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From the description of teaching and learning in classroom practices to issues in the formation of school subjects. The joint action framework in didactics

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From the Description of Teaching and Learning in Classroom Practices to Issues in the Formation of School Subjects

The Joint Action Framework in Didactics

Abstract

This chapter reflects the content of a series of lectures at the Graduate School Subject Specific Learning and Interaction in Elementary School (INTERFACH, 5–8 July 2022, Halle). It focuses on the emergence of comparative research in Didactics in the French-speaking context. The aim is to introduce the main concepts of the Joint Action framework in Didactics (JAD) and to explain how they are used within the Research Group in Comparative Didactics[1], at the University of Geneva. To do so, I use a series of empirical examples that I analyze from several perspectives, each of which is complementary to others. In the last part of the paper, I show the importance of the analyses carried out using this framework for understanding issues about the didactic transposition in the formation of science as a school subject.

Keywords: Joint Action Framework in Didactics; didactic system; didactic transposition; didactic contract; milieu; school subject; science education

1 In this paper, I present the basic principles of the Joint Action framework in Didactics that are useful for describing and understanding the generic and content-specific dimensions of teaching. Concepts from the JAD framework remain open to different interpretations and modelling, depending on the research objectives pursued (e.g., Joffredo et al., 2018).

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1 Subject didactics and comparative didactics in the Francophone educational research[2]

For more than 40 years, a set of research fields called *didactiques des disciplines* [disciplinary didactics or subject didactics] has developed within the educational research community in France and in some French-speaking regions, such as Western Switzerland. This development is characterized by the anchoring of the conceptualization of teaching and learning in school subjects, and their related academic disciplines (Caillot, 2007; Schneuwly, 2011). This research trend is not isolated, as similar developments have occurred in (or been influenced by) other continental European countries, as shown by Hudson & Meyer (2011), Vollmer & Schneuwly (2018) and Pace, Zollo & Sibilio (2023). In this section, I present certain characteristics of Francophone tradition of subject didactics in order to explain the reasons for the emergence of comparative didactics.

The French-speaking subject didactics were built on the idea, increasingly shared since the 1970s, that *the knowledge taught/learned irreducibly shapes teaching and learning practices* (i.e., textbook designs, lesson plans, classroom management and discourses, assessment criteria, etc.). This idea is formalised by the ternary relationship between a teaching pole, a learning pole, and the knowledge content as the third pole, which constitute a didactic system[3] (Chevallard, 1985; see also Schoenfeld, 2012). The didactic system (Figure 1) can be seen as the founding act of the development of subject didactics, marking a paradigm shift[4] from the dual "teacher-learner" model of pedagogy and educational psychology (Schubauer-Leoni, 2000).

2 This section takes up some aspects developed in Ligozat (2023).

3 The triangle gathering the teacher, the students and the knowledge content is also emblematic of the European traditions for research in Didactics, but its meaning differs against the conceptual background of these traditions (e.g., Hudson & Meyer, 2011; Schoenfeld, 2012).

4 The word "paradigm" is used in a general sense without keeping the Kuhnian principle of incommensurability. Didactic research may rather be regarded as a research program in Lakatos's sense.

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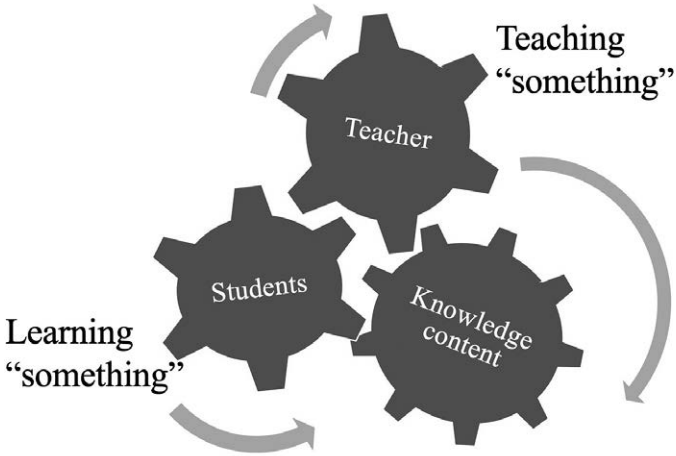

Figure 1.: The didactic system.

Under this view, any study of one pole of the didactic system (teacher, student(s) or knowledge content) cannot be achieved without considering the influence of - or the consequence for- the two other poles. This assumption has methodological consequences. The most important one is that learning cannot be studied without taking into consideration three aspects: (i) the knowledge content involved in instructional tasks, (ii) the material, social and institutional dimensions of the context in which the learning process develops, and (iii) the teaching strategies used by the teacher in structuring classroom interactions.

In subject didactics studies, a central concern is the analysis of epistemological gaps between the knowledge that is constructed and used in different kind of social activities, the knowledge content that is defined in the curriculum texts pedagogical resources, and ultimately, effectively taught and learnt in classrooms. This gap has been theorized as the result of a *didactic transposition* process, which occurs within schools, classrooms, tutorials, etc. as instances of didactic institutions (Chevallard, 1985; see also Chevallard & Bosch, 2014). In this view, knowledge does not exist as "something" that can be directly "passed on" or transferred.

> "Knowledge is not a given, the theory says, it is built up, and transformed, and – such was the keyword – transposed. (…). The main point in the didactic transposition theory is that it considers knowledge as a changing reality, which adapts to its institutional habitat where it occupies a more or less narrow niche" (Chevallard, 2007, p. 132).

