# Learning in Cognitive Niches

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Additional information is available at the end of the chapter

*"Once the hegemony of skin and skull is usurped,*
*we may be able to see ourselves more truly as creatures of the world"*

Andy Clark and David Chalmers

## 1. Introduction

In 2002, the first season's first episode of the Brazilian TV series City of Men, named "The Emperor's Crown", began with a scene of a History lesson in a public school of Rio de Janeiro. The teacher described the facts related to the journey of the Royal Portuguese Family from Portugal to Brazil in 1808, to escape from the threat of Napoleon's inbreak. She used a map of the Western World as a support to locate some countries involved in important historical events in the early nineteenth century: France, England, Germany, Italy, Russia, Portugal and Brazil. The children, characterized as students who lived in the slums built on the hills of Rio de Janeiro, asked questions about information not given by the teacher, but objects of interest to boys and girls familiar with the slum environment in Rio: modern weapons handling, war, violence and death. Some students expressed that the subject of the lesson was not clear for them (one of them thought that there was a participation of the Ancient Romans in the episode), and some had problems about the meaning of some words, such as the polysemous Portuguese word "coroa" (in English "crown"), but their doubts and questions were not solved by the teacher.

At the end of the episode, one of the students, called Acerola (actually a nickname), faced with the need to repeat the information given by the teacher, went towards the map and transposed the History of napoleonic invasions to the current reality of Rio: the countries became hills, each one of them managed by a head, who behaved as a brazilian druglord; the trade of manufactured goods and raw materials, which were pivotal do the emergent industrial capitalism, became drug trade; Brazil, which was a colony of Portugal at that time, became an immense and available space for occupation, conquer and mightiness. But

in Acerola's narrative there was still a great lord who wanted to be the biggest leader of all the neighborhood, and for this aim he sent agents he trusted to govern the conquered territories and eliminate possible or real enemies.

Acerola's explanation reveals that he has clear in his mind that the Portuguese Royal Family had to scape to Brazil because of territorial dispute and power interests in 19th century, but we cannot ensure if he knows that, as he "repeats" the teacher's story, he talks about Napoleon, and not about some druglord; and about Europe, not Rio de Janeiro. In other words, by now we cannot be sure that Acerola understood that the invasions and contentions of the 19th century did not happen in the same terms, motivations and conditions which outline many events that we witness nowadays.

This chapter is about Acerola's speech, and the learning questions it arises: can we assert that Acerola really learned the teacher's lesson? What criteria should we employ to say that he learned it or not? If he only had repeated the teacher's words, this could mean learning? To what extent the interference of his previous knowledge about social problems in Rio over those historical facts ceases to be learning and starts to be free interpretation? And as to the map, which was a didactic artefact for both, the teacher and Acerola: is it the same object in both narratives, or could it be, respectively, a map of Western world and afterwards a map of Rio de Janeiro? Or could it be a third thing whose existence lasted only during the time that Acerola told his version of the story?

Whatever the answers we offer to these questions, they do not belie the fact that Acerola actively interacted not only with the contents expressed by the teacher in such a way to deeply alter them, but he also changed the object around which the lesson was taught – the map. Therefore, our answers must take into account his important agentic actions over the classroom setting, and the fact that these actions are closely related to his degree of learning.

To argue about these issues, this chapter aims to present the theoretical basis for observing learning as an agentic accomplishment based on a two-way affectment between the learner and the environment, and as an "adaptive reorganization of a complex system" (Hutchins, 1995, p. 289). As we define this theoretical basis, we need to raise three important criteria in order to not only discuss issues brought up on the observation of Acerola's actions in the classroom, but also establish how we can adjust this concept of learning to institutional terms: what is the view of cognition which allows us to recognize learning not only as internalization of concepts but also an action over the environment; what is the constitution of the learning environment which allows this twofold relationship; through which means it is possible to observe the didactic artifacts found in this environment, and how they contribute and are representative for learning as a cognitive action of constitutive interchange between person and environment.

This three criteria lead us to observe cognition in a distributed fashion, in order to postulate that the use of the environment in the cognitive elaboration does enhances cognitive action, through the access to more resources available than the neural apparatus.

This idea, called the Distributed Cognition Hypothesis, enables us to establish for the learning environment the status of a cognitive niche: a dynamic setting where cognitive actions modify the cognizer's behavior and also the environment features and properties, including everything which can be perceived in there.

As to the learning niches, it is important to discuss the idea of affordances, features that emerge from the meaningful relationship between species and environment and are fundamental in the discussion about concept formation, learning, and the value of cognitive artifacts employed in didactic practices.

To speak about these issues we are guided by works on cognition which propose a specific mode of observing human actions and cognitive behaviours which establishes that the very act of thinking is not bounded to the brain and the visual system; rather, mind is constructed in a process that includes brain, body and the environment around them. Under this view, the person is someone able to, through reasoning, planning, learning and many other cognitive actions, change himself/herself and the place where he/she lives, interacts and develops.

These premises enable us to relate ideas on environmental perception to facts of conceptualization and meaning construction. Ultimately, it broadens our understanding of what is learning and favors the formulation of pedagogical projects based on the understanding of the learner's cognitive behavior in the classroom environment. In this sense, pedagogical projects which observe the artefacts of the environment as learning resources can accomplish a more productive and authentic relationship among the learner, the contents to be learned and the forms of learning.

