OUTLINE OF A JOINT ACTION THEORY IN DIDACTICS

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ABSTRACT

In this paper my goal consists of presenting aspects of the Joint Action Theory in Didactics on the principle of a twofold specification (Didactic Game and Learning Game), after integrating it in a more general picture. I first make a general presentation of the epistemological background against which the Joint Action Theory in Didactics could be seen. Then the second part of the paper is devoted to the description of a system of tools which constitutes the core of the JATD. In the third part, I give an example of empirical analysis in order to illustrate the categories presented previously. In the last part of the paper, I make some conclusive remarks in order to contribute to the networking process that this group is elaborating.

INTRODUCTION

In this paper I present some aspects of a collective work (Sensevy & Mercier, 2007; Schubauer-Leoni, Leutenegger, & Forget, 2007; Ligozat 2008), which functions as a *collective thought* from which I take most of the ideas I express in this contribution.

1. THE JOINT ACTION THEORY IN DIDACTICS: AN EPISTEMOLOGICAL BACKGROUND

1.1 The logic of practice, language-game and semiosis

In Social Sciences, the main challenge is probably to understand the meaning-making process in practices, thus understand the logic of practice on which people base their behaviors. In our conception, acting according to the logic of a practice is to be able to master a specific language-game in a particular life-form (Wittgenstein, 1953/1997). In order to master this language game, one has to be able to decipher signs of various kinds in an appropriate way. Acting according to the logic of the practice is therefore to be able to participate in a specific *semiosis* process (see Lorenz, 1994). To do that, people have to draw the same conclusions from a given environment, to give the same meaning to the prominent features of this environment. Inside this frame, I argue that the fundamental meaning-making process is an inference process, by which one can grasp and express the logic of the practice, and, doing that, can demonstrate understanding and agency.

1.2 The inference-reference process: institution and thought style

I assume that meaning is mainly processed in analogical inferences. In order to understand how these analogical inferences are made, one must consider that they are processed in context, the analogies being produced from a context to another. A theoretical point is thus to characterize what is a context, that I consider as an *institutional milieu*. Such an institutional milieu can be viewed as a specific reference, a background against which the agreement on inferences ("joint inferences") is made. Lan-

guage-game mastering, semiosis process, and inference-reference strategies in an institutional milieu gather in the process of *recognition of forms*, which is the central feature of our conception of cognition and language. A way of conceptualizing the inference-reference process occurring during this ongoing attempt of recognition of appropriate forms is to consider meaning-making as unfolding in institutions (Douglas, 1987, 1996), which produce thought collective and thought styles (Fleck, 1934/1979). A thought style can be viewed as a kind of shared semiosis, by which people infer similar meanings from signs perceived in a same way, in a common recognition of forms. This common recognition of forms can be seen as a *seeing-as* (Wittgestein, 1953/1997), which is a habit of perception, and make possible the *joint-inferences*. The whole teaching-learning process can be viewed under this description (Sensevy, Tiberghien, Santini, Laubé & Griggs, 2008).

1.3 The logic of practice: the grammar of situations

In analyzing the social world, our concern is a *grammatical* one. We do think that every practice is unfolded according a specific logic, which over-determinate a great deal of it. Thus, as researchers we take a *grammatical stance*, which means that we try to understand the specific situational logic, the *peculiar grammar*, of a given practice. This concern logically stems from the conception of cognition and language we outlined below. If meaning-making is a matter of recognition of forms which are given by the collectives we are in, the description of meaning-making process rests on the identification of such forms, that is, a grammatical perspective. We must point out that a general way of understanding the logic of the practice lies in the comprehension of the situations in which this very concrete practice unfolds. The logic of practice is the logic embedded in the situations of practice. This kind of description helps understand why the meaning making process is viewed as mainly analogical. If the logic of practice is determined by the logic of the situations of the practice, meaning is made by relating the actual situation in which we are acting to the previous ones which resemble to the current one.

1.4 Game, situation, institution

In order to describe the grammar of the situations, we use a way of describing the social world in terms of *games*, by developing a “bourdieusian” perspective (Bourdieu, 1992). We consider the human activity as developing in games. By using the notion of game, we may use the following descriptors: the stakes of the game; the investment of the players in the game; the “feel for the game” that the players can or cannot display; the different kind of *capitals* related to the different games, that is, a way to acknowledge power phenomena in the social world. Thus the game is for us a fundamental grammatical structure, as a model of the social world, and also as a mean to relate institution and situation. Learning to act in a specific part of the social world is learning to play a certain game in situations embedded in institutions.