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Knowledge is encapsulated in social practices, as ways of doing and as discourses in the various social groups in which people participate. The way in which the knowledge content are constructed and formalized in discourses depends on the aims pursued by these practices. This principle is at the heart of the process of didactic transposition. Teaching and learning are specific social practices that aim at the study (by the students with the help of the teachers) of pieces of knowledge constructed in certain social activities. It contrasts with the use of pieces of knowledge in their usual and complex social contexts. Therefore, the content taught in teaching and learning activities is necessarily recontextualized when it enters the classroom to fit the organization and purposes of schools, and to fit the cognitive abilities of the students[5]. As a result, the content learnt in the classroom is always a genuine (re)construction regulated by the teacher, and not a mere "transfer" or "acquisition" of something. A major concern of the French-speaking subject didactics is to analyze, model and improve the compatibility of this reconstructive process with the social practices that characterize the many domains of academic knowledge and fields of human expertise (Schneuwly, 2021). Although the transposition is predominantly a top-down process, it is studied bottom up (*Figure 2*) *i.e.,* from its manifestations in the classroom and in curriculum texts. Such a kind of study reveals continuities and discontinuities between the knowledge taught in the classroom and the social practices of reference.

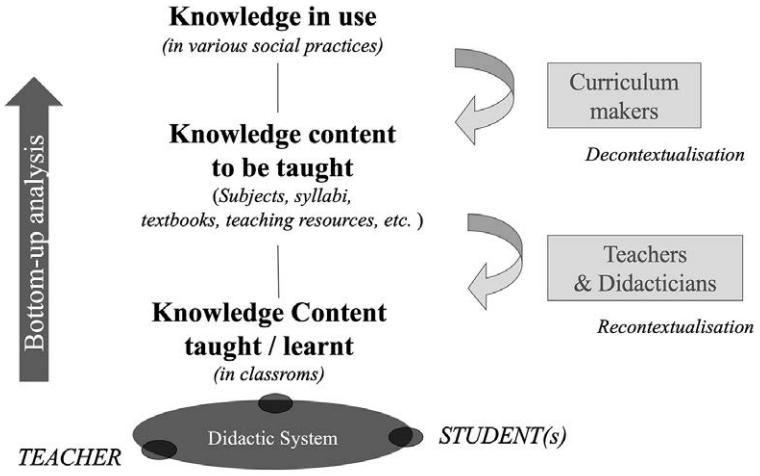

Figure 2: Didactic transposition process.

5 Programming over time, collective management of activities, and the assessment of the learning outcomes. The notion of didactic transposition shares similarities with the notion of "recontextualization" in pedagogic discourses (Bernstein, 1990, 2003).

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Historically, French-speaking subject didactics have pursued a twofold ambition: (1) to be a *descriptive / explanatory science* that contributes to the broader social sciences studying learning conditions and the diffusion of knowledge in society and (2) to be a *design science* that supports teaching and learning in schools by contributing to the construction of curricula, teaching resources and the professional development of teachers. The development of the didactics of mathematics pioneered these ambitions (Artigue et al., 2019) with the elaboration of the Theory of the Didactic Situations in Mathematics (TSDM; Brousseau, 1997) and the Theory of Didactic Transposition (Chevallard, 1985, 1991), which evolved into the more global Anthropological Theory of the Didactics (ATD; Chevallard 1992; Bosch et al., 2020). Both these theoretical frameworks have influenced the development of other subject didactics, and very importantly, that of comparative didactics.

In order to overcome the fragmentation of subject didactics, certain concepts initially elaborated in the TDSM and the ATD were considered as candidates for generic descriptors of the "reality" that is played out in all didactic systems characterized by a knowledge transposition process (Mercier et al., 2002). In the late 2000's, the Joint Action framework in Didactics (JAD) was developed as a generic framework for analyzing and comparing subject-specific forms of teaching and learning practices, thus providing a potential common language basis between subject-didactics. In the following section, I explain the main concepts of the JAD framework on the basis of empirical examples.

2 The Joint Action framework in Didactics

2.1 Foundations[6]

The notion of "didactic joint action" was first coined in the early 2000's to capture the idea that (a) the teacher and the students jointly (re)construct pieces of knowledge content in the classroom within an evolving learning environment; and (b) "we cannot understand the teacher's action in the classroom (and therefore the processes of re-actualisation of knowledge in a specific teaching project), without describing the modes of participation of the students' (Schubauer-Leoni and Leutenegger, 2005).

The elaboration of the JAD framework draws on the social interactionism that marked the study of human communication in the 1980's–1990's (e.g., Crozier & Friedberg, 1977; Goffman, 1981; Mead 1934/1967); but also on the pragmatic turn in the social sciences, which focused on *situations,* as the sites

6 This section takes up some aspects of Ligozat and Buyck (2024, online first).

of transactions between humans and their environment (Dewey, 1938)[7]. JAD embeds a conception of *knowledge as "the power to act in a given situation within a given institution"* (Sensevy, 2012, p. 505). Following Mead (1934/1967), *human actions are social acts*, in which certain features of participants' conducts behave as stimuli for their partners, who respond to it. The response characterises the meaning of the conducts undertaken by the participants. Social acts are joint actions, in which different lines of action are interdependent in order to make sense of a situation – and to behave appropriately in it. From this point of view, most human actions are joint actions, but the didactic ones are very specific (Sensevy & Mercier, 2007; Sensevy, 2014): in their joint actions, the teacher and the students stand in *asymmetric positions*[8] because they do not have the same responsibilities, and they do not share the same perspective on learning situations and the knowledge progression.

(a) Teaching actions are *programmatic*: the teacher knows before the students do, what is at stake in the indeterminate situations[9] they encounter (i.e. the pieces of knowledge to be built), and what question or task will generate the next situations. Very importantly, the teacher can transform or deepen the meaning relations made by the students in a situation in terms of the epistemic necessities of the next task to be dealt with.

(b) Learning actions are *reconstructive*: for each new (indeterminate) situation encountered (at least partly structured by a task given by the teacher), the students have to (re)consider the components of the situation in the light of what they already know to transform it into a determinate one (*e.g.*, solving a problem, answering a question, etc.)..

From these theoretical foundations, a set of concepts has been selected and defined to build a model of teaching and learning as a joint process (Sensevy et al., 2000; Sensevy et al., 2005; Sensevy, 2011, 2012; Sensevy & Mercier, 2007; Amade-Escot & Venturini, 2009; Ligozat & Schubauer-Leoni, 2010).