The next sections briefly discuss the Distributed Cognition Hypothesis, which is the context of the studies on cognition which emerge from the possibility of observing the ecological dimension of the aspects related to cognitive actions, their motivations and effects. This perspective leads us to recognize the cognitive niches as a level of analysis for studies of learning within the school institution. Subsumed to the idea of cognitive niche, we stress the notion of affordance as a central component of the niche, and the forms of thinking about learning in cognitive niches through the perspective of the detection of affordances. We will focus specifically on didactic actions which can conduct to good or bad results in classroom activities.

## 2. The distributed cognition hypothesis

The Distributed Cognition Hypothesis (Clark and Chalmers, 1998; Hutchins, 1995, 2000; Sinha, 2005, 2010; Bardone, 2011, among others) brings the idea that the continuity among brain, body and the environment structures cognition. Following this premise, studies on distributed cognition are concerned about identifying and describing cognitive processes in terms of the relationship between person and environment.

The works affiliated to this hypothesis propose the rupture of the boundaries between internal and external representations and domains of experience, and generate new prospects for the view of what cognition is: no longer biased to the internal or the external

factors which compose it, but requiring mutual and constitutive relationships between these domains (Zhang and Patel, 2006; Franks, 2011), which are evinced through cognitive processes.

The structural connections between species and environment are basically justified by the need to access extra material and symbolic resources that cannot be found in the brain, in order to accomplish the cognitive task posited to the person. The possibility of implementing these connections is recognized as an evolutionary feat of the *Homo sapiens* and some other species, and it exists for the fact that the complexity of our neural system sanctions the activity of incorporating features not foreseen by the genetics. This property demands the search for environmental artefacts in order to create, acquire, manipulate, and storage information and knowledge, to fulfil specific purposes of cognitive action and make correct and suitable decisions.

The ideas about the nature of cognition in an extended and distributed perspective bring, as a real challenge, the need to investigate the boundaries of the units of analysis in studies of cognition, and the set of mechanisms involved in cognitive processes (Hutchins, 2000). These two axes of investigation on cognition must take into account all domains of human existence, which are now seen not in an atomistic fashion, but as an integrated universe. They are respectively related to the concepts of cognitive niches and affordances, hence the importance to take into consideration these two constructs in the study of cognition and settings where cognitive processes and actions are at stake.

In order to do this we assume the non-previous ontological existence of information and features in the environment, because they cannot be found outside the cognizing field. Rather, the emergence of these features is associated to our comprehension that the identification of a given property of an object (which can be found in several other objects) is related to a particular use that we make of it (Bardone, 2011). According to this, it is possible to assert that the very perceptual detection of an object and its properties is constituted by the goals of physical and cognitive actions which justify its presence in that environment. In other words, we will not see anything in an object if it is not included in the universe of action possibilities in a given domain. We will not even see (in a perceptual sense) this object.

The constituents of the external domains can assume several and different tasks in cognitive construction. They were summarized in Zhang and Patel (2006, p. 335) and are transcripted below:

1.  Provide short-term or long-term memory aids so that memory load can be reduced.
2.  Provide information that can be directly perceived and used such that little effortful processing is needed to interpret and formulate the information explicitly.
3.  Provide knowledge and skills that are unavailable from internal representations.
4.  Support perceptual operators that can recognize features easily and make inferences directly
5.  Change the nature of a task by generating more efficient action sequences.
6.  Stop time and support perceptual rehearsal to make invisible and transient information visible and sustainable.

7. Aid processibility by limiting abstraction.
8. Anchor and structure cognitive behaviour without conscious awareness.
9. Determine decision making strategies through accuracy maximization and effort minimization.

All the tasks stressed above are useful for studies on Education and learning. For example, the first one seems to be the main purpose of writing in a broad sense: they are "collective memory banks" (Donald, 1991, p. 311), which help us deal with the need for quick calculi, and retain and transmit information and knowledge. The map used in Acerola's (and the teacher's, we need to say) History lesson fits many of them, including 2: when Acerola employed the map of the 19th century's Western World as if it could portray the reality of 21st century's Rio de Janeiro (hills instead of countries and druglords instead of kings and emperors), he saved the students and himself from mentally launching themselves towards a space and time which they did not participate. So he liberated their minds for the important ideas of the lesson: the circumstances which led to the Portuguese Royal family getaway in 1808.

The duty of recognizing how external representations can contribute for a satisfactory learning task can be better accomplished if every cognitive action is done with clear purposes. They define not only conceptual choices, but also the perception of the objects and their properties, the facts that occur in learning settings, the quality of the use of the features proposed by Zhang and Patel, and, since other people are part of the environment, the ways that the person will interpret the actions of his/her co-specifics. In this sense, goals, and also the problems that must be faced in order to fulfil them, are a kind of an external regulation which structures our actions, conceptualizations and joint commitments (Tummolini and Castelfranchi, 2006; Carassa, Colombetti and Morganti, 2008). Therefore, we can say that our cognition is essentially normatized by these features; normativity is present in the selection of the functions and boundaries of the environment, the perception of its features and the forms of relationship with our co-specifics.