2. THE JOINT ACTION THEORY IN DIDACTICS: SOME TOOLS

2.1 The Didactic Game as a general pattern

We can try to describe the didactic interactions between the teacher and the students as a game of a particular kind, a *didactic* game. What are the prominent features of this game? It involves two players, A and B. B wins if and only if A wins, but B must not give directly the winning strategy to A. B is the teacher (the teaching pole). A is the student (The studying pole). This description allows us to understand that the didactic game is a collaborative game, a *joint* game, within a joint action (Clark, 1996). If we look at a didactic game more carefully, we see that B (the teacher), in order to win, has to lead A (the student) to a certain point, a particular "state of knowledge" which enables the student to play the "right moves" in the game, which can ensure the teacher that the student has built the right knowledge. At the core of this process, there is a fundamental condition: in order to be sure that A (The student) has really won, B (The teacher) must remain tacit on the main knowledge at stake. The teacher has to be *reticent* in order to let the student build proper knowledge, *her* proper knowledge. The teacher has to withhold information, because the student must act *proprio motu*. The teacher's scaffolding must not allow the student to produce the "good behavior" without mastering the adequate knowledge. This *proprio motu* clause is necessarily related to the *reticence* of the teacher. Indeed, according to us, the didactic game, with the *proprio motu* clause and the teacher's reticence, provides a general pattern of didactic interactions.

2.2 From the Didactic Game to the Learning Games

The Didactic Game refers to what we consider to be the fundamental grammar of the teaching-learning process. In order to deeply characterize this process, we use a system of concepts that we aim to unify under the notion of Learning Game. Learning Game, as a way of describing the Didactic Game as it occurs *in situ*, requires itself a structure of particular descriptors : the didactic contract/milieu doublet ; the genesis triplet (mesogenesis ; chronogenesis ; topogenesis) ; the game quadruplet (defining, devolving, monitoring and managing the certainty/uncertainty dialectic, institutionalizing). In the following, we will give some rapid descriptions of this system of concepts. First of all, a Learning Game can be identified by describing the didactic contract and the milieu referring to the piece of knowledge at stake.

The didactic contract and the milieu

We consider the didactic contract (Brousseau, 1997) according to a threefold viewpoint. The didactic contract can be viewed as an implicit system of mutual *expectations* (Mauss, 1989) between the teacher and the students, about the knowledge at stake, an implicit system of *joint habits* (Dewey, 1922) about this knowledge, and an implicit system of mutual attribution of *intentions* (Baxandhall, 1985). It is important to point out that this definition emphasizes the permanent features of the contract, and may explain the analogical process of meaning-making. We consider the didactic milieu under a 2 components description. On the one hand the milieu is a cognitive context, as a common ground, which notably provides the expectations and the mutual attributions of intentions on which the didactic contract rely. With this respect,

the milieu is a system of shared meanings which makes possible the joint action. But this kind of description is not efficient enough to provide a good understanding of the teaching-learning process. One has to acknowledge that in order to learn, the students have to encounter an antagonist milieu (that Brousseau called adidactic milieu), a kind of *resistance* to their action, which is also a resistance to the joint action. Thus this notion refers to the part of knowledge that the students cannot directly assimilate, which resists to their habits, and which prevents them to play the *right game*. The way in which the milieu provides such a resistance can be figured out (or not) *a priori* by the teacher, and even modelled by a researcher. It is important noticing that encountering the resistance of the milieu requires a certain grasp of consciousness. Indeed, by experiencing this resistance, the students have to encounter their ignorance, and the need for a specific piece of knowledge which will bridge this "ignorance gap".

The dialectic between contract and milieu

When students try to play a learning game, some moves are directly given to them by the habits of action related to the knowledge they have recognized as the knowledge at stake. Some of these moves don't enable them to act accurately to meet the didactic situation requirements. In some cases, it is why they encounter a resistance to their action, and they just no longer play the game. It is critical to understand that these encounters and the shared awareness of their reality are a matter of joint action. Among all categories which are used for the description of learning games, the relationship between contract and milieu holds a prominent position. In order to characterize the didactic joint action, one has to identify how the students orient themselves, either by enacting the didactic contract habits or by establishing epistemic relations with the milieu. It means that empirical studies have to reveal what kind of dialectic is built between the "contract-driven students' orientations" and "the milieu-driven students' orientations", in order to understand the Didactic Joint Action and the way mathematical knowledge is processed.

