	<u>Researcher</u> : Yes, yes ... and when she says: 'we're going to do', what is your interpretation of it?
<u>Teacher</u> : Wait a moment...		
<u>Charlotte</u> : The length is 9 cm.	The teacher approves with a bow of her head	<u>Teacher</u> : Multiply!
<u>Teacher</u> : Yes!		
<u>Charlotte</u> : So, this at least ...	Gerald writes, leans over his copybook, then raises his hand.	<u>Researcher</u> : Multiply?
<u>Teacher</u> : The length is 9 cm, so?		<u>Teacher</u> : Yes ...
<u>Charlotte</u> : So, here...		<u>Researcher</u> : Why?
<u>Teacher</u> : Yes!		<u>Teacher</u> : I don't know.
<u>Charlotte</u> : We have to do...		<u>Researcher</u> : You don't know... For you, it's obvious that you have to multiply?
		<u>Teacher</u> : Yes, because it should be bigger.
<u>Teacher</u> : Yes!	The teacher nods her head.	<u>Researcher</u> : So, you think that she has understood that it should be bigger?
<u>Charlotte</u> : That and that...		
<u>Teacher</u> : Yes!	Charlotte points out the numbers in the text of the problem.	<u>Teacher</u> : Yes, I think that she has understood that it should be bigger, but...
<u>Charlotte</u> : And after...	At each 'yes', the teacher nods her head.	<u>Researcher</u> : But you don't ask yourself the question... When she says "that and that"?
<u>Teacher</u> : Yes!	Gerald looks at that Charlotte is pointing out	<u>Teacher</u> : No, in fact...
<u>Charlotte</u> : And after, we will do...		<u>Researcher</u> : For you, that means multiplication?
<u>Teacher</u> : Yes!		<u>Teacher</u> : Well, we multiply

Charlotte: And that...

Teacher: Yes!

Charlotte: And that...

Teacher: And yes!

Gerald: teacher, I don't mean that!

that and that, we have to "do"...

Researcher: She said "do", she didn't say "multiply"?

Teacher: Mm... But in fact, when she showed me the numbers, when she made those gestures "that and that", I said yes!

Researcher: What does it mean, that?

Teacher: That there is a relationship between the two!

**Pupils' individual actions.** Between the 20<sup>th</sup> and 25<sup>th</sup> minute, Charlotte, Gerald, Justine and Gregory came up with some ideas (Table 6). Gerald, Justine and Gregory suggested division. Charlotte thought that the problem contained a "trick" and assumed that she had found it. Gerald quickly abandoned his suggestion to divide, which was ignored by the teacher.

Together with Justine, he interpreted the measurements totally ignoring the notion of scale, and decided that the biggest "real car" would be the one corresponding to the model with bigger dimensions. Justine's, Charlotte's and Gerald's preoccupations at that moment were: (a) *to suggest division as a possible way to solution*, (b) *to obtain validation*, (c) *to facilitate the task*, and (d) *to make a good impression*. Four pupils in the group assumed that math operations were required to solve the problem. Gerald, Justine and Gregory suggested division, Charlotte a sum. Charlotte's preoccupations were: (a) *to find a hidden trick*, and (b) *to make a good impression*.

**Table 6.** Classroom verbalizations (Minutes 20 to 25)

Classroom verbalizations	Video and Behaviours description
<u>Justine</u> : Teacher, I think I've found something.	The teacher leans over the four pupils.

Gerald: 22 divided by 7.

She listens to their suggestions.

Justine: For the...22 divided by 7.

Gerald looks in turn at the teacher,

Gregory: 3 leaves 1. Yes: 3 times 7 is 21, leaves 1.

Justine, Gregory and Charlotte while

Charlotte: I've found a trick! I've found a trick!

they are speaking. Charlotte leans

Teacher: So...

towards the teacher, and, smiling, talks

Charlotte: I've found the trick, Teacher!

to her.

Teacher: Why do you believe there's a trick,

Charlotte?

Charlotte: Well, because there, it makes  $1/20$ ....

Teacher: Yes...

Charlotte: And that there,  $1/40$ .

Charlotte points out the scales in the text of the problem.

Teacher: 45, yes...

Charlotte: 45...

Gerald turns to the teacher and raises his hand before speaking to her.

Teacher: Yes.

Gerald: Ah, I think I've got it, Teacher!