Normativity, materialized in the goals for cognitive actions, is thus seen as a structuring factor of our way of thinking and social life as well (Tummolini and Castelfranchi, 2006). The assumption of normativity in these terms brings benefits not only to the study of the human being and his basic perceptual and conceptual experiences, but also to the social, cultural and institutional realms:

"In the continuist model of nature and culture [...], cultural norms do not have necessarily intentional or mentalist origins. They can arise from the phylogenetic and ontogenetic readiness of well-adapted beings to learn and use social forms and regularities as a basis for inference and action, which ends up loading them with a normative weight" (Kaufmann and Clément, 2007, p. 10).

Normativity can be found in high-level cognitive action (Schmidt, Rakoczy and Tomasello, 2011), and so as in Acerola's speech. He is doubly regulated from the relationships between him and the teacher, on the one hand, and between him and the students, on the other hand.

They both at the same time compel him to built a kind of discourse which satisfies his didactic necessities: to minimally repeat what was said by the teacher, selecting the facts which defined the fugue of the Royal Family to Brazil, and accomplish this task in conditions to say things which can be meaningful to the students. To do this, he accesses the previous knowledge related to their own space and time, and leads them to understand what motivated facts occurred in another space and time. He could not be successful in his enterprise if he had not taken this twofold goal into account.

## 3. Cognitive niches

The History lesson depicted in this chapter is an event occurred in a highly institutionalized environment – the classroom, where we can find very specific social and cognitive practices. As to institutional contexts of learning, it is the most immediate level of analysis of these accomplishments, and is considered here as a cognitive niche.

A cognitive niche is a dynamic setting established and associated to the adaptative relationship between people (among other species) and environments. It comes from the idea of ecological niche in Evolutionary Biology (Cosmides and Tooby, 2000; Clark, 2006; Bardone and Magnani, 2007), and it is related to the dynamics of the adaptation mechanisms developed for living in different environments and habitats. A good definition for niches is given by Sinha (1988, p. 131), and fits perfectly the Distributed Cognition postulations: "a niche is a negotiated, ordered, spatial-temporally structured relationship between organism and habitat, in which behaviours are in part transformative of the environment to which they are adapted". Like any ecological-environmental structures constructed by many species, cognitive niches are made for protection and survival, a better perception of the environment, facilitated access to resources and resolution of immediate problems. As a result of the person's action, cognitive niches become meaningful settings wherein people can create tools and techniques, and develop abilities. This perspective brings possibilities to observe the ways in which the capacity of creating and maintaining niches give people the opportunity to develop themselves cognitively and learn, and favour the cultural and material enrichment of social groups.

Evidently, the idea that cognitive development and learning presuppose the person integrated to the environment is not new. It can be found for example in Vygotsky's work (Vygotsky, 1987), and substantiates influential theories such as the one presented in Tomasello (1999). But now the cognitive transformation proposed by these authors can be seen together with the fact that learning can also affect and re-structure the environment around the learner.

The idea of cognitive niches employed in studies of learning environment presupposes the articulation between concepts originally associated to perceptual mechanisms and theoretical constructs related to conceptualization and learning. This association is possible due to the fact that perception and conceptualization are strictly associated phenomena. Articulating this account to studies on cognition and learning can bring to light several phenomena and also expand our notion about learning, as this action allows us to define

with more accuracy what components are desirable and what variables must be observed for a learning task to be accomplished.

The definition of the classroom as a cognitive niche, taking into account all the variables delineated above, can help to create for the students an atmosphere auspicious for their success in school, because it opens space for a reliable observation of issues, processes and artifacts associated to learning, and for a specific study of the school environment, which is a setting whose features and behaviors are already known by learners and school agents.

These actions take, as a core point, the student's cognition and knowledge as constitutive features of every learning accomplishment. Therefore, if we seek to understand the basis of the cognitive actions of the students, we will be able to perceive, from how they think, who they are, instead of establishing in advance who they will be, and from this prescribe how they learn – a criticism posed by many authors who problematize the institutionalized learning and meaning construction (Walkerdine, 1988; McDermott, 1993; Lave, 1993; Sinha, 1999, among many others).

In this chapter we are focusing on the cognitive niche as a setting constructed through a dynamics related to the understanding and engagement in interactions wherein intersubjectivity negotiations, normative crossings and possibilities of re-semiotization to solve problems of meaning (and recreate meanings as well) are at stake. It can help us assume cognition in a situated becoming, where things constitute an intersubjective flow of negotiation and (re)semiotization of the structuring features of our cognitive construals of the world.

In the History classroom niche that we are observing, two different events unfolded relatively to the goals of each one, to the learning conditions of each information, and from the establishment of who talks and who listens – since both exercised an agency over the cognitive processes that take place in that setting. In both cases, the niche remained the same as to its basic constraints, but each event made it work under different conditions, which were caused by the change of roles that the contingencies determined.

When the teacher was the keynote speaker, the intersubjectivity conditions were defined in advance and not negotiated; rather, they were established in such a way that the students had to strive to transport themselves to the space-time depicted by her. Their previous knowledge was not accessed, because the teacher did not fulfill the task to bring information and contents of their everyday lives to the semiotic construcion in the classroom setting. The result was that there were free associations and a few actions of re-semiotization of material and symbolic objects to meet the needs of understanding. The possibilities of learning were not favored.