The game quadruplet

What we call "the game quadruplet" is a set of categories that we use to describe the way the teacher has the students playing the game in the joint action (Sensevy, Mercier, Schubauer-Leoni, Ligozat, & Perrot, 2005). *Defining.* The defining process can be viewed as a way of introducing the definitory rules of the learning game, in order for the students to be able to play this game. *Devolving.* When a game is defined, it has to be accepted by the students. That means that the students have to elaborate an adequate relation to the milieu. *Monitoring, managing the certainty/uncertainty dialectics.* The monitoring process refers to any teacher's behaviors produced to modify the students' behavior in order to enable them to produce the relevant strategies they need to win the game. In doing so, the teacher plays on the level of certainty/uncertainty of the students' action. *Institutionalizing*[1]. In the ongoing didactic process, the teacher needs to recognize parts of the targeted knowledge in the students' activity as the relevant one for the learning game at play. In doing so, it

[1] The terms 'devolving' and 'institutionalizing' refer to Brousseau's concepts (1997).

makes the student understand that their activity reached the knowledge at stake, which is not only the "classroom knowledge", but also the knowledge of a social community, which is larger than the school community.

At another scale and with other purposes, we consider a triple dimension that describes the teacher's work, relative to starting and maintaining a didactic relationship (Chevallard, 1991, 1992; Sensevy, Mercier, Schubauer-Leoni, Ligozat, & Perrot, 2005) in the playing of the game.

The genesis triplet

Mesogenesis (i.e. the genesis of the milieu) describes the process by which the teacher organizes a milieu, with which the students are intended to interact in order to learn. *Chronogenesis* (i.e. the genesis of the didactic time) describes the evolution of knowledge proposed by the teacher and studied by the students, as it unfolds in the joint action. The teacher has to monitor the knowledge process through a lesson or several lessons, in order to meet his didactic intentions. *Topogenesis* (i.e. the genesis of the positions) describes the process of the division of the activity between the teacher and the students, according to their potentialities. The teacher should define and occupy a position, and enable the students to occupy their positions in the didactic process.

3. AN EMPIRICAL ILLUSTRATION

We focus now on an empirical example. The learning game occurred in an adidactic situation: the puzzle situation (Brousseau, 1997, p. 177) within a very large "didactic engineering" (N & G. Brousseau, 1987). I will make a first analysis of this episode, before trying a more general description of the same episode. The puzzle situation is a first situation for the study of linear mappings. It is put to students as following (Brousseau, 1997): "Here are some puzzles (Example: "tangram"). You are going to make some similar ones, larger than the models, according to the following rule: the segment that measures 4 cm on the model will measure 7 cm on your reproduction. I shall give a puzzle to each group of four or five students, but every student will do at least one piece or a group of two will two. When you have finished, you must be able to reconstruct figures that are exactly the same as the model". *Development*: after a brief planning phase in each group, the students separate. The teacher has put an enlarged representation of the complete puzzle on the chalkboard.

In the studied episode, as usual in this case, the students have added 3 cm to every dimension. The result, obviously, is that the pieces are not compatible. The teacher comes to a group at this moment. We give the transcription of the dialogue between the teacher and the students.

The puzzle episode

1.	Student	There's a problem it looks as if one is missing
2.	Teacher	There's a problem, yes
3.	Student	But already here it's leaning a lot here and then it's there
4.	Teacher	Yes and it should be leaning in the same way?
5.	Student	Here we can see that the pike/point it touches the other one here again there is a problem and here it should be there it does like this there it does like this it would have been correct
6.	Teacher	And everywhere here you have added 3 are you sure you've added 3
7.	Student	yes
8.	Teacher	1,2,3, 1,2,3, 1,2,3
9.	Student	Well not to this one
10.	Teacher	1,2,3, have you added 3 everywhere?
11.	Student	Well it is correct

12.	Teacher	Then what must be challenged?
13.	Student	Well It's wrong well this piece is a good one
14.	Teacher	Well no it's not because it doesn't make up the good puzzle
15.	Student	Here it doesn't make 3
16.	Teacher	Where 3?
17.	Student	It only makes 2
18.	Teacher	Well 3? It's 3 more where?
19.	Student	On each side
20.	Teacher	If I were you I'd think about the method I used maybe this is what's not good
21.	Students	Yes
22.	Teacher	Maybe it's you're sure you've added 3 you didn't make any mistakes when you cut out the pieces, ok ? Everyone has cut on the lines?
23.	Students	Yes
24.	Teacher	Well so maybe you mustn't add 3 you must do something else
25.	Tony	But from 4 to find 7
26.	Teacher	Ah
27.	Student	There's a problem here too
28.	Teacher	Are you listening Tony
29.	Students	Yes
30.	Teacher	Go on try to look into this problem

3.1 **The puzzle episode: a first description**

A possible structure of the episode

In ST (Speech Turn) 1, the student acknowledges that "there is a problem". We can analyze the excerpt by structuring it into for parts : in the first part, from 1 to 11, the teacher want the children to agree that if there is a mistake, it is not a measurement mistake; the ST 12 (*Then what must be challenged?*) is the teacher's first try to give to the students an incentive to challenge their method, but without effect; in the second part, from 13 to 19, the teacher and the students return to the discussion of the measurement method, notably by arguing about what is a "good piece" (13-14); in the third part, from 20 to 26, the teacher takes a high topogenetic position, in order to focus the students' attention on the "proper signs" of the situation; in the forth (last) part, one can think that the students are beginning to challenge their methods (25-27), so the teacher leaves the students and goes to another group.