Charlotte: And, since it's not the same number, it

can't be that this one bigger because already there,

it's 2 cm and there it's 7 cm. So, you need to add

Charlotte looks at the teacher, waiting.

something and it'll increase the number...

Gerald turns again to the teacher,

Gerald: Teacher, I think I've got it!

raises his hand before speaking.

Teacher: You believed right from the start that the two cars are not the same?

Justine points out the text of the problem with her finger. The teacher

Justine: Well, no, no. This one is smaller because

listens and then leans over Charlotte.

9 cm and 3.2 cm. And that this one is 22 and 7 cm.

Charlotte: So if you add this and that it will give a

Gerald takes advantage of a brief

result. And there is something we have to add

moment of silence to speak up.

here. But I don't know what...

Gerald: No. Otherwise, Teacher, we should do a

40, a 45, divided by 20...

Charlotte: No, but that's not what I mean. It's just

that, there is...It looks like there, it's this one

that's going to win. Because if you add things on to this, it'll give a big result and we'll drop this one...

Teacher: And what makes you say that it will give a big result?

Charlotte: I don't know, I don't know: that's the way it is!

---

1

2 Justine indicated that 1 cm on the model corresponded to 45 cm of the actual car  
3 surface. She came close to the expected solution. She unsuccessfully tried to explain to  
4 the teacher (minute 35) that the ratio 1: 45 could be added as many times as necessary.  
5 She suggested a solution which involved adding the number that corresponded to 1 cm on  
6 the scale. The teacher did not understand Justine's reasoning and thus did not realize that  
7 she had almost found a solution. In this situation, Justine's preoccupations are the  
8 following: (a) *to use an iterative addition method to solve a problem* and (b) *to obtain a*  
9 *positive validation*.

10 In the 54<sup>th</sup> minute, after the teacher had highlighted important numbers, Gerald  
11 immediately suggested a solution. He kept searching for a solution despite the teacher's  
12 repetitive demands for explanation and her rejections of his answers. His preoccupations  
13 were: (a) *to suggest a solution which involved calculating the perimeter* and (b) *to obtain*  
14 *positive validation*.

15 Charlotte then implicitly indicated her solution. She pointed to the numbers on the  
16 problem sheet, accompanying her gestures with successive deictics ("*that and that*"). She  
17 was careful about indicating the numbers to be used in an equation and did not provide an  
18 equation that expressed the relationship between these numbers. She assumed that her  
19 explanation was sufficient for the teacher. Her preoccupations were: (a) *to offer a*  
20 *solution based on multiplication* and (b) *to obtain positive validation*.

### 21 ***The configuration of activity***

22 The configuration of activity can be described from the individual action of the  
23 teacher and pupils. This section discusses the three dimensions of the configuration of

1 activity: a process that emerges from (a) the coupling of individual actions and (b) the  
2 points of articulation meaningful to the agents; and (c) a process that creates balance and  
3 emerging order.

#### 4 5 **Pupils' inquiry and its coupling with the teacher's action.**

6 The analysis of the pupils' courses-of-action demonstrates their attempts to find a  
7 solution to the problem. In their search, they proceeded with a pragmatic inquiry (Dewey  
8 1938/1963) whose progress was slow and complex; they used all available clues,  
9 considering and abandoning many leads and, exploring until they found the solution.

10 At first, they thought that the answer was contained in the text. They assumed that a  
11 bigger "real car" would be the one with bigger measurements. They knew that some  
12 problems could contain traps: Charlotte tried to figure out a possible trap. When Charlotte  
13 and Gerald's first suggestions were rejected by the teacher, the pupils continued their  
14 search for (a) the correct equation and (b) the right numbers to use. They suggested  
15 addition, division and multiplication, manipulating the numbers in different ways. It  
16 should be noted that the problem was composed by the teacher which led to her setting up  
17 her own expectation structure (to work out the problem, one needs to multiply the  
18 dimensions of each model by its respective scale and then compare the results). This  
19 expectation structure led her to invalidate any proposals that did not rely on  
20 multiplication, as not conforming to her expectations.

21 The students finally thought of multiplication: their proposals of addition had been  
22 invalidated (minutes 24, 34), as well as those of division (minutes 20, 35, 38). From  
23 minute 38 on, all the proposals were exclusively about multiplication. They then looked  
24 for the numbers to multiply. The hints given by the teacher were aimed at bringing them  
25 to successive multiplications (minute 42). Two students wanted to multiply 45 by 2. But  
26 this idea was not accepted, and the students did not grasp that 45 needed to be multiplied  
27 by 9 and then by 3.2.