However, when Acerola was the keynote speaker, some diferences in the niche were observable: there was more intersubjective negotiation, promoted by the fact that Acerola and his colleagues dealt with the same everyday reality, thus he had the chance to bring and add common knowledge to the semiotic construction in the classroom, and helped them understand the contents of the lesson. This could have helped him fulfill his task.

As to the intersubjectivity conditions which are specific to the classroom niche, we still need to stress that the possibility of the success of Acerola in interacting with his colleagues because they all bring together the same previous knowledge does not justify the failure of the teacher. On the other hand, having commom and shared everyday previous knowledge does not guarantee the teacher's success in promoting learning in the classroom. Rather, one of the fundamental actions for minimal conditions of referential intersubjectivity (Sinha and Rodriguez, 2008) is the recognition that the previous knowledge of the learners is a constitutive feature of the didactic practice. This condition allows them to build bridges between what they already know and the new information that the teacher is offering them. This is a basic didactic prescription and keeps its value in all perceptions about cognition and learning, whether or not distributed.

## 4. The notion of affordance

In the construction and maintenance of cognitive niches, the detection of affordances (Gibson, 1979; Norman, 1988; Zhang and Patel, 2000; Hutchby, 2001; Chemero, 2003; Gorniak and Roy 2007; Bardone, 2011) is a result of cognitive actions and emerges from the seek for artefacts available to fulfil specific action goals. They are not previously offered, but subespecified by the aims and/or norms for existing in a given environment.

Apart from the discussion about the source of affordances – whether they are detected via direct perception of objects, taking the line of study of Gibson (1979), or whether they encompass cognitive processing and previous knowledge, according to the alternative proposal of Norman (1988), if we observe them against the premise of the constitutive relationship between person and environment, we can establish that they are not *in things*, nor *in us*:

> "Affordances are the primary entities that are perceived, and perceiving affordances is perceiving the meaningful world. Importantly for current purposes, affordances are not merely entities in the environment, and they are also not projections of meaning by animals onto a merely physical environment. Affordances are features of animal–environment systems, and exist in such systems only in virtue of animals that have the appropriate abilities to perceive and take advantage of them" (Anderson and Chemero, 2009, p. 306).

Likewise, considering affordances as an important concept in Cognitive Psychology represents recognizing that cognition is a situated and, above all, qualitative dynamics, based on principles which define the values of things in environments, due to the fact that what is conceptualized as an affordance is something which can be useful to solve some problem and achieve some goal. Thus, in this sense, we can repeat Gibson's words (Gibson, 1979, p. 140), also quoted in Bardone (2011, p. 78): "The  perceiving of an affordance is not a process of perceiving a value-free physical object (…) it is a process of perceiving a value-rich ecological object". But we can add that these objects are ecological as well as conceptual, and they are also a reliable source for us to understand, from our choices of what is

important in a specific enterprise, what constitute our identities situatedly established in each context of action and thought.

This idea allows us to connect the concepts of affordance and cognitive niche in a Distributed Cognition perspective: the possibility of recognizing affordances in a specific setting is directly related to the recognition of this setting as a niche. The opposite can also be said: if the person is placed in a given environment and is not willing to recognize affordances (or something else) in that environment because he/she does not have any purposes to be there, it is quite possible that he/she does not recognize that setting as a real cognitive niche.

This fact reveals the extent to which what we see is tied by our goals of being there. It is in this sense that we construct cognitively the possibilities of affecting environment and being affected by it. In this perspective, the detection of affordances is an activity that, besides requiring and revealing intelligence, improves procedurally the intelligence of those who detect it (Dennett, 2000; Franks, 2011), because it is a procedure closely connected to the semiotization and re-semiotization of things, and is also an action that brings new things into existence.

If we take into account that affordances are built under the functionalities and contingencies of cognitive actions in a given niche, we can assert that material artefacts in the classroom can be affordances, to the extent that they are seen as something functionally useful in specific moments. In this sense, their functions can be re-created as this action becomes necessary to solve new problems.