7 Beyond Dewey's definition of a situation as a "connection with a contextual whole" (Dewey, 1938, p. 66), the definition of the situation (present in Schütz's phenomenology and discussed by Goffman with the concept of frame) considers that the nature of the participants' activities depends not only on the objective characteristics of the situation (e.g., characteristics of instructional tasks in classrooms), but also on the way by which participants make meaning of and interpret the situation. This interpretation is based on the spatio-temporal and interpersonal coordinates of the act of discourse, which constitutes intersubjectivity (Rommetveit, 1974).

8 This distinction is at the core of the first characterization of didactic systems developed in the Anthropological Theory of the Didactic TAD (Chevallard, 1992, 2007).

9 The distinction between indeterminate and determinate situation goes back to Dewey's conceptualization of inquiry (Dewey, 1938). From the student's perspective, a task provided by the teacher constitutes an indeterminate situation if its components do not hang together, or in order words, if it calls an inquiry or questioning. Conversely, a determinate situation is a closed "universe of experience", in which components and relations fit into a unified whole.

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2.2 Four fundamental dimensions of the teacher's action structure (and the corollary student's action structure)

A first approach to modelling the joint action of the teacher and students in the classroom is provided by *four fundamental dimensions of the teacher's action* which guarantee the establishment and continuity of the ternary relationship that unites the teacher, the students and the knowledge content to be learned (Sensevy et al., 2000; Sensevy et al., 2005)[10].

(a) Defining: This dimension consists in setting up the components and the frame of a learning situation (e.g., a task to be achieved, and certain rules of action to achieve it) that will appear indeterminate for the students, so that there is "something" to learn to make it determinate. In most cases, *defining* requires the indication of a common reference (e.g., previous situations, rules of action or knowledge content built in the classroom) to clarify what is continuous and what changes in a new situation.

b) Regulating / managing uncertainty: When the students encounter an (indeterminate) learning situation, an inquiry develops in which the students build certain meaning relations. Regulating refers to actions that the teacher can take to manage the meaning relations made by the students towards the determination of the situation. *Regulating* means indicating relevant relations, raising questions and controversies for deepening, or transforming certain relations and dismissing other non-relevant relations. From this point of view, *regulating* is always managing the level of uncertainty in which the students act.

(c) Devolving[11]*:* this dimension consists in organising conditions for the students to take certain responsibilities in determining a learning situation. It is not a given that a learning situation, even a "well-defined" one, will be invested in by the students (e.g., the teacher can give an example to show the students that the task is feasible, that even if they do not foresee an answer, they can try one, etc.). In fact, *devolving* is not limited to the moment when a learning situation is initiated, but it is a process that accompanies the teaching process itself. At every moment of a lesson, the teacher must prompt the students to take on new learning conditions.

(d) Instituting[12]: this dimension refers to the collective recognition of the rules of action used, and meaning relations made, as part of the common reference for further actions. Again, *instituting* is not limited to the closure of a learning

10 In this section, I translate and adapt the definitions of the four dimensions of the teacher's action structure in the seminal paper written in French by Sensevy et al. (2000).

11 This dimension generalizes the notion of "devolution" elaborated in the Theory of Didactical Situations in Mathematics (Brousseau, 1997).

12 This dimension extends the notion of "institutionalization" elaborated in the Theory of Didactical Situations in Mathematics (Brousseau, 1997).

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situation, but it goes along with the construction of a shared reference in the classroom, legitimising what the students do at different moments. From this point of view, *instituting* contributes to the knowledge content development in the classroom and to the broader process of institutionalising the pieces of culture conveyed in schools.

All these dimensions are part of the teacher's repertoire of action, but not in the same way. *Defining* and *regulating* are clearly in the hand of the teacher. The teacher is responsible for setting up situations in which the students can learn something. They are also responsible for supporting the students in making relevant meanings about these situations so that some knowledge can be (re)constructed from them, in line with the curriculum objectives. In contrast, *devolving and instituting* are more dependent on the students' actions in response to the conditions set up by the teacher.

From these last two dimensions of the teacher's action structure, it is possible to delineate certain corollary *dimensions of the students' action structure*:

1. *Finding a purpose in the learning situation encountered* (i.e., anticipating possible ways through from what is already known).
2. *Investing the space of action opened up by the teacher in this situation* (i.e., exploring what can / cannot be done, making distinctions, trying solutions, checking results, etc.).
3. *Judging the relevance of one's own actions* in order to decide how to continue or stop the inquiry in the learning situation (i.e., to know whether the task is successful or not).

The dimensions of the students' action structure have not received much attention in the JAD framework yet. I draw them as theoretical consequences of the teacher's action structure, but we have empirical evidence of the dimensions of the students' action structure, *when they fail to be enacted*:

1. Students who do not find a purpose in the situation they have, tend to look for other purposes (e.g., chatting with classmates).
2. Students who do not invest the action space given to them in learning situations tend to wait for answers and solutions to be developed by others. They avoid taking any cognitive risk in constructing new meaning relations[13].
3. Students who do not allow themselves to judge their own actions and results tend to rely on the teacher to tell them whether what they have done is right or wrong.

13 This pattern was reported by Brousseau & Warfield (1999), about the "Case of Gaël" a low achieving student in mathematics at primary school.

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To conclude this section, I would like to emphasise that each dimension of the teacher's and the students' action structures cannot be considered in isolation. All dimensions are at play in teaching, but certain ones may be more salient in certain circumstances (cf. Section 3). These dimensions give a pragmatic base for theorising teaching and learning as a joint action, but they are too broad to be used directly for analysing classroom events. Therefore, a descriptive set of concepts has also been developed to address a fine-grained analysis of the teaching units observed in classrooms[14].