28 In the 54<sup>th</sup> minute, Gerald came up with a solution: he suggested multiplying  
29 numbers to calculate what he called the "perimeter". He made an equation using the  
30 highlighted numbers. He realized that the nature of the model measurements (length and  
31 width) and their spatial grouping were *affordances* (Gibson, 1979; Norman, 1993), that



1 is, the available resources. These measurements reminded him of another classroom work  
2 that involved finding the perimeter and area of polygons. Unfortunately, he confused the  
3 two notions.

4 Finally, Charlotte suggested her solution: she pointed to the numbers she was using  
5 two by two. She did not demonstrate the equation because she assumed that her reasoning  
6 was obvious to the teacher.

7 The pupils' proposals were made on the basis of diverse clues in association with the  
8 teacher's actions, the actions of their classmates, and some elements found in the text as  
9 clues: teacher's validations or invalidations and explanations, her mimics and solutions  
10 offered by the pupils from the same group and from other groups, and the location of the  
11 numbers in the text. Gerald's suggestion (minute 54) was consistent with both the clues  
12 collected during the inquiry (one has to multiply) and with his school culture  
13 ("something" can be calculated using the length and width of a polygon). Charlotte's  
14 suggestion was also consistent: she did not demonstrate her equation because she  
15 assumed that the solution was obvious to the teacher. The protagonists had collectively  
16 come to conclusion that in order to solve the problem, one had to multiply. All that she  
17 had to do was to correctly indicate the numbers that had to be multiplied. Charlotte's  
18 suggestion was also supported by a topological clue: the symmetrical organization of the  
19 data on the problem sheet was an *affordance* for her, indicating the relation between the  
20 measurements and the scales.

## 22 **The configuration of mathematics inquiry activity**

23 The configuration of activity emerges from the points of articulation between  
24 individual actions of teacher and pupils. Individual actions are made possible in return by  
25 these points of articulation. This concept accounts for the dynamic character of situational  
26 constraints which link the teacher and pupils by multiple "reciprocal dependencies" and  
27 thus contribute to forming a collective. They thus allow for the emergence of the form  
28 which inversely makes them possible. Articulation points are the situational constraints  
29 that are meaningful to the teacher and pupils: (a) the nature of the pupils' work, (b) its  
30 spatiotemporal organization, (c) the presence and functioning of artefacts, and (d) the  
31 types of interaction between agents. These constraints are only meaningful to certain

1 agents, and even then, the meaning is attributed according to a personal and partial  
2 interpretation: what is meaningful in the problem at a given moment to one pupil is not  
3 necessarily meaningful to the others at the same moment. These constraints nevertheless  
4 play an essential role as they contribute to the emergence, balance, and maintenance of  
5 the configuration in the classroom. Mathematical problem-solving requires that the pupils  
6 conduct an inquiry to diminish the level of uncertainty of the situation which is initially  
7 confusing and unpredictable. This motivates them to search for clues, to suggest various  
8 hypotheses and to construct guaranteed assertions (Dewey, 1938/1963) until the solution  
9 is found.

10 The spatiotemporal organization of the classroom and the nature of the pupils' work  
11 render possible both cooperation and competition. This organization is situated in the  
12 school culture (Gallego, Cole, & The Laboratory of Comparative Human Cognition,  
13 2001): the organization of groups is linked to the ideas of "constructivist pedagogy" that  
14 are frequently evoked in teachers' training centres. Their inquiry is simultaneously  
15 cooperative and competitive (Rognin, Salembier & Zouinar, 2000) within each group and  
16 between groups. According to these authors, the agents cooperate when they are engaged  
17 side by side in verbal or non-verbal interactions, when their actions are coordinated and  
18 synchronized, and when the aims they pursue are equally coordinated. The articulation  
19 between the preoccupations of helping and accomplishing classroom work contributes to  
20 the production of mutual intelligibility and shared understanding, the characteristics of  
21 cooperative activity (Rognin, Salembier & Zouinar, 2000) that help to regulate  
22 coordination between agents. Improvised and informal processes – of validation, the  
23 institution of actions, inquiry – take over from mechanisms of adaptation and self-  
24 organization. This allows the protagonists to coordinate to accomplish tasks related to  
25 problem-solving or text reading. The suggestions made out loud by pupils from one  
26 group, followed by the teachers' validation or invalidation, are taken into account by  
27 pupils from other groups. The pupils' search for solutions is re-directed by their need for  
28 validation. The suggestions are similar to probes sent toward the teacher to collect clues.  
29 They enable the pupils to progressively diminish the complexity of the problem and to  
30 eliminate hypotheses.

