Enactivism and Didactics. Some Research Lines

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Abstract: From the beginning of the new millennium several authors coming from various different fields have addressed the topics related to enactivism. These topics were introduced in the Eighties by Varela and then developed by Thompson and Rosch who worked on embodiment and embodied cognition. In the didactical field, the contributions by Proulx, Begg and Li explored the potentialities of the enactive approach to interpret the teaching and learning processes. The present article aims at exploring experimentation paths in the educational field, which are based on the enactivist approach, and at presenting the first results of those studies already started. After a short focus on the theoretical aspects, to catch the topical elements of that approach, we will set the attention on the action and on the role of perturbation in the teaching/learning processes.

Riassunto: Dall’inizio del nuovo millennio vari autori appartenenti a campi di indagine differenti hanno affrontato ricerche con un approccio enattivista. Tale approccio fu introdotto negli anni ottanta del secolo scorso da Varela e poi sviluppato insieme a Thompson e Rosch che hanno lavorato sull’embodiment e sulla conoscenza incorporata. In campo didattico i contributi di Proulx, Begg e Li hanno esplorato le potenzialità di un approccio enattivista per interpretare i processi di apprendimento e insegnamento. Il presente articolo, sempre partendo dall’approccio enattivista applicato alla ricerca in campo didattico, analizza se e come il concetto di “accoppiamento strutturale” proposto da Varela possa essere utilizzato per studiare la relazione tra i processi di insegnamento e apprendimento. Indaga inoltre sull’affinità di tale concetto con quelli di empatia (Bertboux), simulazione incarnata (Gallese), co-attività (Altet e Vinatier) e propone piste di ricerca sul campo per validare l’ipotesi proposta.

Keywords: Enactivism, Didactics, Perturbation, Teaching/Learning Processes.

Autonomy, Structural Coupling and Perturbation

In enactivism, every system has a dynamic autonomy, that is, a structural closeness that is at the basis of its self-organization that explains the endogenous randomness of the autonomous systems (Damiano, 2009, 33).

* Even if the work is an all authors’ collaboration, the pages 37-40 are made by Valentina Prenna; the pages 40-57 are made by Pier Giuseppe Rossi.
Such a concept is complementary to the Piagetian idea of “thermodynamic openness, to show the properties of a system to exchange energy and substance with the outside” (Idem).

Also, the learning subject is at the same time autonomous and immersed in the world, thanks to his/her body with a biological, neurological, sensori-motor structure, with its own skills and competencies, a body that offers specific options of action. The “living body” (Thompson, 2007) puts the subject in connection with the other, interacts with the surroundings, en-acts reality catching the offered triggers (Proulx, 2004).

The interaction between the subject, with his/her living and active body, and the environment, creates co-emergencies and produces the “structural coupling”. In this way, the subject and the environment are supposed to be connected, in a relationship of co-specification, a relationship of interdependence, in which there is no direct action of the one on the other, but reciprocal perturbations and compensations that result in compatible configurations. Such a modelling can find an analogy in what Gallese calls attunement (Gallese et al., 2007).

The concept of emergence is central to enactivism, that is, the production of new properties from the interaction between processes and from elements already existing. An “emergence” (Di Paolo et al., 2010) has its own identity that redefines the properties of the sub-units forcing them to a collective and coordinated new organization.

The system is autonomous and chooses the modalities with which it wants to act. The perturbation per se determines just a phase of disequilibrium, but it does not affect in an automated way the further organization. Just analysing the perturbation, it is not possible to predict the effect on the system or the trajectory that it will take during the adaptation, since the transformation it will experience depends on the specific structure of the system itself, and on the way it catches the triggers and reacts to them. The coupling is contextual and the cognitive identity which co-emerges is temporary (Damiano, 2011), since it is the product of the relation between a specific destabilization of the system and one of the possible choices and configurations than can emerge in reply to it.