2.3 The didactic contract - milieu dialectics

Two interrelated concepts borrowed from the Theory of Didactic Situations in Mathematics (Brousseau, 1997) make it possible to conceptualise *situations* in which teaching and learning joint actions take place. However, JAD introduces a distinction between instructional tasks on the one hand, which are prepared, defined and managed by the teacher, and learning situations on the other hand, which are task oriented but open to the contingency of the participants interpretation (Schubauer-Leoni et al., 2007). Therefore, the concepts of *milieu* and *didactic contract* have been reframed in a socio-interactionist and pragmatist approach to take into account both the teacher's and the students' perspectives in making sense of the situation that they have[15].

(a) The *milieu* characterizes the learning environment in which the teacher and the students act. It consists of the material and symbolic components that the teacher or students use, talk about, interpret, etc. in carrying out instructional tasks. It includes both the conditions for knowledge development (characteristics of tasks) and the actual knowledge development (meaning-making) over time in the classroom interactions.

(b) The *didactic contract* characterises the interdependence of actions taken by the teacher and the students in the development of pieces of knowledge content in the classroom. These actions are based on a set of rules, norms and expectations that the participants enact about the task, in the light of the purposes that they assign to the situation. The didactic contract frames the ongoing negotiation of the meaning of the components of the milieu, and thus of what knowledge content can be learned – from actions in the milieu[16].

14 For a detailed description of the level of analysis of classroom data with the JAD, see Ligozat and Buyck (2024, Online First)

15 The dialogue with the Swedish pragmatist approach to classroom discourse (Wickman & Östman, 2002; Wickman 2012; Hamza & Wickman, 2014) offering tools for analyzing the participant's practical epistemologies has been influential in this latter development.

16 The concept of the didactic contract has given rise to a great deal of theoretical analysis in the French didactics, following its empirical demonstration by Guy Brousseau (cf. Brousseau & Warfield, 1999). In particular, Sarrazy (1995) stresses that "in the Goffmanian perspective,

The dialectic between the didactic contract and the milieu makes it possible to conceptualize teacher's and student's joint action not only as a mutual influence but as a transaction that takes place in the milieu, through the didactic contract (*Figure* 3).

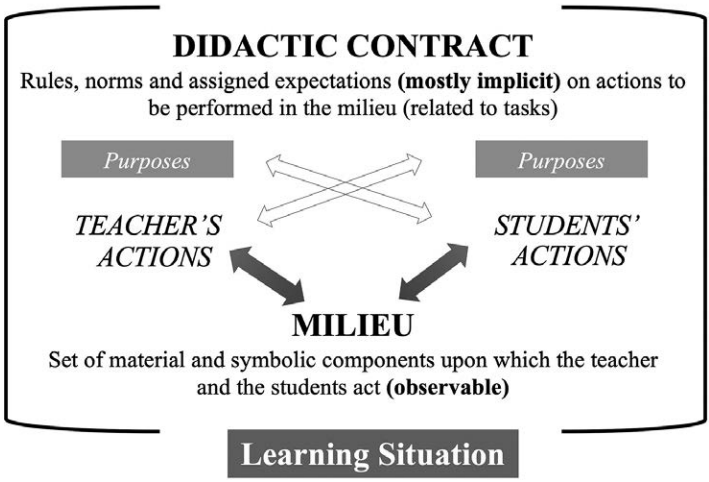

Figure 3: The contract and milieu dialectic.

The components of the milieu are directly accessible to the teacher and the students (and can be observed), whereas the dimensions of the didactic contract are implicitly played out in classroom interactions (and can only be inferred by the observer). Students' actions as well as teacher's actions on the components of the milieu are performed in the light of certain purposes that they assign to the situation; these purposes may not be the same for all the participants at the same time. The functioning of the didactic contract becomes visible when one of the participants does not act according to the expectations of the others, thus creating a "breach in the didactic contract" (Sensevy et al., 2001; Ligozat et al., 2018). Breaches in the didactic contract typically reveal divergences in the purposes pursued by the classroom participants. In any learning situation, the didactic contract is not univocally set up, and its stakes are the focus of ongoing negotiation between the teacher and the students. In other words, whereas the milieu can directly be observable

the didactic contract could be defined as the set of acceptable and shared modalisations, that must be actualized in relation to knowledge within the framework of a didactic interaction" (p. 90, my translation).

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through interactions in the situation, the didactic contract only becomes visible through breaches generated by either participant (teacher or student(s)). To illustrate the didactic contract-milieu dialectic and the four dimensions of the teacher's action structure, I draw on upon three episodes taken from a primary school science unit (5–6-year-olds) about how ants live in the wild. These episodes[17] show three cases of *breach of didactic contract* in the management of learning situations. Furthermore, each episode showcases a specific dimension of the teacher's action structure.

Regulating meaning relations

This episode takes place in the first lesson, after that the teacher and the students read a documentary book about the ants' life. The teacher selected some pictures from the book and asked the students to find similarities between them. The students discussed the pictures for 15 min in groups, then they explain their findings to the whole class. The students first describe what they see on each picture.

Episode 1. Describing pictures about ants.

1-SAL: it's your turn LOR

2-(*LOR points at* ***a picture*** *pinpointed on the board*)

3-LOR: there is **an ant** with / its (inaudible)(LOR *mimics* ***antennae on his head***)

4-Teacher: what did you say?

5-LOR: **two ants who fight**

6-Teacher: who **fight each other**?

8-LOR: yes and (inaudible)

9-Teacher: **who play**?

10-LOR: yes

11-Teacher: (*addresses other students*) what are they doing?

12-VAS: **a kiss**

13-Teacher: they would **kiss each other** / you think?

14-SAL: they **talk to each other**

15-Teacher: **they talk** / that's how … **they communicate between each other** / yes

This picture is drawn from the book „La fourmi travailleuse infatigable" Milan Jeunesse (2007)

17 Episodes are transcribed from the video recordings of the teaching unit. Bold characters indicate the main components of the milieu. The speech turns in which a breach in the didactic contract occurs are highlighted.

