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Review

Student's activity and development: Disentangling secondary issues from the heart of the matter

Nathalie Bulle

National Center for Scientific Research (CNRS, Paris), France

The present analysis starts from two observations. First, the notion of student activity is usually associated with what is good from an educational point of view. Second, this notion is also usually associated with constructivism, so that constructivism potentially embraces the whole of contemporaneous educational thought, to the point that, in a sense, it is impossible not to be constructivist (Jenkins, 2000; Osborne, 1996). More specifically, constructivism is based on the general premise according to which knowledge and meaning are actively constructed by the human mind. As this construction is relative to collective – scientific or social – knowledge and to individual knowledge, constructivism particularly involves knowledge theory, educational or developmental psychology, and learning methods (Matthews, 1999; Sjøberg, 2007, p. 2).

Nevertheless, the scope of constructivism is often restricted in education literature, as shown by its common assimilation to the overt, experiential, contextualized, or else, interactionist activity of students (Mayer, 2004). This assimilation is such that one of the central principles attributed to it in education is the idea that individuals construct their knowledge "by their interaction with the physical world, jointly, in social contexts and linguistic environments" (Sjøberg, 2007, p. 3; Taber, 2006). It is, for instance, significant that the scientific discussions grouped together in the collective work, *Constructivist Instruction: Success or Failure?* (Tobias & Duffy, 2009), are centered on the "situated-learning/minimal guidance versus explicit teaching methods" duality. Conversely, decontextualized and verbal types of teaching tend to be associated to student's passivity and meaning deprivation alien to constructivist aims.[1]

Therefore, by aptly promoting the idea of students' activity, constructivism tends to monopolize the good in education but – and this becomes doubtful – some dominant constructivist currents create specific norms of the good. The result is a narrowing of the way psychological research and education science develop. To address this situation, this article proposes a critical analysis of the constructivist notion of student's activity by clarifying its various main meanings. This analysis will allow us to differentiate between crucial psychological assumptions regarding the way knowledge develops and empowers the human mind.

Three major issues are primarily distinguished at three different conceptual levels: the humankind level, the individual level and the social or interactionist level. The first, epistemological, issue which primitively defines constructivism, relates to the role of humankind in constructing knowledge and, especially, the question of whether knowledge is "made" or "discovered". The second, psychological, issue relates to knowledge construction in the individual's mind. One assumption of the present analysis is that a fundamental psychological question is whether human knowledge development follows an upward dynamics – that is, based on contextual or else functional understanding – or a downward dynamics – that is, based on conceptual or else structural understanding. This alternative will be characterized by an opposition between naturalistic and rationalistic psychological approaches. The third, often promoted as a politico-moral issue, relates to the students' degree of own involvement.

The three major issues first raised are used in the remainder of the article to disentangle fundamental psychological assumptions from secondary questions attached to the constructivist notion of activity. To this end, in the second part of the article, a representation of the main psychological approaches of knowledge development is proposed, based on a two-dimensional space. The

E-mail address: nathalie.bulle@cnrs.fr.

[1] It would be fastidious to refer to the numerous texts where this association is made in education science. We find in Rousseau's *Emile* an anticipatory, provocative, form of opposition between formal learning and the development of the power of thought: "You give science - splendid. I busy myself with the instrument fit for acquiring it" (Rousseau [1762] 1979, p. 126).