**We-Centric Space and Co-Specification**

Gallese connects the concepts of attunement and of we-centric space to the structural coupling. If the subject, immersed in reality, is in relation
with the other, knowledge is not only a cognitive/rational process and specifically individual, but conversely, it seems to arise from the circular and continuous flow of sensori-motor interactions between the mind-body-artefact-world that produce an *attunement* (Gallese et al., 2007).

The findings on mirror neurons (Rizzolatti et al., 2001) in the field of neurosciences have contributed a lot to enhance the connection between the *mind-body-artifact-world*, embodying what Varela realized: the relation between inter and intra psychic.

Our seemingly effortless capacity to conceive of the acting bodies inhabiting our social world as goal-oriented persons like us depends on the constitution of a “we-centric” shared meaningful interpersonal space. I propose that this shared manifold space can be characterized at the functional level as embodied simulation, a specific mechanism, likely constituting a basic functional feature by means of which our brain/body system models its interactions with the world (Gallese et al., 2007).

Gallese (2007) discusses the mentalist vision of intersubjectivity. He supposes the existence of a neural mechanism in charge of the “Intentional Attunement” that characterizes the dimension of intersubjectivity. According to such a hypothesis, when the subject enters a relation with the other, a neurophysiological mechanism of “embodied simulation” would activate, thanks to the action of mirror neurons. We mean a shared place, a we-centric space, in which the system body-mind modulates the interaction with the outer space (Gallese, 2003) and in which the coupling subject-object creates knowledge and dynamics, and reciprocal, symmetric (even if not identical) transformations.

The attention is focused on the embodied simulation. When we observe the other doing an action, the same neural process activates when we do an action.

Acting and observing are specular processes and Gallese defines “embodied simulation” (2005, 2009) as the process that implies the understanding of the other and his/her expressions (actions, emotions, conceptualizations), activating the same neural processes in his/her body. We suggest referring to Gallese (2003) and Damasio (1999; Adolphs, 2003; Shiv et al., 2005; Rudrauf, Damasio, 2005) for the relation between empathy and simulation, but also to Berthoz (Berthoz, Jorland, 2004; Berthoz, 2003;
Berthoz, 2009) who highlights the symmetry between neurosciences, simplicity and enactivism.

The action becomes the place in which the subject, the subjects and the environment, meeting each other, interact co-specifying themselves. When the action puts the subject in relation to the other, it acquires the dimension of intentionality. Thompson and Stapleton (2009) offer a phenomenological notion of intentionality:

A relation to that which transcends the present state of the system (where what transcends the system does not have to exist in the sense of being a real entity). In saying that the mind is intentional, phenomenologists imply that the mind is relational.

The action creates a dimension of intersubjectivity when it connects the body-mind-world.

In the relation, subject and object create an interactive organization, units in dialogue (Damiano, 2009). Every element specifies in the interaction with the other, but it keeps its own organizational autonomy.

The relational dimension acquires a strategic relevance: when the individualities couple an autopoietic, space-time occurs. None of the individual elements can guide this space, since it is their interaction that gives the direction whereby the whole system evolves.

**Enactivism and Education**

In the didactical action, two systems exist that interact with each other and with the same environment: the teacher and the student. Each of them perturbates the other and changes according to its structural characteristics. Such a perturbation happens, and when it happens, in the didactical practice, that is, in the space-time during which the students and the teacher interact and accomplish tasks, it puts into crisis their equilibrium.

Learning can be described as a process of reorganisation of the subject due to the external inputs. Learning co-emerges in the situation and both the teacher and the students learn, even if what is learnt are different procedures, knowledge and dimensions for each system. Autonomous, reciprocally consistent, multiple trajectories are created.
The perturbation can present different characteristics. It can be the event (Morin, 1972), that is something that was not initially foreseen in the designs of the teacher and that modifies the plan.

Morin (Ibidem) highlights that events “are the moments in which the system passes from a state to another” (Ibidem, 278) and the relation between events and systems is at the same time uncertain and determined. Learning consists of making events significant, in transforming the event-rumour in the event-sign (Ibidem, 285). Besides, Morin states that the event does not have the same value for all observers, but that it depends on the perspective of the observer. Speaking about the event, thus, implies that the perspective of the observer has a primary role (Damiano, 2009).