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In this episode, the picture chosen by the student LOR is a central component of the milieu. It implicitly defines a purpose in the didactic contract, and thus the situation that the students should address (*i.e.,* to find out what the ants are doing). LOR tries different descriptions of the picture until the teacher clarifies the task for all the students: "*what are they doing*" (SpT 11). In the descriptions, many meaning relations are built by the students as new components of the milieu. Certain meanings are acceptable (fight, play) whereas other seems too far from the teacher's expectations (kiss). When the meaning relation "*a kiss*" (SpT 12) emerges, it creates a breach of the didactic contract. We can infer this from the doubt expressed by the teacher "*they would kiss each other you think?*" (SpT 13), about VAS's utterance. The breach is overcome by a new meaning relation ("*they talk to each other*" SpT 14) built by another student. However, it does not fully match the teacher's expectations, since she reformulates: "*that's how they communicate between each other*" (SpT 15). In fact, there are many interpretations possible about what the ants are doing in this picture, but anthropomorphic models of relationships between ants cannot be agreed. From the teacher's perspective, it is out of place in the didactic contract. The teacher's final reformulation *regulates* (or clarifies) certain purposes of the didactic contract: the characterization of living beings should use generic relational models and not human-specific models.

Defining the learning situation

This episode takes place in the last part of the second lesson about ants living, after that different pictures about ants were described and gathered according to four categories (food, reproduction, body characteristics and living environment). The teacher presented four coloured posters, each of them representing a category to be filled with relevant illustrations and information found about the ants.

Episode 2. Drawing ants in the wild

1-Teacher: I am going to give you a sheet of paper and you can think about a drawing that you are going to fit in our four posters / you may draw an ant while eating / you may like to draw where the ant live / how is the body of the ant / or explain the birth of the ant / or the transformation for example

2- (the teacher puts white sheets on the tables and the students start drawing)

3-STE: but not an ant who rides a bicycle?

4-Teacher: no you don't draw an ant riding a bicycle/ indeed / we are not telling fairy tales now

In this episode, the teacher defines the students' task with a detailed instruction: to draw a selected aspect of the ants' life that belongs to one of the categories represented on the posters. The instruction, and its many components

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such as the presentation of the categories (eating, living, the body, the birth, the transformation), characterises the milieu of the situation that the students have to deal with. At first sight, the instruction seems very explicit, but there is still room for other meanings to be given to it by the students. When STE suggests the possibility of drawing "*an ant who rides a bicycle*" (SpT 3), it creates a breach of the didactic contract. This breach can be clearly noticed from the answer by the teacher "*you don't draw an ant riding a bicycle*" (SpT 4). While the meaning relation made by STE may be relevant in other learning situations (e.g., situations in which students are asked to use imagination for literary or artistic tasks), the teacher clearly means that it is not relevant in this situation. The formulation by STE "*not an ant that…*" shows that he is testing the boundaries of the didactic contract (*i.e.,* what is allowed or not in this task). Here, the teacher clarifies what cannot be done. This contributes to *define* the broader disciplinary context related this learning situation: doing science is about drawing facts about the real life of ants.

Tension between devolving and instituting in teaching

In this episode, the teacher reads some sentences found in the documentary book and written on flashcards. The students' task is to relate them to one of the four categories previously defined (living environment, birth, food, body) and shown on the four-colour posters. When the teacher reads the sentence "*First there is a larva, a nympha and then an adult*" (card 4), a student QUE suggests putting it onto the "Birth-related" poster.

Episode 3. Classifying information into categories (four coloured posters)

1-Teacher: one talks about babies / indeed /please say it if you disagree!

2-AMI: I disagree with QUE

3-Teacher: why?

4-AMI: because / because the body (shows card 3 onto the Body-related poster) // the head the thorax it's the same / it's the parts of the body

5-Teacher: yes but here it's written (reads the sentence on card 4) / first there is a larva / a nympha and then an adult // where would you put it then?

6-AMI: (takes the card 4 and hesitates for a while)

7-Teacher: it's the transformation of the ant / wouldn't you put it with the babies? / would you put it somewhere else?

8-AMI: because I heard / I heard

9-Teacher: because you thought about / it's got a head, a thorax and an abdomen (points at the card 3) / and it's the body- / this is true!

10-AMI: yes

11-Teacher: so it was true what QUE said

12-AMI:(puts the card 4 back onto the Birth-related poster)

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In this episode, sentences written on flashcards and the four-coloured posters (featuring conceptual categories) are central components of the milieu. The teacher explicitly opens some space for controversies about the meaning relations constructed by the students. This is a double *devolving – instituting* act since the classroom collective is explicitly given the responsibility of evaluating the relevance of an individual student's proposa. AMI takes this opportunity for suggesting an alternative relation of card 4 to the "body-related" poster. She tries to justify it by pointing to an analogy with the sentence on card 3 (head-thorax – parts of the body)[18]. However, this creates a breach of the didactic contract. We can infer it because the teacher does not take up AMI's meaning relation. Instead, i) she relaunches the task by reading again the content of card 4; ii) she makes new inputs in the milieu with the meaning "*it's the transformation of the ant*" (SpT 7) and the negative question "*wouldn't you put it with the babies?*" (SpT 7) calling a positive answer; and iii) she reads the content of card 3 in full ("it's got a head, a thorax and abdomen" SpT 9) to confirm the relation with the "body-related" poster (it's the body – it's true). Through these steps, the teacher fills the breach of the didactic contract by emphasizing the meaning relations between the content of card 4 and the "birth-related" poster on the one hand and the content of card 3 and the "body-related" posters on the other hand. However, in doing so, the teacher *institutes* the categories featured by the posters as exclusive and the discussion about the categorization of flashcards is no longer up to the students. The purpose of the learning situation is then to find out the correct categories into which facts about ants can be placed and not to build multiple relationships between facts and categories (which would reflect the biological complexity of living beings). In this episode, there is a tension between *devolving* the evaluation of meaning relations between flashcards and posters to the classroom collective and *instituting* the "correct" answers expected by the teacher.