So as the map used by the teacher and Acerola. The teacher has used the map in its prototipical function, but Acerola, as he delivered his lesson, he brought into existence a new kind of map, which came from the blending of conflicting dimensions: the Western World of the past, and the Rio de Janeiro of the present. It is not possible not necessary to design and manufacture a specific map which can bring these specific information. But it is possible to conceptually build it through the interaction of the determinant features of Acerola's and the teacher's speeches. He did that this way because the teacher's map did not fit his need to adapt the previous knowledge of the students to the information of the lesson.
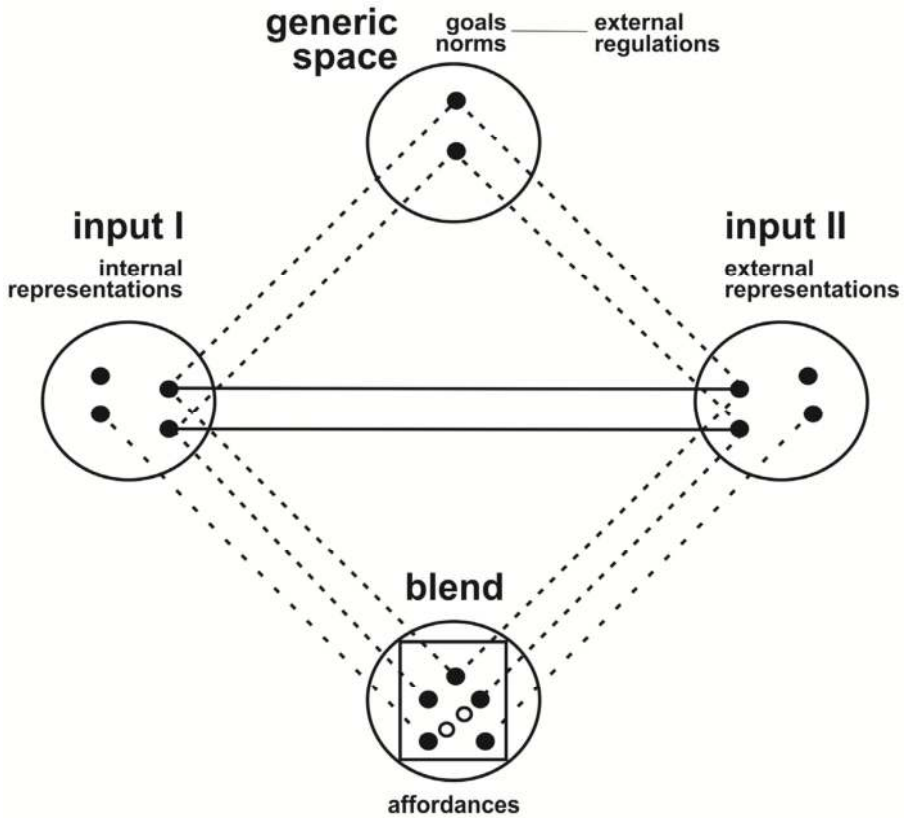
## 5. Affordances and conceptual integration

The cognitive operation which describes the relationship between internal and external domains is called *conceptual integration* (Fauconnier and Turner, 2002; Sinha, 2005; Zhang and Patel, 2006), a general process which accounts for phenomena in low and high level cognition, as well as perceptual phenomena. Also known as *blending*, conceptual integration is the term which gives name to a net of sophisticated processes which subsumes relationships among domains of every kind and the creation of novel artefacts, ideas, techniques, etc. Conceptual integration is also used to describe online construction of meaning in every domain of experience. In the blend, features of these domains are coupled according to the aspects they bring which are relevant for the specific aim of the cognitive processing. There are no

constraints for associating these domains and features, but these aspects are detected from the emergence of a generic space which opens the possibility that these features and domains be blended. The effect of the blend, located in the blend space, is the new "thing" – meaning, representation, concept, affordance and many other accomplishments, which carries features of the inputs but brings traces of its own (Fauconnier and Turner, 2002).

The detection of affordances is also in charge of conceptual integration. As elements found in the blend space, affordances can bring features which are unique entities in a unique event of mutual and transforming situated interchange between person and environment. This premise is important for us to detect the sources for the meanings and affordances produced in the niches, and what constitutes them.

The basic structural model for conceptual integration is summarized by Fauconnier and Turner (2002, p. 46) and adapted to the perspective proposed in this chapter.



**Figure 1.** Structural schema of conceptual integration – detection of affordances

The conceptual integration model (blending) associated to affordances is of the double-scope kind (Turner, 2008). It occurs when the inputs are formed by different domains

(Turner employs the term "frames") which do not share the same organizing structure – in the case of affordances, differently structured external and internal domains. The input spaces are filled by, on one side, the internal representations of the person, and, on the other side, the environmental representations. In this operation, the normative component includes the goals of cognitive activity; it embraces the generic space which allows the possibility of articulation between the inputs, and defines some terms and directions of the blending operation.

The blending scheme predicts that, although the input spaces can be filled by distinct domains, they can present matched counterparts (indicated by the full line). It also presumes that the formation of new concepts assumes an autonomous nature in relation to the inputs (signalled by the white circles), and admits that the effect of the process can function as input for other blending actuations. These properties turn the blending process into a cognitive processing model which can describe the detection of affordances not as the product of the construction and maintenance of niches, but as a part of the cognitive continuous flow from the bases recognized in this chapter. In sociogenetic terms, they are also a niche structuring component, providing the ratchet effect, which is the improvement of human inventions from generation to generation (Tomasello, 1999).