The event, in this case, is often characterized by different results from the ones expected, by questions and solicitations proposed by the students. In such a case, the break is perceived as such by the students and the teacher.

In other cases, perturbation is the obstacle (epistemological, didactical, ontogenetic) that the student meets in his/her path (Brousseau, 1983; D’Amore, Pinilla, 2007, 46-49). In such a case, it is the teacher who perceives the perturbation, that is, he/she identifies the hiatus between the conceptualisations that the student has built and the scholarly body of knowledge. According to his/her analysis, the teacher can propose to the student some activities which destabilize him/her. An example of those activities is the critical experience of the didactics for concepts that makes the student aware of the hiatus itself.

In both cases, the teacher has a relevant role: in the first one, because he/she accepts that the break will become the starting point for further action; in the second, because he/she activates the process itself, by proposing situations that destabilize the conceptualizations of the students.

The presence of perturbations, events and subsequent intentional actions creates the premise for the processes of reorganization of the relations and for the creation of we-centric spaces, that is, spaces in which the two perturbed systems bring into question themselves. In such a situation, often, an attunement is produced and the two systems behave as “units in dialogue” (Damiano, 2009).

The interactive dimension between the teacher and the students is more and more often the object of analysis, through the use of different theoretical grounds, that point out aspects which are not similar, but are aimed at an understanding of the dynamics of listening and reciprocal understanding. Being able to go deeper into the analysis of the interactions...
lets the teacher focus, according to the different perspectives used, if, how and why subjects affect each other and the subsequent evolutions of the situation.

Altet and Vinatier, even if they don’t speak about *we-centric spaces*, use the word co-activity to describe the episodes in which the interactive relationship between teacher/student reifies (Vinatier, Altet, 2008). The two authors find the same conclusion produced by Tardif and Lessard, who highlight the centrality of the connection between the interaction of students/teachers and events and they state that they “are the interactive plots with students that guide the rationale of the events in class” (1999). According to Altet (2012), the analysis of interactions enables the highlighting of a process of interpersonal adaptation in class, through which it is possible to identify modalities of adjustment – or not – between the teacher and the students in their action. “The management of the interactivity is one of the organizing of elements of the didactical practice” (*Ibidem*, 300).

The articulation of learning-development is created in the co-elaboration with the students.

The communication and didactical agreements are created through the dynamic of exchanges. The interlocutors build an interrational organization that redefines those agreements in situ, subjectively creating a space of conceptualization of the created object. The activity of the single is addressed to the activity of the others; the work of the single is the activity of the others and vice versa. In relation to an object, the knowledge. We can speak about co-activity (*Ibidem*, 305).

The concept of co-activity is proposed by Vinatier and Numa-Bocage (2007).

L’hypothèse que nous partageons est que le contrat de communication et le contrat didactique, les systèmes d’obligations, ainsi que les normes, valeurs, et règles qui déterminent l’activité sociale de chacun, sont chahutés par la dynamique des échanges. Nous concernant, nous avons été amenées à considérer qu’il se construit, entre les interlocuteurs, au-delà de toute détermination contractuelle, ce que nous appelons une «organisation interactionnelle», laquelle redéfinit ces contrats *in situ*, en élaborant subjectivement un espace de conceptualisation de l’objet travaillé (*Ibidem*, 87).
A crossed analysis, between the cognitive and relational aspects, enables us to identify a “kind of stable and strong co-activity that arises from a tension between inter-subjective needs and epistemic games” (Ibidem, 88).

The two authors propose the analysis of a lesson, whose actors are a maître spécialisé and a student. In this situation, the attention is focused on two indicators: the level of conceptualization, both of the student and of the teacher, and the nature of the interpersonal relation.

The lesson is analysed through the verbal exchange between the teacher and the student. It is divided into four episodes. In the first two, the teacher is dominant and the student has a low profile and communicates with long silences. In the second, the resistance of the student forces the teacher to use some indicators and give orders, while the student still shows a low understanding of what the teacher is proposing. In the third episode, the frame changes, since the teacher proposes a new approach to reading and a reasoning based on inferences. Specifically, he takes into consideration a question by the student, which looked back to activities previously done. The student then shares with the teacher the difficulties met during the class work. With the fourth episode, the sequence is closing with the anticipation of the activities to be done in the next lesson.