31 Moreover, when one group tries to draw the teacher's attention as she moves around,

1 suggestions come not from the group but from competing individuals: each pupil is trying  
2 to create a positive image of him- or herself. This competitive urge prevents them from  
3 putting their suggestions and findings in writing, and solutions are thus never sufficiently  
4 developed for the students to arrive at true “problem-solving”. These proposals cannot be  
5 validated by the students themselves

6 The artefacts used in this configuration have cognitive functions. They structure  
7 individual action and the articulation of individual actions (Norman, 1993). The teacher’s  
8 help is structured by the word problem, in particular by the expectation structure she has  
9 developed. This idea corresponds to the problem- solving pedagogy, advocated by the  
10 French Department of National Education. Moreover, the choice of complex numerical  
11 data (measures and scales) prevents younger pupils from making mental equations. By  
12 asking for a comparison of the two vehicles requires comparing two sets of data (4  
13 measures and 2 scales), making it more difficult to establish a correct relationship  
14 between numbers.

15 The teacher-pupil’s interaction, characterized by the pupils’ requests for validation,  
16 and the validations–invalidations of the teacher, narrows down the field of possibilities  
17 for the pupils’ inquiry. When the pupils make their suggestions, validation is more or less  
18 explicitly requested. These requests facilitate their task, helping them to avoid wasted  
19 time on dead ends. The suggestions flow in quick succession due to the pupils’  
20 competitive preoccupations and to their interpretations of the teacher’s reactions to their  
21 suggestions. Validations and invalidations of pupils’ suggestions are given frequently.  
22 Their frequency avoids dead time, refocusing pupils’ individual actions, and helping them  
23 avoid wrong leads. The frequency of help also allows maintaining pupils’ involvement in  
24 their schoolwork.

### 25 26 **The inquiry in mathematics: a balanced configuration of activity.**

27 This configuration of activity presents a state of balance established between  
28 tensions. Tensions are provoked by (a) convergence – divergence of agents’  
29 preoccupations and (b) the constraints linked to the points of articulation in the  
30 configuration of activity. These two types of tension are closely articulated because  
31 constraints modify the agents’ goals by opening and closing possibilities for action.

1 Pupils' preoccupations with obtaining validations, making a good impression, or  
2 facilitating the task are articulated with the teacher's preoccupation with keeping them  
3 involved in a given task. These preoccupations are somewhat divergent: while the teacher  
4 expects the pupils to be involved in a problem-solving task, stimulated by the need for the  
5 right solution, the pupils expect the teacher's immediate validation, approval, or an easier  
6 way to find the solution. However, these expectations transform into actions which, for  
7 the teacher, manifest the pupils' involvement. At the same time, the teacher's  
8 preoccupations with helping pupils and pupils' preoccupations with finding the solution  
9 are largely convergent: they correspond to similar expectations, linked to the search for a  
10 correct answer. In spite of the profound divergence between some of the preoccupations  
11 and expectations of the agents, a state of balance is achieved and the configuration  
12 becomes viable.

13 Moreover, certain tensions in this configuration of activity are linked to points of  
14 articulation and, in particular, to the use of a word problem and the forms of interaction in  
15 the classroom. The teacher's choices during the conception of this problem caused  
16 substantial difficulties for the pupils. They considered a large number of calculations and  
17 relations between the numbers. This explains the long duration of their inquiry (85 min.),  
18 a high number of incorrect answers, the recurring moments of discouragement, and the  
19 teacher's need to constantly sustain their involvement. However, this involvement did  
20 remain high, and an hour later the pupils were still searching actively and suggesting  
21 solutions. At the same time, the problem itself became a factor of tension balance,  
22 mediating the pupil's inquiry and the teacher's help.