Based on these three episodes, the analysis milieu – didactic contract dialectic shows the divergences that occur in the interpretation of the task it unveils the purposes pursued by the classroom participants. By becoming explicit, these purposes contribute to (re)define the learning situations. In Episodes 1 and 2, the breaches are generated by certain students whose answers are too far from the disciplinary purpose of the task (anthropomorphic description or fictional construction of the life of ants). On the contrary, Episode 3 features a breach generated by a student who challenges the teacher's structuration of content about ants towards an increased integration of facts that is consistent with the subject epistemology. Interestingly, the manner by which the breaches are

18 From the observer's perspective, the description of the three states of the development of the ant may be viewed as changes in the ant's body (morphological transformation). I will go back to this in the final section.

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solved tell us something about what the teacher prioritizes in the formation of the subject (cf. Section 4). *The milieu – didactic contract dialectic is an important gateway to understanding how the didactic transposition about a subject-specific domain works inside the classroom.*

2.4 The triple genesis as a system of descriptors of the knowledge content development

The dialectic between the milieu and the didactic contract can also be described dynamically in the interactions between the teacher and the students through a set of *three geneses* (Sensevy, 2007; Schubauer-Leoni & Leutenegger, 2007; Ligozat & Leutenegger, 2008 following Chevallard, 1985/1991, 1992; also see Ligozat et al., 2018).

(a) The *mesogenesis* describes the evolution of the components of the milieu as objects of meaning constructed by the teacher and the students. It includes designations and definitions of components of tasks, rules of action, meaning relations constructed, and possible tensions or contradictions raised by participants (teacher or students) between the components of the milieu.

In the course of the mesogenesis, it is possible to identify two other geneses, predominantly managed by the teacher (cf. Fig. 4):

(b) The *topogenesis* describes moves in the division of responsibilities between the teacher and the students in meaning-making. This division is reflected in the positions (high/low) taken by the teacher in discourse (e.g., dominating, accompanying, distancing, delegating). These positions allocate a space of action to the students regarding the meanings to be constructed from the task (mesogenesis). If the teacher's positioning is rather low, students can move their own positions (high/low) in making convergent or divergent meanings with the purpose of the task.

(c) The *chronogenesis* describes moves in knowledge content development in the classroom. Based on the meanings constructed about the task (mesogenesis), these moves regulate and institute the knowledge content progression over time through different kinds of actions in discourse (remind/anticipate; redefine, relaunch, reorient; confirm, rebuild, further) performed by the teacher. The students can also participate to the knowledge content development, depending on the space of action given to them by the teacher (topogenesis), and the degree of convergence of the meanings they make with the purpose of the task.

This triple genesis provides a structure for decomposing the teacher and the students' joint action in the (re)construction of knowledge contents in the classroom. The asymmetrical relationship between the teacher and students in didactic joint actions is characterised by the programmatic actions of the

teacher in managing the topogenesis (*i.e.,* giving some specific responsibilities to the students) and the chronogenesis (*i.e.,* moving the knowledge content forward). Schubauer-Leoni et al. (2007) and Ligozat and Leutenegger (2008) proposed a coding set of categories to describe the three geneses from the empirical teacher-student interactions. These categories are summarized in Figure 4.

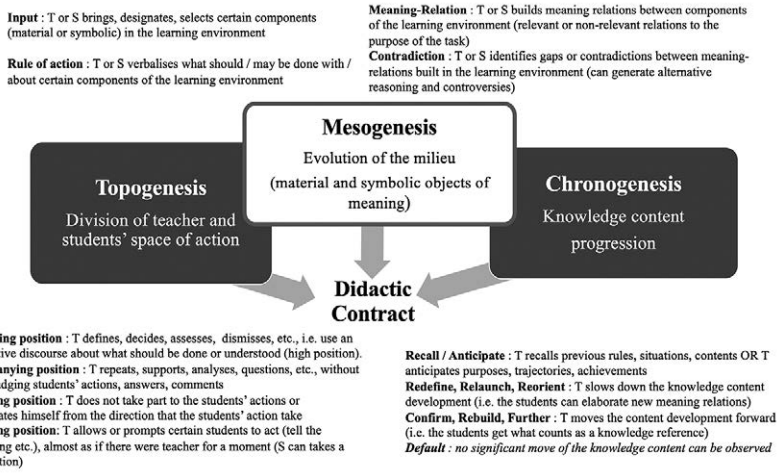

Figure 4: Coding categories of the triple genesis.

We can now return to the analyses of episodes 1, 2 and 3 presented in Section 3, to examine how the space of action between teacher and students is divided up (topogenesis) and how knowledge content develops over time (chronogenesis). The combination of topogenetic and chronogenetic analyses is necessarily rooted the mesogenesis, *i.e.* the evolution of the milieu (cf. Section 3).

In Episode 1, the teacher first adopts a low topogenetic position (accompanying) and gives the students the responsibility of trying to describe the picture. When the student VAS makes the meaning relation (ants – a kiss), the breach in the didactic contract goes along with topogenetic and chronogenetic moves:

- The teacher dissociates herself from VAS's position. She delineates responsibilities the in discourse with "*you think ?*" (SpT 13), which means that she does not share what VAS think.
- The teacher challenges the meaning relation made by VAS and the knowledge content progression remains latent. The students must think of an alternative proposition.

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After that SAL tries the meaning-relation (ants - talk to each other), the teacher then takes a more dominating position to clarify what the ants are doing (and not doing) with the statement "*they communicate*". This statement accelerates the knowledge content progression and opens the floor for another question to be addressed.

In Episode 2, the definition of the task clearly belongs to the teacher. From the beginning, she is in a dominating position to give the instruction. When the student STE introduces the possibility of drawing "*an ant who rides a bicycle*" (SpT 3), the teacher overcomes the breach in the didactic contract by giving a rule of action ("*you don't draw an ant riding a bicycle*" SpT 4). In doing so, she strengthens her topogenetic position (dominating), while no salient chronogenetic move can be observed, since we do not observe the construction of any piece of knowledge that would stem from the task.