In the moment in which the interaction was to arriving at a break (at the end of the second episode):

l’activité du maître s’appuie sur un changement de mode et de registre d’action en fonction de l’articulation d’indicateurs situationnels de deux ordres: relationnel et cognitif. Le changement de registre d’exigence, dans la tension entre apprentissage nécessaire et soutien de la personne pour permettre son développement, semble être une dimension centrale du travail des maîtres, il constitue selon nous une dimension pragmatique de l’organisation interactionnelle entre l’enfant et lui (Ibidem, 93).

The change in the register, which occurs at the beginning of the third episode, produces a break in the previous situation and lets the interaction take place; with such a change, the processes of adjustment activated by the teachers concretise. It is also interesting, the change of pace highlighted by the authors: “Les moments de ralentissement dans l’approche métacognitive semblent correspondre aux moments de maintien de la relation et semblent éviter la perte de confiance en soi de l’élève” (Ibidem, 94).
Enaction and Didactics. The Experimental Path

We can describe the didactical action as a sequence of linear and dialogic processes (Rossi, 2011). In linear processes, the activity is made by a sequence of actions made by the teacher and by the student (explanation, questions and answers, tasks, task execution, assessment). In dialogic processes, determined by a break in the equilibrium, interactive processes take place in which the simultaneity of the action of the two actors, characterized by quick exchanges, prevails compared to the sequence of actions. We need to specify that the two typologies of processes are synergic between them, since the linear processes prepare and, later, organize what happens in the dialogues, while the dialogic processes perturbate the linear ones and explore them in a multi perspective and multimodal way.

The dialogic processes are often activated by perturbations that bring into question the previous equilibrium of the two systems, the teacher and the student, and require that both put themselves in line, even if at different levels and objectives.

We cannot speak about identical processes, but of attunement between the two processes. If a teacher and a student, for example, become aware of an obstacle met by the student during his/her path, the possible further equilibrium implies that the student overcomes the naive conception and an approach to the scholarly body of knowledge. For the teacher, the knowledge of the naive conception and the identification of its origin and, often, the identification of some complexities of the scholarly body of knowledge that had previously been underestimated – and that come from a symmetry between the ontogenetic and phylogenetic processes, as highlighted by D’Amore (2007).

The Event in Class

Video recordings, with a total amount of 60 hours, have been made in three classes of primary schools, of three different institutions located in Ascoli Piceno and Ancona. Some episodes, lasting few minutes, have been isolated and the emergence of an event has been caught.

The focus is specifically on the identification of those moments in which the perturbation destabilizes the path, producing a deviation from the planned path. The analysis aims at highlighting if, and how, the teacher
catches and reacts to the event, and describes, in qualitative terms, what happens in the class.

**Experimental Data (Teacher 1)**

We will analyze three episodes regarding Teacher 1 when it seems to be related to an event.

In the first episode, while the teacher is explaining the progress as a monotone and a continuous process, a student says “But something from the Sumerians to the present day has remained the same” (Episode 1).

In the second one, a student asks: “but in the future, will students at school only study our civilization or maybe even the Egyptians?” (Episode 2).

In the third one, a student asks if, in barter, is it important to count only the quantity of the goods or also is the quality as being important (Episode 3).

A premise. Sometimes the event is “prepared”, introduced by words or behaviour (which the teacher is not always aware of) that show the happening of a structural coupling, an *attunement*. For example, in the first episode, a few minutes before the student’s question, the teacher had said:

**T1:** Soon, we will see what happens when, and how, writing evolved, right? Because it follows a natural development, like everything else right?… By primordial forms… then everything evolves slowly, and what does it do? It tends to improve…

**S2:** Improve?

**T1:** Improve, yes, like everything right? That is, with the passage of time… Then just look, we have done the framework of civilization… to improve is a great word because it is a process, isn’t it?? [progress is better].