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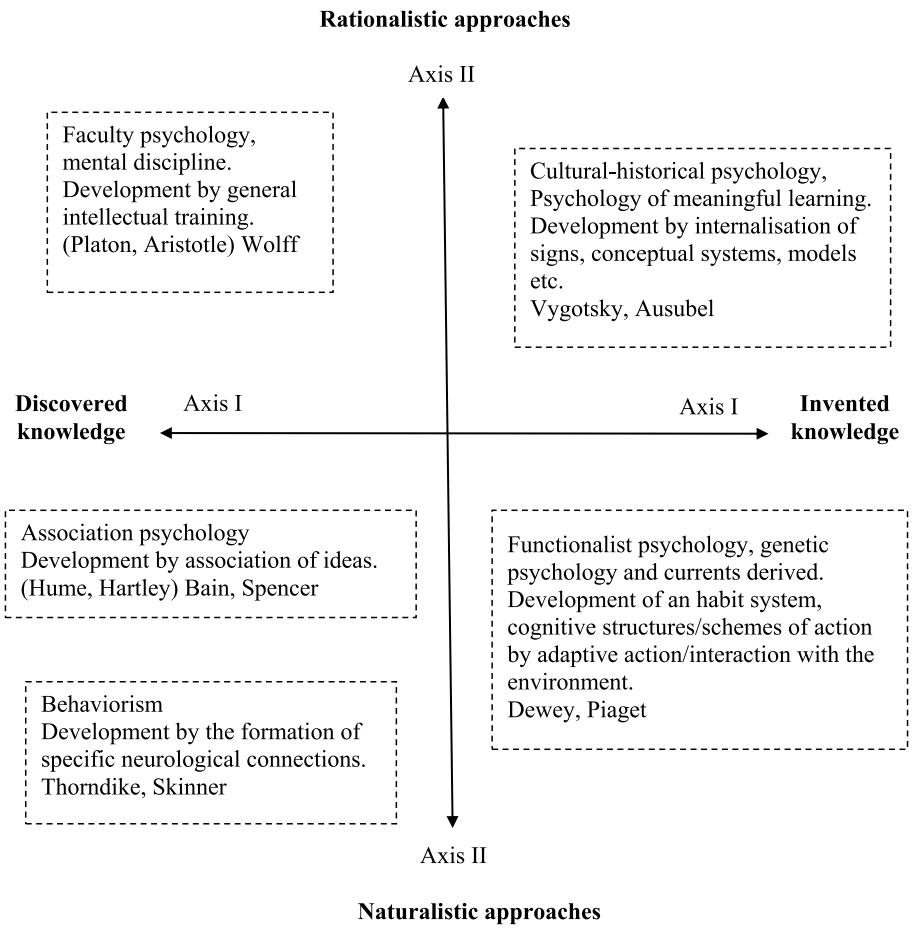

Fig. 1. The psychological foundations of modern learning theories.

psychological assumptions at stake are differentiated around the theoretical tension opposing naturalistic approaches to rationalistic approaches on an axis defined vertically, whereas various trends are distinguished depending on their positioning on the epistemological axis defined horizontally by the "discovered versus invented knowledge" tension (both axes are drawn in Fig. 1, which is discussed in section 2). In the third and fourth parts of the article, the respectively naturalistic and rationalistic broad psychological approaches are compared. Besides, the politico-moral interpretation of the students' activity differentiates methodological orientations of teaching within each psychological trend identified.

1. Epistemology, psychology, methods and students' activity

1.1. Issue I: is knowledge made or discovered?

A definition of constructivism as a theory of knowledge originally proposed by Ernst von Glasersfeld and often cited (see Kilpatrick, 1987; Lerman, 1989; Matthews [1994] 2015), involves two points: (1) Knowledge is actively constructed by the cognizing subject, not passively received from the environment; (2) Coming to know is an adaptive process that organizes one's experiential world, it does not discover an independent, preexisting world, outside the mind of the knower. Assertion (1) defines a "trivial" form of constructivism according to Glasersfeld (1989). It is obvious, as Denis Phillips (1995) remarks, that we no longer believe today that individuals come into the world with innate ideas (in the form of essential truths) or that most of our knowledge is gained by a kind of direct absorption: On the whole, human knowledge is constructed in the minds of individuals and, moreover, the bodies of knowledge developed over the ages by generations of researchers are themselves constructions. In short, whether it is the cognitive structures of individual subjects or collective knowledge accrued by disciplines, we can say with Phillips that nowadays, in a very broad, loose sense, we are all constructivists, but "God is in the details". More specifically, (1) draws a general line between constructivist approaches and the rest, whereas assertions (1) and (2) together define what Glasersfeld identifies as a "radical" constructivism (see Matthews, [1994] 2015, chap.7).