In Episode 3, the teacher is first in an accompanying position to give the students some space to express their agreement or disagreement with QUE's proposal (placing card 4 "First there is a larva, a nympha and then an adult" on the "Birth-related" poster). AMI proposes an alternative classification, and the knowledge progression is reoriented toward the comparison between card 4 and card 3 ("*It's got a head, a thorax and an abdomen*"). However, AMI does not manage to make any significant meaning relation out of this comparison. First, she hesitates (SpT 6), then she cannot finish her sentence (SpT 8). The teacher then takes a more dominating position in order to make a new meaning relation about card 4 ("*it's the transformation of the ant*" – SpT 7), to suggest a rule of action ("*wouldn't you put it with the babies?*" – SpT 7) and to confirm the correct classification of card 4 on the "Birth-related" poster (SpT 11 and 12). From this moment on, AMI's space of action is strongly reduced (she can only agree with the teacher, in SpT 10), and the knowledge content progression is moved forward by the teacher on the sole basis of the meaning relation built by QUE. This chronogenetic move does not integrate the alternative categorisation of card 4 as a "bodily" phenomenon occurring in the life cycle of the ant.

The analysis of the triple genesis shows variations of the teachers' positions in the topogenesis (accompanying, dominating, or distancing positions). These positions open up, reduce or widen spaces for students' actions. At the same time, in the chronogenesis, the rhythm of the knowledge content progression also changes between moments when the knowledge construction is latent (dependent on the meaning-making process about the components of the milieu) and moments when the knowledge construction moves forward (certain meaning relations made are taken up and shared as something that "counts" as valid). *The combination of the topogenesis and chronogenesis (anchored in the mesogenesis) unveils what meanings relations are privileged by the teacher*

and to what extent students participate in the development of knowledge in the classroom.

3 The Joint Action framework: a tool for the bottom-up analysis of the didactic transposition

Beyond the illustration of the descriptive categories of the JAD, Episodes 1, 2 and 3 were selected as significant events of the teaching unit on ants in the wild from the perspective of the didactic transposition. In this final part, I resume the results of the analysis of Episodes 1, 2 and 3 to discuss how they illustrate the didactic transposition.

The progressive building of a disciplinary context in early school years

Looking at all the episodes together, they inform us about how a disciplinary background is being subtlety and progressively built up as a common reference for learning science in early school years. The teacher introduced the unit by setting the goal to learn about ants in order to present this living being during a school exhibition. At no point during the unit, she explicitly tells the students that they are having a "science" lesson[19]. The Students therefore experience this subject gradually, through the distinctions that the teacher makes with other disciplinary background.

The teacher introduces certain distinctions in the discourse when the directions that the students' actions take diverge from certain ways of describing and categorising aspects of living beings.

- Episode 1: not "kissing, talking" (reflecting human behaviour) but communicating (as a generic description of the relationships between living beings);
- Episode 2: not "an ant riding a bicycle" or telling fairy tales (artistic or literary context) but drawing real life facts (as an example of scientific observation);
- Episode 3: "larva, nympha and adult" should be recognised as an aspect of the transformation of the ant (Birth category) and not as an aspect of the insect morphology (Body category).

The distinctions introduced in Episodes 1 and 2 engage the students with standards for observing and explaining scientific facts. However, the distinction introduced in Episode 3 is problematic: from the observer's perspective, the description of the three states of the ant's development is a morphological

19 This is a common practice in the first grades of primary school, during which the students cannot yet envision the knowledge-domain (discipline) and its characteristics before they have an experience of it. But this practice would need to be confirmed by specific investigations and it may be different in other countries.

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transformation, and it could be related to the "Body" category. Interestingly, the student AMI who suggested this alternative, shed some light on the epistemological status of the categories established in this lesson. First, "Body" and "Living environment" reflect anatomical and ecological categories, whereas "Food" and "Birth" reflect biological functions that are common to all living beings. There is no reason to regard these categories as exclusive, in fact they are all interconnected. Thus, the disciplinary background that is progressively built in this classroom diverges from the epistemological models of biology as an academic discipline (Schwab, 1978). In what follows, I will argue that this divergence is related to the process of didactic transposition.

A shift in the epistemological function of scientific knowledge content

These three episodes can be recontextualised in the whole structure of the teaching unit. To do this, I build a synopsis of the teaching unit, reflecting at least three levels of analysis (Table 1)[20].

Tab. 1: Synopsis of the teaching unit about ants in the wild (grade 1).

Types of tasks (MACRO Level)	Teaching phases (UPPER-MESO Level)	Selected Episodes (LOWER-MESO Level)
Lesson 1 (45 min)		
Discovering the ants' life	Searching of documentary books about the ants' life in the school library	
	Reading of a documentary book about the ants' life (whole class)	
	Commenting and relating pictures about ants (work group)	
	Commenting and gathering pictures about ants into categories (whole class)	*Episode 1 – Describing pictures about ants*
Lesson 2 (45 min)		
Categorising aspects of ants' life	Resuming the relations found among pictures about ants (whole class)	
	Building for categories about ants' life: Birth, Food, Body and Living environment (whole class)	
	Representing aspects of ants' life according to the categories established previously (individual drawing)	*Episode 2 – Drawing ants in the wild*

20 For a full description of this methodology, see Ligozat and Buyck (2024).

Lesson 3 (45 min)		
Preparing thematic posters for presenting the ants' life	Recalling previous activities (whole class)	
	Categorizing pictures, drawing and information about ants on four posters (featuring the established categories about ants' life) (small groups led by the teacher)	*Episode 3 – Classifying information about ants onto four coloured posters*
School Exhibition		
	Presenting the content of each poster to other schoolmates	