And then:

**T1:** Well, in theory… but here you see… if you take a house in the twenty-first century, do you manage to understand the evolution when comparing it to a house of the Sumerians? There were only two open-
ings, one to get into the house and one to make the light enter… there has been an evolution, everything tends to improve… in theory, because the improvement comes out of other problems that we do not list now. You can sit down.

In the analysed episodes, it can be perceived, that when the event appears, there is an initial disorientation of the teacher, who takes time with sentences like “good question”, “I had not expected that, however, you’re right”, “you have said something very important, I did not want to start from here, but we got there”. Often, when pronouncing these phrases, the teacher turns towards the camera, as if he is searching for some distance from the situation to reflect upon what to do. This can be perceived (by the teacher’s face and the tone in which the sentences are put) as “taking time” for making quick assessments (in the order of one or two seconds) related to the epistemological dimension (relevance of the question raised, its impact on the key concepts of history), the dimension of didactical engineering (how much time to devote to the subject, how to re-organize the projected path), and the dimension of values (respect and promotion of the questions issued by the student).

At the same time, the teacher explicates, even unconsciously, that he is reorganising the path due to a good and constructive intervention by the students (“good question!”), and recognising them having an active role in the didactic path.

Section provides an analysis of Episode 1. (T1 is the teacher, S1, S2, S3, S4, S5, S6 are the students)

<table>
<thead>
<tr>
<th>T1</th>
<th>Now…</th>
<th>T1 notes that S3 has raised his hand asking to speak. He has decided to devote space to the question…</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>tell me S3</td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td>regarding food, one thing is neither improved and [is]</td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>I like what S3 is saying, about food! (commento: towards the entire class in a high tone of voice – many students turn towards him)</td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td>one thing is neither…</td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>Neither the worse… [what?]</td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td>[worse] the water… men have always used water</td>
<td></td>
</tr>
</tbody>
</table>

BIO-EDUCATION, SIMPLEXITY, NEUROSCIENCE AND ENACTIVISM
| T1 | This is interesting… but…  
Teacher smiles, looks at the camera as if he’s looking for support, there is silence for a few seconds, then he tries to answer |
| T1 | Although I would say… in my opinion, I do not know what do you… well I ask you: he said that the water has maintained the same characteristics that it had at the time of the Sumerians, has it not? In your opinion, today, in the twenty-first century, water is a beverage, it is necessary, it is a source of life… In your opinion, has water the same characteristics of that time? Has it improved? What can you say about it? Raise your hands and I’ll let you speak… |
| S2 | Teacher, one thing that has changed is that at the time of the Sumerians, water was respected; it was used to do things, but now when we get water, we drink it and maybe some of it is thrown away. |
| T1 | … that could be so… so now you can say that we should what? (0.2)... save water, right?… You see, the positive aspect is that you come home and get the [water] |
| S1, S3 | [fresh water] |
| T1 | … currently bottled water, you don't have to go with your bucket [and take it] to the river |
| S2, S4 | [or get it with the pitchers] |
| T1 | and the water is also clear, isn't it? |
| S3 | Clean |
| T1 | You turn on the tap or open the bottle, you drink, ok… now you see you've raised an issue of respect, then maybe our bad attitude towards water, leaving the tap running, or… […] Then, something else? |
| S6 | That water at the time of the Sumerians was not good to drink and now it is [in practice] |
| T1 | Yes, but… |
| S3 | [But I read] in the books, that they built a machine to remove the sand from the water |
| T1 | Over there! |
| S3 | [a small filter!] |
| T1 | Yes, they [tried] to make it good to drink… then it is obvious, they had different physical characteristics and capabilities to ours so [the system] |
| S1 | [They were more accustomed to…] |
| T1 | Their immune system; they were able to defend themselves; maybe today, we’re used in a different way… but… is there any other aspect that comes to your mind? |
The teacher’s attitude of acceptance and the revival of the question posed by the student opens a parenthesis which lasts for 8 minutes, during which, through dialogue, the entire class is involved in an interactive process that enriches both subjects (teacher and students), and that builds new connections between prior knowledge.