Therefore, the question, which characterizes all forms of epistemological constructivism, refers to the problem of knowing the

extent to which the world is knowable as it is, and to what extent subjects (individual or collective) impose their own mental structures on knowledge. In short: “is new knowledge, whether it be individual knowledge or public discipline – made or discovered?” (Phillips, 1995, p. 7). In opposition following this line are, on the one hand, forms of foundationalism that tend to base scientific knowledge on some secure ground. Typical examples are classical empiricism relying on sense-experience and classical rationalism relying on the power of human reason and its self-evident truths. Both pose the object of knowledge as prior and independent of forms of knowing. On the other hand, among the modern epistemologies that are, generally, constructivist in the simple sense of the term, two major paths oppose one another depending on the respective role they allocate to conceptual systems and to the notion of “experience”. According to the first, which can be associated to broad postpositivist trends (Phillips & Burbules, 2000, p. 25), human knowledge is inherently conjectural and constitutes conceptual systems that relate hypothetically to the external world. According to the second path, which can be associated to radical constructivist trends, knowledge, conceived as adaptive, is assumed to be intrinsically linked to subjects’ actions in context. Concepts thus get a functional meaning. The existence of the external world is not denied, but the notion of object disappears in favor of the notion of experience that combines subject and object. Accordingly, Glasersfeld, whose radical constructivism is rooted in the psychology of Jean Piaget, explains that knowledge refers to what we can do in the world of experience. Especially, because knowledge is supposed to be formed only in the experiential world of individuals, it cannot be transferred from a teacher to students (Ernest, 1993; Glasersfeld, 1995; 2001). As Phillips (1995) notes, these constructivist approaches, which redefine knowledge as an adaptive function, are modernized forms of educational progressivisms – which were developed under the influence of evolutionary doctrines at the turn of the 20th century (Cremin, 1962).

In summary, issue I identifies a first epistemological tension opposing conceptions of knowledge as discovered and as invented depending on whether or not the knowledge intrinsically implies forms of human and social mediation. Whereas contemporaneous epistemology is constructivist in the broad sense of the term, it opposes simple to radical constructivist conceptions. This split is associated to psychological assumptions which offer the bases for issue II.

1.2. Issue II: is the driving developmental dynamics upward or downward?

Epistemology and psychology are closely linked as shown, for example, by the associationism of the classical empiricists, the Cartesian cogito, the Kantian critique of pure reason, the evolutionary Kantianism of Herbert Spencer (Richards, 1987, chap.6) or else, the genetic epistemology of Piaget. But there exists no unequivocal link between the status of human knowledge – discovered or invented – and the cognitive activity proper to individuals. Proof of this lies in the fact that psychological activity is involved even in non-constructivist epistemologies. The case of classical empiricism is an example (as noticed by Phillips, 1995). Even if empiricists considered the object of knowledge as prior, they did not deny that individuals have their own knowledge activity: The mind was supposed to build, by association (in a near-automatic way), complex ideas from simple ones which were directly received through the senses. The history of educational ideas suggests, in fact, the following assumption: Educational notions of activity and passivity are essentially relative to the way psychological theories conceive development and learning. The individuals are qualified as active from a psychological point of view if what they do is assumed to underpin their intellectual growth – that is, the improvement of their capacity of thinking and understanding. In other words, if the idea of student activity[2] is associated to what is good from an educational point of view it is, mainly, that learning has to be developmental, in a broad sense. The psychological notion of activity thus refers to preconceptions regarding intellectual and learning development. Moreover, the idea that learning has to be developmental “in a broad sense” means that more general as well as more specific intellectual and cognitive capacities and also, functional capacities, may be involved: Development may concern, for instance, logical skills, understanding in particular fields of study, or even more specific competencies. In this broad sense, whatever psychological preconceptions are controlling the idea of activity, development is, to some extent at least, supported by formal learning – the question being how.[3]

Simple epistemological constructivism entails the basic condition of psychological activity according to which learning should be progressively constructed on the basis of the students' prior knowledge and faculties of understanding – that is, the basic meaning of educational constructivism as “the view that all learning involves the interpretation of phenomena, situations, and events, including classroom instruction, through the perspective of the learner's existing knowledge” (Smith et al., 1993–1994, p. 116). Beyond this assumption, and in relation to intellectual development and learning issues, we shall focus on the specific tension opposing “rationalistic” to “naturalistic” conceptions, which, in fact, broadly encompasses the split evoked previously between post-positivist and radical constructivist epistemologies.