The possibility of describing the emergence of affordances as a blending process brings some advantages which motivate their use as a structural description for many cogntive phenomena, among them the creation of affordances in specific niches:

- It is a description which explains the relationship person-environment as a genuine cognitive process, since (among other reasons) it can be subsumed under some basic principles of non-autonomous and non-computational Cognitive Sciences, such as interdominial mapping (Fauconnier, 1997), and on-line and real-time nature of meaning construction (Coulson, 2001) – both of them clearly compatible with the Distributed Cognition Hypothesis; in this sense, it is associated to the Cognitive Psychology tradition, endorsing and refining classic studies about interactive information processing (McClelland and Rumelhart, 1981).
- It is a concept identified not only in the flow of the relationship person-environment, but also in the evolution and creation of artefacts, technologies, etc. (Fauconnier & Turner, 2002; Sinha, 2005). For this reason, it is object of interest in studies in Evolutionary Anthropology (Mithen, 1999), and Developmental Psychology (Karmiloff-Smith, 1992; Tomasello, 1999). It is used to explain and describe: in the phylogenesis, the evolutionary gains of *Homo sapiens* in his/her relationship with the environment; in the ontogenesis, the development of the person; and, in the sociogenesis, learning - in these contexts always keeping the idea that cognition can transform and (re)create environments.
- Last, but not least, it is a model which allows precise identification of the elements directly at issue in the detection of a specific affordance, without losing sight of the other features involved in the process. For this reason, it allows the managing of the context, favouring the work of those who need detailed descriptions of affordances to succeed in their cognitive actions.

Mostly, the option for recognizing affordances through describing them via conceptual integration comes from the last item above, because it satisfies the need to systematize the cognitive behaviours which, allied to the socio-cultural experiences proper to the classroom, offer a scenario of the specific conditions of learning settings.

Indeed, when we describe the conceptual construction of the map used by Acerola as an affordance to help the students understand events if the past in a context of articulation with their previous knowledge, we can see clearly which features in this formulation were at stake. We can also see how was the image conceived by him from his own conceptualizations about the dimensions included in the process: space, time and territorial definition, to be articulated to the external information given by the teacher's map.
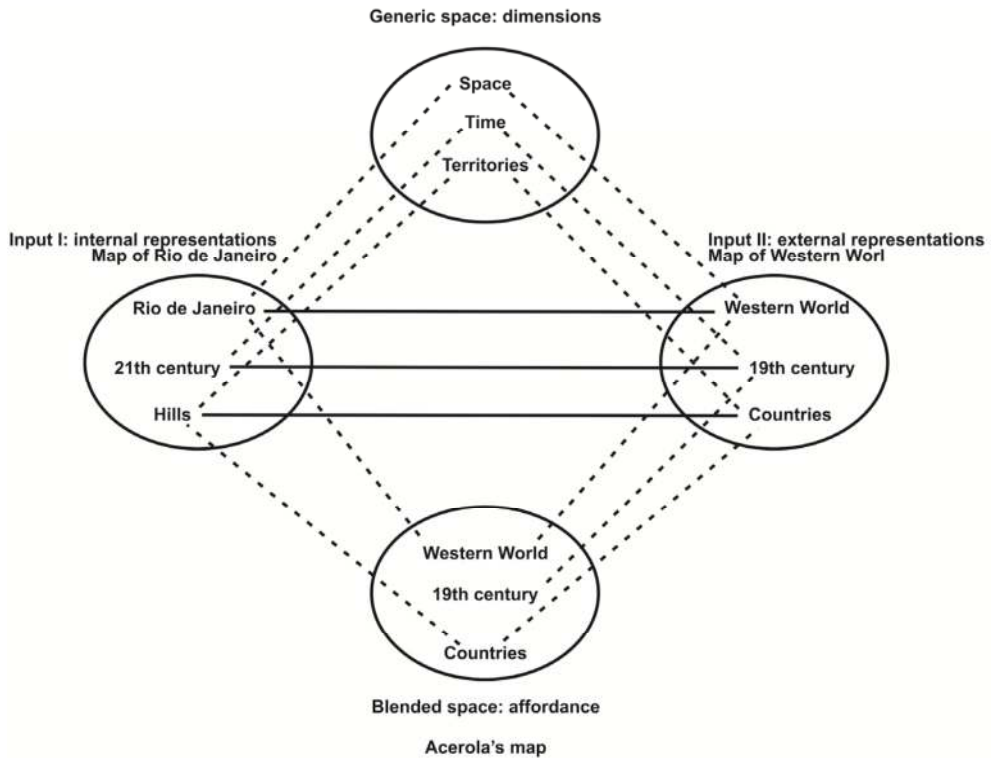


**Figure 2.** Structural schema of conceptual integration – Acerola's map

The map created by Acerola through conceptual integration, which presumes the existence of hills in the 19th century's Western World, could never exist in a supposed exact reality, let alone exist previous to his lesson, because in the 19th century there were not hills conceptualized as countries and occupied by slums. There was not even the concept of slum. As a matter of fact, the map cannot exist outside the events occurred in that niche, and outside the relationships, goals and norms that were regulating the meanings and affordances produced there.

What enables the conceptualization of a map which depicts, at the same time, the Western Countries and the Rio de Janeiro's hills is a cognitive operation called compression (Fauconnier and Turner, 2002, p. 113). It is related to conceptual integration and refers to information, concepts and dimensions which are selected and adapted to create novel knowledge structures. What we can see now is that the effectiveness of this creation can be better acknowledged when it is observed in a situated fashion, and when the purposes of their existence are taken into concern. In the specific case of Acerola's map, it results from the compression of information associated to the dimension of space: the features of two different places are compressed, and this selective operation captured only information of these places which could not crash during his speech, in order for his colleagues to understand the facts he was portraying.