**BIO-EDUCATION, SIMPLEXITY, NEUROSCIENCE AND ENACTIVISM**
Video analysis also highlighted that the behaviour and the postures of the students in the classroom has changed compared to the episode before the dialogic parenthesis.

In the previous episode, the teacher is sitting in the chair, while four students are standing next to him in front of the other students, and only three or four children are sitting and are following the lesson with interest. Among the other students, some are resting lying on their desk, others are chatting in a low voice, a couple are manipulating a pencil making marks on the bench, and one is playing with a toy car. There are few students who are looking towards the teacher.

While the students, who were standing up, are coming back to their benches, S3 asks the question: “regarding food… there is one thing that has not improved and neither has worsened” …

The teacher reacts immediately “I like what he’s saying about food” (towards all of the students in a high and firm tone of voice); and the children that were distracted turn towards him to listen; the others, who were standing up, sit down quickly. After the teacher’s second sentence, the other children focus on him, and a student that was sitting relaxing on a chair stands up in an upright position to follow the speech. When the teacher requests for a contribution, five children raise their hands, and even those who do not participate have changed their positions on their desk. They are sitting on their chairs, but with their backs straight, or they are kneeling. A few of the students continue with their other activities. Furthermore, the majority turn their gaze to the subject who in turn is speaking.

At one point, the teacher invites the children on the right-hand side of the classroom to speak, but they seem to be less involved.

During all of the time of the dialogue, the teacher is on the sidelines, sitting near the window, in order to put the class group in the centre of the scene and to make it the protagonist of the dialogue.

When the teacher closes the parenthesis with “We were a bit caught up there, let us go back to reading the text…” we perceive a reduction of emotional tension and many children take up their previous positions on their chairs, indulging in the class once more.

Throughout the discussion, 5 children are more involved, while the majority listen with interest looking up to the speaker. Only 3 children have continued with their activities.
Episode 2 begins with the following exchange.

<table>
<thead>
<tr>
<th>S1</th>
<th>If after a thousand of years, these people (historians) begin to study how we lived, will they forget about the Egyptians?</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>You've come up with a great question!</td>
</tr>
<tr>
<td>T1</td>
<td>In your opinion, why is history important? Can people in the future forget about the great civilizations of the past to study… just our civilization?</td>
</tr>
</tbody>
</table>

There is a pause for reflection that lasts 3 seconds.

In this case, the teacher uses a rhetorical question to guide the continuation of the debate, and this dialogue, then highlights the relevant aspects of the epistemology of history and its purpose, thanks to a statement by the student.

Episode 3 begins as follows:

<table>
<thead>
<tr>
<th>T1</th>
<th>The Sumerians used writing to record who had paid tribute and what he had paid.</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Teacher… but the amount of what they had paid depended also on the quality of… The teacher smiles, takes time, almost 6 seconds, then</td>
</tr>
<tr>
<td>T1</td>
<td>That is a wonderful question! Because of the quality, right… if I have to pay a tribute, I have a box of apples, and I give you all the… […]… it is a great question… and there is also a logical reassignment… I can answer that… I do not know… Indeed… What do you think? You have to answer, not me!</td>
</tr>
</tbody>
</table>

**Experimental Data (Teacher 2)**

The lessons of a second teacher have been analysed. We report a single episode, in which an event emerges. The episode has the following opening.

<table>
<thead>
<tr>
<th>T2</th>
<th>Shows a copy of a conceptual map on the issue of Australopithecus</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2</td>
<td>What does this remind you of?</td>
</tr>
<tr>
<td>S</td>
<td>Something in the text!</td>
</tr>
<tr>
<td></td>
<td>Some in choir;</td>
</tr>
</tbody>
</table>
The students then support their analysis and the teacher shows how their observation has changed his idea modifying the flow of the lesson.

The context in another episode, relating to the same second teacher, is the collective reading, followed by guided underlining, with the addition of information from the teacher.