Some teacher's moves in the Joint Action

We can focus on several teacher's moves in this excerpt. 1) In ST 4 (*It should be leaning in the same way?*), the teacher holds a "come-along position", which means a low position in the topogenesis, at the same level as the students. We can think that a good students' answer could be something like "Yes, because the model and the reproduction must have the same dimensions, the same properties" (this answer would be based on the conservation of proportions), but the students do not really understand the question. 2) In ST12 (*Then what must be challenged?*), the teacher's move is produced in order to make the students understand that they have to change their way of conceiving the problem. It is worth noticing that this calls for a different position from the teacher: not a "come along position", but an "analysis position", in which the teacher does not use the same kind of reticence about his knowledge. But this move does not work, for the students go on discussing about their measurement. 3) In ST 20, (*If I were you I'd think about the method I used maybe this is what's not good*) the teacher takes a higher position, in a very interesting utterance: "*If I were you*" functions as a prominent sign in the didactic contract. For the students, that may

mean that the teacher is saying an important thing; by using the word "*method*" the teacher draws the students' attention to the fundamental meaning in this episode; 4) In ST 22, the teacher makes a summary of the students' work that one could paraphrase by saying "Are sure that your measurement was right ?". It functions as a kind of frame for an inference which could be: if you are sure that your measurement was right, then you have to challenge the method. 5) In ST 24 (*Well so maybe you mustn't add 3 you must do something else*), the teacher draws herself the inference (if it is not a measurement error, then it is a method error). Tony's reaction is very informative of his endorsing of the additive strategy; it's a kind of encounter of ignorance. For the first time in the episode, the additive strategy is questioned, which may function as a sign for the teacher that the learning process is going on.

3.2 The puzzle episode: a re-description

Here the learning game takes place inside an *adidactic* situation (Brousseau, 1997)[2]. First of all, the students have to encounter their ignorance, with the resistance of the milieu. In this learning game, as we have seen, they have to make a clear distinction between what is a *measurement error* and what is a *method (mathematical) error*. In order to move the didactic time forward, the teacher has to be sure that the students are convinced they have not made a measurement error. It is a necessary condition for them to challenge their method (i.e. the additive method). We can re-describe the episode using some theoretical tools of the JATD.

Reticence and proprio motu ; topogenesis and chronogenesis

The topogenetic characterization of this learning game enables us to understand how the teacher is progressively taken more and more responsibility in the didactic transactions. From a low topogenetic position (ST2, *there's a problem, yes*), he reaches a rather high topogenetic position (ST 24, *Well so maybe you mustn't add 3 you must do something else*). At the beginning of the episode, the reticence is very important, and the teacher does not unveil his didactic intentions. At the end of the episode, even if the teacher has displayed a part of his intentions, the reticence remains important. Indeed, nothing has been said about the proportional reasoning, which is at the core of this situation. The state of the milieu makes possible such an evolution, for there is a kind of agreement between the teacher and the students that the measurement is right. Thus we can acknowledge the specific interplay between chronogenesis and topogenesis in this rather short episode. The high topogenetic position is possible only because the didactic time - which is the knowledge time - has gone by, as we can see in the comparison of ST 2, 12, and 24. The teacher's "feel for the game" enables her to accomplish gradually this topogenetic rising while keeping an effective didactic reticence.

[2] In order to be understood properly, this episode would have to be replaced in a more general structure, investigated at different scale-levels. We are focusing here on the micro-level of the didactic transactions, but a complete inquiry would necessitate a meso-level and a macro-level investigation (on this point, see Ligozat, 2008). This is a fundamental methodological issue for the Joint Action Theory in Didactics, which rests on the necessity to provide enquiry processes with a plurality of description levels, using for this purpose specific tools (in particular *synoptic table* and *didactic plot*).