When based on a naturalistic point of view, psychologies conceive of knowledge as adaptive and, as such, derived from the individuals’ interaction with their environment, in a broad sense. In this framework, for instance, habits represent features of the physical world as much as of the psychological world, and tend to serve as an explanation of meaning. Adaptive principles of organic development are thus extrapolated to thinking. This naturalistic orientation typically involves the continuity, or unity in terms of development, of elementary and higher intellectual functions.

By contrast, when based on a rationalistic point of view, psychologies conceive the development of higher human intellectual

[2] Cognitive or, else, intellectual activity is in play here, whether it translates into overt activity or not. As David Ausubel (2000, pp. 51–52) explains, for instance, even in “reception learning” the process of understanding and appropriating meanings is “exceedingly active”.

[3] Note that, in Piaget, development was more narrowly conceived of as being associated with the idea of general structures of thought, which were themselves thought of as independent of formal learning. Under this influence, cognitive psychology tended to focus on children's thinking independently of their learning up until the 1980s (Cf. Siegler, 2000).

faculties as differing from that of basic faculties, due to something new, specific to human reason. In ancient educational conceptions, such specificity involved the philosophical and theological separation of the human knowing faculty, associated with the idea of soul, and the bodily capacities, what is identified by the idea of "dualism" in philosophy. With the development of psychology as a science, human rational specificity has sometimes been interpreted as referring to the relatively recent evolution of exclusively human intellectual capacities. It is the case in Lev Vygotsky's 'cultural-historical' psychology, which interprets the use of artefactual signs for thinking as involving a radically new form of intellectual development:

> The later stage (of the development of inner speech and verbal thought) is not a simple continuation of the earlier. *The nature of the development itself changes*, from biological to sociohistorical. Verbal thought is not an innate, natural form of behavior, but is determined by a historico-cultural process and has specific properties and laws that cannot be found in the natural forms of thought and speech. (…) The problem of thought and language thus extends beyond the limits of natural science and becomes the focal problem of historical human psychology (Vygotsky [1934] 1986, pp. 94–95).

The idea of a break in the economy of human intellectual development can be linked to various contemporary approaches from evolutionary psychology and cognitive psychology (Bulle, 2014). David Geary (1995) distinguishes in this respect biologically primary knowledge, such as learning to walk and talk, from biologically secondary knowledge, such as learning to read and write. The dual-process theories of cognitive psychology for their part also distinguish two (interrelated) patterns of cognitive activity, one based on former brain development that dominates intuitive, implicit, rapid, effortless, highly contextualized and socialized processes, and the other based on the more recent, cultural evolution of human cognitive abilities that dominates conscious, explicit, decontextualized and depersonalized reasoning (Evans, 2003; Evans & Frankish, 2009; Hazzan & Leron, 2006; Kahneman, 2003). Cognitive-load theorists defend this same break by relying on the distinction between working memory and long-term memory: The former possesses reduced information-processing capacities that are dependent on structuring by the long-term memory (Kirschner, Sweller & Clark, 2006, 2007; Sweller, 2009).

Broadly speaking, naturalistic and rationalistic approaches oppose driving developmental dynamics – upward and downward respectively – and, correlatively, basic forms of understanding. The former conceives of understanding as what may be called *contextual* or *functional*, based on operational links between elements of experience as the result of situated practices, whereas the latter conceive of it as *conceptual* or *structural*, based on relationships between more or less abstract concepts representing and organizing knowledge internally.[4] According to the rationalist kinds of assumptions, the fact that concepts are apprehended thanks to signs, linguistic or otherwise, involves specific developmental dynamics.[5]

On these bases, issue II identifies a psychological tension opposing naturalistic and rationalistic types of developmental approaches in psychology depending on whether the driving developmental dynamics, in a broad sense, is upward or downward. Moreover, another aspect of students' activity may imply a politico-moral issue regarding the students' degree of own involvement.