<table>
<thead>
<tr>
<th>T2</th>
<th>For several years, they lived contemporary to Neanderthal man… what does that mean?</th>
<th>T2 reads and then asks</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>they lived at the same time.</td>
<td>In chorus.</td>
</tr>
<tr>
<td>T2</td>
<td>The sapiens sapiens Man is an evolution; but at the same time, in the same period, Neanderthal man and homo sapiens sapiens both lived together in the same place</td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>In fact, the DVD shows that Neanderthal man moved because homo sapiens sapiens invaded the places where he lived…</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>Oh… look, S1 is giving an input… repeat aloud please… […]… this observation. This is very beautiful; we will finish the lesson today with this concept and re-open tomorrow!</td>
<td>A discussion in class starts</td>
</tr>
</tbody>
</table>

And again (Episode 2):

<table>
<thead>
<tr>
<th>T2</th>
<th>Where there are big natural disasters, what do people do? They move away if they can!</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>But they don’t invade another place!</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>Very good! S1 has said something very important!… which is the difference between the conquerors who go to other lands, and those who go away to… I do not know… let S1 answer to this question. I had not planned this; however, it’s a very intelligent remark!</td>
<td></td>
</tr>
</tbody>
</table>

From the video analysis of the third teacher, we have not detected any possible disruption on a first reading. A closer analysis, however, highlighted that dialogic situations were created, thanks to questions posed by the teacher himself, who plucked conceptualisations previously expressed by the students during their activities, or took into account the misconceptions in the literature. Even in this case, the questions generated a different level of attention in the classroom. They expressed both the desire to par-
participate in the debate, and showed their interest, indicated by the different postures that they adopted.

The Videos and the Research through the Case-Studies Analysis

The analysis of the video recorded allowed us to discover special routines that the teachers put in place while they were not aware of them. The first teacher, for example, always adopted the same routine, but he became aware of it only after re-viewing it and after a discussion with the expert:

1. At first, he welcomed the question with a giggle. 2. “Beautiful question!” 3. “Well, I would say…” 4…“No, try to answer by yourselves…”

The sequence of actions described reflects the dynamics of the decision analysed by Alain Berthoz (2004, 302), recalling that the brain, when making decisions, evaluates “the difference between the forecast and what really happens”. The initial phase in which the teacher faces the event that suddenly appears and breaks the ordinary course of the lesson is designed as a moment of acceptance of the new (“I did not want to start from here”) and a further distancing.

According to Berthoz, in fact, the decision making process involves three elements. The first element is to keep in the memory the present, and simultaneously, retrieve the past, in order to be able to identify the elements that are capable of providing clues to act appropriately. The second aspect of the decision process, in fact, requires a quick and almost immediate assessment about gains or losses that may result from a choice that leads to an estimation of the elements involved and to a projection of future developments that may result from the choice.

The temporal dimension in this process is extremely significant: the teacher has to take a decision very quickly, and this leads to a necessary selection of information, that can be perceived in a hierarchical manner, through a process of supervisory attentional systems (Miller, Cohen, 2001). This highlights some of the visions and perceptions of the class and the context in which the event takes place. The third element of the decision-making process in the situation described is the desire to root the decision in the reality of the moment, so that the choice of the teacher to grant the application and raise the question, asking for the active involvement of students, in response to a perceived need to involve the class in the management and development of the argument.
Finally, it could be said that the decision develops a “movement back and forward between the intention of the action and its end” (Berthoz, 2004, 66). It is made explicit in the sequence and indicated by the behaviour of the teacher and his verbal interactions.

The presence of routine is common to all of the teachers’ activities and emerges especially in the critical moments when the teachers need to decide quickly. In such a situation, automatic, consolidated behaviour prevails, rather than the behaviour suggested during the didactical event. The viewing of the video allows the teachers to highlight their routines, to become aware of them, to improve them, and to understand the situations in which they have performed most effectively. In addition, it improves the personal luggage of each teacher for coping with particular cases of emergency. Training teachers to assume behaviour or their best practice would not have the same impact on the action in the case of “emergency”, because of the role of automation in such situations, the importance of the teacher’s habitus in the teaching and the situated characteristics of the teachers’ actions.