23 The forms of interaction contribute to the balance of the configuration. They are  
24 characterized by the opening of interaction windows (Gal-Petitfaux, 2003) that provide  
25 possibilities for individual action. They contribute to the validation – invalidation of  
26 suggestions: when the teacher opens an interaction window with Charlotte (minute 20),  
27 putting aside the suggestions of other pupils (Justine, Gerald and Gregory), they perceive  
28 it as an implicit rejection of their suggestions. Moreover, when the teacher interacts with  
29 one of the pupils, the opening of this interaction window allows the others to develop  
30 various preoccupations of searching for the solution, but also those of distraction. There  
31 is no doubt that these forms of interaction are also supported by the constructivist

1 pedagogy taught in teachers' training centres. This pedagogical approach insists that the  
2 pupils have to "all learn by themselves" and to "construct their knowledge". And finally,  
3 these forms of interaction allow for the conduct of the inquiry and for the problem  
4 solving. In mathematics, they help achieve the state of relatively comfortable balance for  
5 the actors, enabling pupils to solve problems and the teachers to keep them involved in a  
6 given task..

### 7 **Formalization of the notion of configuration of activity**

8 Although configurations of activity were studied during a mathematics lesson in  
9 primary school, they concern all types of social activities. We can observe their  
10 emergence in the classroom during different lessons, on the field in team sports (Elias,  
11 1966), in orchestras, offices, workshops, restaurants, etc.

12 In the classroom, configurations are limited in time by the teacher's and pupils'  
13 individual actions and by the articulation of these actions. Therefore, even when the  
14 teacher instructs the pupils to start working, it may be not sufficient: the pupils need to  
15 become deeply involved in the task. In the classroom space or in specialized rooms,  
16 configurations are limited by the phenomenal capabilities of the agents: they cannot see  
17 through the classroom walls or hear farther than a few meters. These are shared situations  
18 (Durand Saury & Sève, 2006), simultaneously experienced and given by the sensorial,  
19 perceptive and cognitive capacities of the agents.

20 Although configurations are emergent forms, they may be embedded in both the  
21 professional culture of teachers and the academic culture of pupils; in turn, their viability  
22 (i.e. their stability-in-time associated with the possibility for both teacher and pupils to  
23 satisfy their intentions) constitutes to and perpetuates these cultures. Their stability can  
24 also be explained by limitations of the teacher's intervention: configuration allows the  
25 teacher to conciliate multiple and contradictory constraints in a multidimensional and  
26 very complex task, as Doyle showed (1986), and we can hypothesize that the classroom  
27 configurations stability is linked to this aspect of teachers' work.

28 The emergent properties of configurations are not incompatible with the fact that the  
29 most viable configurations become components of the school culture (Gallego & al.,  
30 2001) which are inscribed in teachers and pupils' culture. These components of a local

1 culture are “near at hand” every time the agent wants to act in a particular context. This  
2 cultural inscription allows configurations to self-perpetuate in time and space through the  
3 intermediation of agents’ memory and the artefacts that transport them (Lemke, 2000): a  
4 blackboard, a ruler, the desk arrangement — they all contribute to the emergence of  
5 identical configurations of activity in different places and at different moments.

6 The agents have only slight and partial consciousness of these configurations, and the  
7 configurations do not result essentially from the agents’ conscious “determinations” (to  
8 form work groups, to find a solution, etc.). But determinations, as well as knowledge (of  
9 the problems of proportionality, etc.) and culture of both pupils (solving problems,  
10 finding the calculations that need to be made, etc.) and teachers (ways of organizing  
11 work, assigning tasks to pupils, etc.) (Gallego & al., 2001) form the material from which  
12 the collective activity is configured. “Determinations”, knowledge and culture contribute  
13 to the configurations that characterize an academic subject, a school grade, and even the  
14 school in general.

15 Configurations of activity concern educational tasks, some of which are very old,  
16 like collective oral reading or problem-solving. For example, configurations of the  
17 “taking turns” type are found in many school subjects. They persist in time and, when  
18 needed, are reactivated by teachers who create certain conditions for their emergence.  
19 They are transported by artefacts (the blackboard, problem sheets, textbooks, etc.) that  
20 ensure their semiotic function: artefacts are the memory of past actions and the support  
21 for rules of action and the typical way of doing things in school. In the history of  
22 education, for example, configurations can be transformed by modifications of artefacts  
23 (textbooks) or the classroom space and by the slow evolution of norms and regulations in  
24 the classroom.

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