As an affordance, Acerola's map was an object created in a unique and specific niche construction, to suffice his specific task of appropriating the information given by the teacher and deliver them to his colleagues. He built it through the negotiation between the need to reproduce information about History and the will to express himself in order to be heard by the students. And it is quite presumable that he has been successful in this undertaking.

## 6. Distributed cognition and school – Environments of learning

The Distributed Cognition Hypothesis proposes the agency of the environment in meaning construction and the detection of what is meaningful and important for fulfilling action goals in a given setting. These ideas provoke methodological changes in cognitive investigation (Clark and Chalmers, 1998, p. 10), as elicits new and fresh comprehensions about facts and phenomena relating cognitive actions and behaviours – learning, and also memory, language acquisition, beliefs, intersubjectivity, cognitive development, psychomotor abilities. It means that the idea of learning in cognitive niches cannot be the same as the one put by traditional theories of cognition, which usually does not consider the situated identity of the learner in educational contexts. Learning in cognitive niches, as we see, is an agentic, dynamic and creative cognitive action which includes the appropriation of institutional practices, norms, instruments and behaviours (Wertsch, 1998; Sawyer & Greeno, 2009).

Consequently, in the classroom cognitive niche, with its variety of material and symbolic artefacts, we can expect a set of cognitive behaviours and the emergence of a given kind of affordances which are specific of that niche, and are not found anywhere else – as we could testify in the observation of the History lesson depicted in this chapter.

Studies on Evolutionary Psychology corroborate the idea that the cognitive actions and behaviours identified in the classroom niche can be described as a phylogenetic achievement, due to the Developmental Psychology supposition for the phylogenetic basis for constructing and understanding cognitive behaviours related to specific settings for pedagogical actions (Premack and Premack, 1996; Csibra and Gergely, 2006). These studies favour the definition of the proper nature of pedagogy and teaching and learning actions as cognitive systems. So all people involved in teaching and learning activities are operating cognitively in a way which is specific for pedagogic purpose, and not for any other one.

Assuming these postulations, we advocate that the classroom is a delimited universe where learners, at the same time, are affecting and being affected by its structural organization, which includes the contents to be taught and the material and symbolic artefacts chosen to instrumentalize learning. They construct (= act meaningfully) over the symbolic and material artefacts offered by the teacher and the courseware, and turn them into things that they can understand, utilize. In this structured setting, any semiotic object posited as a public use is an object of negotiation, so material and symbolic artefacts are part of the intersubjective negotiation and normative regulations in the classroom.

These regulations are institutional: the school as an institution structures the way people cognize in the niche: the process of institutionalization is a specific case of conceptualization of an entity in the world; it establishes a code which specifies how an action in a certain context should be interpreted, or, similarly, establishes the sufficient conditions for the application of institutional concepts (Tummolini and Castelfranchi, 2006). Even in classrooms of different Disciplines, their common normative regulations and intersubjectivity conditions lead people to assume functionally similar cognitive behaviours, recognizing themselves as situated subjects, and to tackle with material and symbolic objects in a functionally similar fashion as well.

These assumptions, together with the observation of the meaningful acts of Acerola in his role of teacher-learner, bring the importance of taking into account the importance of the students as cognoscent agents in the classroom semiotic construction, as well as the artefacts they interact with. Both need to be framed in the classroom as an institutional space. The quality of joint conceptualization from these artefacts, which includes the way they are seen by teachers and students, is an important variable for achieving the quality of interlocution, and learning, ultimately.

One of the consequences of this perspective is establishing the student as an agent of his own learning enterprise, although the asymmetric intersubjectivity condition is one of the classroom institutional patterns: teachers must assist students in the task of turning the classroom environment in a source of affordances. The duty of the one who searches for understanding and creating good learning environments and conditions is to define the bases from which this essential task can be accomplished, and how all important features of teaching and learning must be idealized and situated towards it.

About this concern, some initial points are already established: we know that learning occours with an improvement of our capacity of observing and detecting affordances in the niches where we are settled, relatively to our goals of cognizing. We also know that the previous knowledge of a person is pivotal for him/her to detect affordances. Therefore, the more previous knowledge he/she fits to the niche, the more useful affordances he/she will be able to capture. As a matter of fact, we could see, from the cognitive actions of Acerola, that his previous knowledge and the employment of the knowledge common to all the students in the classroom structured the creation of an affordance which could help him give more understandable information to his colleagues.

Therefore, teachers need to help students detect the affordances needed for the activity at issue, having in mind that the ability of perceiving affordances is directly related to the quality

of the dynamics in the niche (Franks, 2011, p. 174). They do that by observing, before properly beginning the activity, what the students by themselves recognize as affordances in the classroom setting, and what artefacts and previous knowledge they bring to the classroom. In doing so, teachers will be identifying and eliciting the internal domains of the students which might be blended to the external ones in order for the students to detect all suitable affordances which will help them learning contents in a particular activity (Tomasello, 1999).

But teachers can only do this after having established to themselves and to the students the learning goals intended through that activity, and must be sensible to detect whether the students are keeping or not these goals in mind. This is necessary because the learners will only perceive what is important and useful for them to perform a specific activity in a given context if they know what they are performing that activity for. These actions can provide the students with more possibilities to act semiotically over the artefacts, and these behaviours are linked to their stronger singularization in the classroom, and to more possibilities of effective learning. During the years, the recurrence of this kind of action can help learners develop metacognitively (Perfect and Schwartz, 2002; Israel et al, 2005; Waters and Schneider, 2010), or, in other words, to construct their autonomy as learners, from the establishment of their own goals to accomplish a specific activity, and from the conscious employment of the resources for the established aims.