This recontextualization informs us about the didactic status of the four categories, "Birth, Food, Body, Living environment", in the teaching unit (*i.e.* their function in the progression of the knowledge content). These categories serve multiple teaching purposes: they help to organise the information read in the documentary book, to interpret the illustrations and to present the content on the ants' life in the school exhibition. The knowledge content development is based on the "instructive reading"[21] of biological facts that need to be organised to be remembered. Instead of modelling core aspects of the disciplinary structure of biology (e.g., the complex interrelations between the environment and the living functions), these categories reflect an encyclopaedic approach of the natural world. This divergence in the function of the knowledge content taught is a phenomenon related to the didactic transposition (Chevallard, 1985, 2007). The function of knowledge content changes during its recontextualization in the classroom because the teaching process within school organisations has to comply with many constraints and beliefs that go beyond the epistemological features of the subject: organizing poster presentations during a school exhibition is a way to motivate students, having distinctive categories helps memorisation and assessment of what is learned, reading documentary books are a good ways to connect science and language, etc.

In Episode 3, AMI's interpretation provides an opportunity to show the interconnection between the categories "Body" and "Birth", by associating morphological changes to the growth of the ants. This phenomenon, which is called a "situated reconstruction of the functions of knowledge content", has

21 Chartier (2007) uses the term "instructive reading" to refer to reading practices in the first mid- 20th century that combined language knowledge with specific knowledge (e.g., history, science). In this approach, scientific knowledge is a given, presented as fixed and definitive conversely to the scientific inquiry, with all that it implies in terms of questioning, formulating hypotheses and experimentation.

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been reported in mathematics lessons (e.g., Mercier et al., 2000; Quilio, 2017). As noticed by Quilio (2017), the situated reconstruction of the function of knowledge content by the students is hardly recognised by the teachers, because *the didactic transposition is a naturalised process*: the way teachers are used to present the knowledge content is incorporated in their practice[22], so that it seems to be the "only possible way" to present it.

In the case of this teaching unit, the shift in the epistemological functions of the biological categories reflected by the four categories used by the teacher is important and it could be easily interpreted as a lack of "pedagogical content knowledge" (Schulman, 1986). However, the didactic transposition plays a central role in all didactic systems, and it is unavoidable (Chevallard, 1985; Schneuwly, 2021). The question is not that the knowledge content taught in classrooms should be identical to the knowledge in use in academic disciplines, but the question is rather in which way the knowledge taught in classrooms can be compatible with the subject epistemology. The analyses of the knowledge content developed in classroom practices carried out with JAD are one way of addressing this question. More generally, this is a matter for analyzing teaching resources and teaching practices by subject didactics research. From this point of view, the teaching unit on the life of ants has a limited compatibility because the encyclopaedic way of classifying information only processes the results of scientific inquiries. It shadows the questions that prompt inquiries in the scientific practices and that are fully part of science as a discipline (Chevallard, 2007). Therefore, some possible improvements of this teaching unit require the integration of a scientific investigation on how the general biological functions (feeding, reproduction) work for ants from the observation of empirical facts that include morphology and living ecosystems.

4 Concluding remarks and perspectives

In this chapter, I presented the main concepts of the Joint Action framework in Didactic (JAD) by analyzing a set of empirical examples of classroom interactions with the different "layers" of categories successively. I also gave an outlook of the function of JAD interactions analysis for discussing didactic transposition issues in the formation of subjects in classrooms. This chapter has a propaedeutic function that is to show how the different layers of analyses can be made with JAD. But of course, these layers are not necessarily

22 As the global definition of what is to be taught and how in schools, the didactic transposition is a broad institutional process involving many stakeholders (politicians, curriculum makers, textbook authors, teacher trainers, inspectors, headmasters, teachers' association, etc.). It operates beyond the control of individual teachers, who participate in it through the incorporation of "teaching habits" shared in the teaching profession (Chevallard & Bosch, 2014).

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needed all together for reaching the conclusions that I brought about the didactic transposition of the scientific content in preschool grades.

From the study performed this chapter, it should be clear that the JAD focuses on how knowledge content develops in the teacher's and students' interactions, and how the students are enabled to participate (or not) into this development. However, it should also be clear that the JAD relies upon the analysis of the knowledge content embedded in the learning situations that the students encounter. This analysis involves two complementary movements: the top-down movement concerns the analysis of task features from an outsider's perspective and the bottom-up movement concerns the analysis of the participants' purposes and reasons for doing what they do (insider's perspective). Both movements enable to reconstruct the situational (practical ways of doing) and institutional (school subject epistemology) viewpoints in the transposition process. The articulation between the analysis of the specific dimensions of knowledge and the analysis of the joint action of the teacher and the students provides a global model for the analysis of didactic systems.

For more than a decade, classroom studies conducted with the Joint Action framework in Didactics have shed light on *what* is taught and potentially learnt (*e.g.,* Ligozat et al., 2018), *who* is enabled to learn *what* (*e.g.,* Amade-Escot et al., 2015; Verscheure &Debars, 2019; Amade-Escot &Verscheure, 2023), and *what patterns of teaching actions* can be modelled to understand consequences for student learning (*e.g.,* Sensevy et al., 2005; Sensevy, 2014, Tiberghien & Malkoun, 2010; Tiberghien & Venturini, 2019). From this whole body of empirical research, the JAD has demonstrated its ability to analyze teaching practices in different subjects (mathematics, sciences, physical education, French language, etc.) from a generic set of conceptual categories borrowed from the main theoretical frameworks developed in the Francophone didactic research. The JAD allows to relate different subject-specific teaching practices through the same analytical lens.

Besides the many descriptive and critical analyses of the didactic transposition carried out with the JAD, the question of "what is good teaching?" remains latent, especially when the conclusions show that the knowledge content developed are limited with respect to the potentialities of instructional tasks (teaching resources) and the learning objectives set in the curriculum. To address this question, a model for analyzing the didactic quality of teaching based on the JAD (JAD-MTQ) is currently being developed (Ligozat & Buyck, 2024).

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