The contract-milieu dialectic

At the beginning of the episode, the students are caught in the didactic contract enacted by the situation. As a student said, "from 4 to find 7" one *has to make* an addition. This "additive contract" could be considered as a thought style in this episode, which provides a way of perceiving and a way of acting. Another feature of the didactic contract at play could be found in a lack of experimental culture which prevents the students to distinguish the "measurement realm" from the "conceptual realm", and which brings a kind of "experimental fuzziness". Thus the present learning game stems from the students' observation that the puzzle pieces do not fit together. This observation has to be seen as a resistance of the milieu, a relevant feedback for the modification of the students' strategy. But this resistance is not obvious for the students, and the teacher's work consists of helping the students "read" the milieu. For the researcher (and for the teacher as well) a fundamental aspect of this episode consists in acknowledging how the contract/milieu dialectic needs to be built in the transactions. The milieu feedback is not at all naturally perceived by the students. In the uncertain didactic transactions, what counts as an evidence for the teacher (the pieces do not fit together), which provides an accurate inference (the additive strategy does not work) is very far from the students' relationship to the milieu, given that this relationship is shaped by i) the "additive contract" and ii) the "experimental fuzziness". The students have to build another relationship, and they can't do that alone. The teacher's monitoring is fundamental to foster the students' relevant relationship to the milieu and its events, which will enable them to "resist" to the contract habits and to renew them. In that, for the teacher, enacting the contract-milieu dialectic in the didactic transactions is a way of taming the uncertainty while building a relevant certainty, and enabling the students to accurately recognize the "empirical facts".

4. NETWORKING MATHEMATICS EDUCATION THEORIES: SOME BRIEF CONCLUSIVE REMARKS

0. The Joint Action Theory in Didactics (JATD) is a didactical Theory. It responds to the fundamental definition of Didactics as a science: the science of conditions and constraints under which *the diffusion of knowledge* is enacted. In order to situate this theory (JATD) in relation with the Theory of Didactic Situations and the Anthropological Theory of the Didactic, we can argue that while these two theories first focus, from a logical point of view, on the nature of *knowledge* (what is knowledge which is taught?), the JATD first logically focus on the *diffusion process* (What is going on when a specific piece of knowledge is taught). This is what we may call *the actional turn* of the JATD. This difference of logic means a difference of problems: the kind of problems the JATD attempts to solve, in a bottom up process, are that of the *didactic action*.

1. Prediger (2008) proposes an interesting way of characterizing theoretical conceptualizations according to three types, as idealized poles: "individual learning", "class teaching", "institutional structuring". In this perspective, it seems to me interesting to notice that a crucial point for the JATD consists in an attempt to understand how the institutions, in Douglas' meaning (1987, 1996) shape the individuals' personal life in thought styles (Fleck, 1934/1979). So, one can say that in the JATD the "institutional

concern" is the first one. It does not mean that the JATD is not interested in "individual learning" or in "class teaching". On the contrary, we believe that the development of mathematics education theories needs a theory of didactic experience, if we call "didactic experience" these life events which enable people (and not only students or teachers) to gain knowledge as power of acting. But an essential feature of the JATD lies in the theoretical principle which assumes that meaning-making is mainly at work in the situations that institutions enact.

2. In the same paper, Prediger (2008) proposes another interesting way of characterizing studies with respect to the "prioritized types of research intentions". Thus the studies are located on an axis from "improved understanding" to "improved practices". As the other theoretical endeavors in French didactics, the JATD is rather on the "improved understanding" pole. But I would like to say that this type of reasoning could be dangerous, if researchers do not succeed in building a kind of normativity. This normativity, rationally and empirically grounded, could enable them to identify some principles in order to understand the didactic value of teaching-learning practices.

3. As a conclusion I would refer to Radford's paper (2008) about the problems of networking theories. In this paper, Radford considers theories as "flexible triples" of "principles, methodologies, and paradigmatic research questions" (Radford, 2008, p. 322). He then argues that "If we dig deep enough, we will find that difficult to connect theories are more likely to have fundamental differences in their system of principles" (Radford, 2008, p. 325). As any theory, the JATD rests on some principles. It seems to me that it could be useful to distinguish epistemological principles, which represent a theory of knowledge for a given theory, from theoretical tools, which are used directly in the enquiry process. In a good deal of published papers, the epistemological principles in the background of the research, which one can see as the roots of the theoretical tools, are not really worked out. It seems to me very important to clarify these epistemological roots if we want to network theories. In this perspective, a primary concern, following Kidron et al (2008), could be to shed more light on the role of social interactions in theoretical approaches, with respect to their epistemological roots. As Kidron et al show, all the researchers agree on the importance of taking into account this type of interactions in their theoretical frameworks, but what is the meaning and the value of such an agreement ?

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