But obviously several factors can jeopardize the success in these actions, and they can be related to problems in the detection of affordances in a given environment. Bardone (2011) presents some of them, showing that these problems can be either in the person, or in the environment. Difficulties in the detection of affordances due to problems of the person are called "hidden affordances": they occur, according to Bardone, when the person cannot make use of the signals because either he/she is not enabled to detect affordances, or he/she does not see the clues for recognizing them. Difficulties in the detection of affordances for environmental problems are called "failed affordances", and occur when the affordances are badly offered or elaborated, and this impedes their identification.

Hidden and failed affordances can occur (at the same time, in some occasions) when the student does not bring to the classroom the previous knowledge enough to be articulated to the goals of action and cognitive behaviour specific of the learning task. They also occur when there is ambiguity in the configuration of the available signs, and this problem it not solved by the teacher. It also occurs when there is no clear definition of the goals to undertake a specific task in the classroom, or these goals are not offered as they should be.

Moreover, taken the asymmetrical nature of the relationship between students and teacher, the problems in the detection of affordances emerge when the teacher does not establishes himself/herself as the "triggerer" of the students' learning process, does not elicit the students' previous knowledge, and does not act upon the tasks in the classroom in order to adapt their structure to help the students detect by themselves the affordances as situated guides for learning.

That's what happened to Acerola's teacher: she was not sensitive to perceive that her students' were not aware of the time and space of the events that she was describing; that's

why she heard questions about Ancient Romans and modern weapons, but didn't bother of them. The result was that the map that she was using as a possible affordance has failed in its aim to help students construct a conceptual view of past and elsewhere events.

## 7. Final remarks

At the end of this text it is time to answer the questions we put to ourselves at its beginning.

We do assert that Acerola really learned the teacher's lesson, since we established that learning and creating concepts are cognitive operations that blend the material and symbolic objects presented in the environment to the previous knowledge of the learner, and this operation brings new, unique and singular concepts. Notice that Acerola's learning can be attested because his speech selected information with great property: he omitted secondary data about countries and names, but kept the main ideas about the historical moment and motivations for the Royal Family's journey to Brazil.

From what is said above we can say that if he had only repeated the teacher's words, this could not mean learning, because in this situation he would not show precisely the conceptual integration which is the cognitive learning operation par excellence. But we have to stress that the interference of his previous knowledge about social problems in Rio over those historical facts ceases to be part of a learning process and starts to be free interpretation when we cannot identify in his speech the data which came from the objects and ideas found in the environment available as resources for creating new concepts.

The map was a didactic artefact for both the teacher and Acerola, but obviously the latter knew how to use it as a real affordance, because he showed that he could clearly understand the task to transport the students to another place and time, and saw the map as a way to go in this journey. This turned the map into something different from a map of Western World and a map of Rio de Janeiro: a map which cannot be taken as "real", but it was completely meaningful and did pertain to that special moment they constructed in the classroom.

In this chapter we intended to deliver some ideas about learning in institutional environments, from the perspective that human cognition operates and develops itself in a distributed fashion, and within the scope of cognitive niches. Taking this premise into account, discussing how learning occurs in the cognitive niches, and defining the classroom as an essential *locus* where this operation takes place, means taking into consideration not only the person who learns, but also the relationships between people themselves, and between people and context. The best advantage that this perspective can bring lies in the epigraph of this text: the more we search to understand what cognition is, in real contexts of cognitive action, and the more we incorporate to Cognitive Science the evidence that our relationship with the world is interchanged with our ways of thinking, the closer we find ourselves to understand who we are, ultimately. And, doing so, we will be able to effectively help the students who present learning problems - which in the past were considered as their problems, but now are seen as an outcome of how the school is being constituted as a niche and as an institution, relatively to the aims it is created for.

This possibilities bring the task to improve didactic practices and pedagogic projects not only from a better understanding about learning as a cognitive accomplishment, but also from comprehending how it is possible to construct a better institutional structure for this aim. To face this challenge, the body of research in Cognitive Science, especially in distributed cognition, can bring resources for a wide and necessary institutional discussion about learning processes. And the assumption of the classroom as a cognitive niche can materialize the necessary interchange between cognitive and social sciences, because its complete comprehension demands the articulation of cognitive and cultural systems.

However, we must say that the non-autonomist and non-essentialist perspective of cognition, in which we are inscribed, is not turned to define *a priori* how people cognize in a given context. But the fact that the classroom is a normatized space, i.e., a space regulated by social and cultural constraints, elicits an attempt to establish some parameters of the way the students deal with symbolic and material artefacts, and deliver possible understandings about the intersubjective structures that can be found in the classroom. Keeping these purposes in mind, the studies on distributed cognition can ally to other achievements which have pointed to the need to problematize school as an institution – its alleged aims and the historical and ideological basis upon which it is funded, in order to provide the students with a better quality of work and learning, during the time that they are there.

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