The event is episodic and contextualised, and it could raise a doubt about the usefulness of the proposed analysis for educational research.

In fact, although it is not possible to transfer or re-perform what has already happened, from the examination of the video several invariants and routines come out. They can affect two important issues for teacher training: the relationship of the teacher with the event and the relationship between linear and dialogical approaches.

First of all, how to react when faced with an event?

Examination of the video shows three possible answers that the teacher can display when faced with the event:

1. The teacher does not recognize what is happening as an event occurs or, if perceived, he/she does not express this perception. The teacher does not consider the event and proceeds on his/her path; the teacher ignores the event; or he/she considers it not useful to address a deviation from the planned lesson.

2. The teacher recognizes the event, but postpones the discussion to another time. The teacher points out what happened with phrases like: “The question is interesting, but we will answer it at a later time” and/or does change his/her path, or only marginally and in a controlled way, but highlights the question.

3. The teacher collects and manages the event. The event becomes a
moment of questioning of the two perspectives and strengthens an attune-
ment. The analysis made on the videos show that the teacher emphasises
the question, does not hide the initial disorientation, and also brings out
explicitly the role of students in the reorganisation of the route.

The video of the episodes reported in sections 3.2 and 3.3 were reviewed
and discussed and there were some reflections about how to act toward the
event. The teachers emphasized the role of time, and the search for an epis-
temological coherence between the deviation and the global path to take. It
also emerged that the more experienced teachers, who felt themselves more
competent, are more than likely to accept the event.

All of the videos were analysed by the researchers and the disciplinary
experts have found out some interesting questions that have arisen from
the students that the teacher had not perceived. During the “co-explicita-
tion”, the discussion between the teachers and the researcher, following the
analysis conducted by the researcher (Vinatier, 2011), the researcher asked
the teachers why he/she had not collected a given question. The teachers
answered that they ignored a question only when they did not perceive
the question as an event, or when they believed that the question would
be dispersive and feared not being able to control the dynamics. In such
a situation, the teacher stated that he/she was so concerned about the be-
haviour of a child, that he/she had not noticed the statement, while, in a
second situation, he/she had not seen the epistemological significance of
the question.

The analysis of the events highlights the variables that the teacher si-
multaneously monitors during the teaching action. Although the event is a
unique and unrepeatable process, it is possible, thanks to the vision of the
video and to the subsequent discussions, to make the teachers aware of the
variables in context, to know how they act in emergency situations, and to
discover how they place themselves and act in front of the event.

Through the analysis of the sequences, which follows the work done in
class, the teacher takes advantage of a larger amount of time to deal with
the live action. He/she makes the different systems (the teacher, the stu-
dents, the class) the object of his/her study, to identify those moments that
become relevant for the development of the teaching sequence itself. The
presence of more professionals, teachers and researchers, involved in this
path of co-analysis, offers the chance to examine verbal communications,
behaviour and productions, each of them with its power in influencing the
others. Identifying the modalities, with which we create a we-centric space in which the unit’s dialogue makes us explore the decision of the subjects in action, mostly implicitly, and that guides the choices towards one of a possible world that can be created.

Teaching and learning represent a situation of co-determination that needs to be deepened to give visibility to that dynamic between productive and constructive processes (Rabardel et al., 2004; Altet, 2012). While people act, they create objects, interactions, and situations that represent, at the same time, the fundamental space-time for the identity construction, both for the professional teacher and for the student. The perception of change, as a system in dialogue with other systems, is to be investigated and to be made explicit, in order to offer a further contribution to the professionalism of the teachers, who are not just involved in listening to the situation that replies to their interventions (Schon, 1993), but also perceives themselves as a unit, with dialogues, that affect and build conceptualisations in relation to the situations. The research of different trajectories to deepen the awareness of the teacher finds, in the enactive perspective, an interesting space to make explicit the modalities of dialogue, the answers and the decisions, the conceptualisations, the true objects of study in the development of the professional identity.

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**Notes**

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