1.3. Issue III: must learning be led by the students or the teacher?

Attributing a politico-moral meaning to the alternative identified as "students' versus teacher's lead" is not straightforward. However, pedagogical methods invoking students' activity are often associated with ideas of students' own involvement, and also social transactions which engage the students' political individuality. The asymmetric relationship between teacher and students has thus been brought into question, and their activity or participation laid claim to, in the name of the democratic transformation of our society. The plural and poorly defined notion of "traditional education" has in this context been closely associated with ideas of "passivity" and "receptivity" on the students' side, and authoritarianism on the teacher's side. But psychological and developmental assumptions are closely linked to these assimilations.[6] Besides, the latter are usually vague, with misleading implications (Azer, 2001; Colliver, 2000; Fox, 2001). Broadly, we find a high correlation between constructivist claims, the idea of students' own involvement and the contextualization of learning, involving action in situation and interaction within a learning community. For instance, the pedagogical orientations known as active, progressive, "student-centered" or, today, "group-centered", and constructivist (in a radical sense), tend to assimilate the overt, experiential or interactionist activity of the students and their genuine involvement (see for instance Hmelo-Silver, 2004; Hung, 2011; Loyens & Gijbels, 2008).

The right, psychological, interpretation of the students' activity (and, thus, development) is obviously a politico-moral concern. But, beyond psychological preconceptions, we assume that the question of students' own involvement may be considered as a secondary politico-moral issue. In this framework, the various teaching methods considered allow different degrees of students' own

[4] A distinction between functional and structural understanding is proposed, for instance, by Hiebert et al. (1996): Understanding from a functional perspective is described as "participating in a community of people who practice mathematics" (Hiebert et al., 1996, p. 16).

[5] The crucial role of the "semiotic mediation" in human thinking, which is central in Vygotsky's work, has to be credited to Abbot Etienne Bonnot de Condillac and is the basis of his critique of Locke in his *Essay on the Origin on Human Knowledge* (Condillac [1746] 2001. Cf. on this subject Hardcastle, 2009; Sinha, 1989).

[6] Let us take the example of the educative approach of John Dewey (1938a), as presented in *Experience and Education*. By virtue of the operational meaning accorded to all concepts – involving means and ends relationships - learning is based on "experience" and, correlatively, habits (for a critical appraisal, see Bulle, 2018). In this respect, Dewey defends a principle of "continuity of experience" for the learning of a study topic. He accuses methods and programs that deviate from this principle of being part of a pre-scientific age, which also means, pre-democratic: He opposes the teacher's position as an "external boss or dictator" to that of a "leader of group activities". His politico-moral interpretation of leadership is thus inextricably associated with his psychological preconceptions.

involvement and teacher's mediation. In short, the notion of student's activity may involve a politico-moral issue at the social or interactionist level which, as such, must be distinguished from epistemological and psychological issues. It concerns certain methodological characteristics and sets, on a continuum, the subjects' own involvement up against more or less intensive forms of the teacher's mediation.

2. The psychological foundations of modern learning theories

As stated, the epistemological, psychological and politico-moral issues previously highlighted will be used in the remainder of the article to disentangle fundamental psychological assumptions from secondary issues attached to the constructivist notion of activity.

In order to put these psychological assumptions into perspective, a two-dimensional space is outlined in this section. In this representational space, the epistemological tension, "discovered versus invented knowledge," defines a horizontal axis (I) and the tension between naturalistic and rationalistic types of approaches defines a vertical axis (II).[7] In this representational plane and among the broad lines of modern educational psychology, four major trends are now distinguished (see Fig. 1).

Rooted in naturalism, in the lower section of vertical axis II, psychologies are based on an adaptive conception of the mind. Also, in this lower section, to the left of horizontal axis I (discovered knowledge), are located those psychologies which directly bear the mark of classical empiricism and association psychology. They underpin a "bucket theory of the mind", as described by Karl Popper (1972), viewing our mind as a receptacle, originally empty, into which information about the outside world flows through our senses, accumulates and becomes "digested". The modern resurgence of associationism, as represented by behaviorism which does not feature consciousness as an explanatory factor and is linked to the development of functionalism in psychology (Wozniak, 1993), is located in this same part of the illustration.

Still in the lower part of vertical axis II (naturalistic side), but located to the right of horizontal axis I (invented knowledge), other currents of psychology belong to the various lines of functionalist psychology which can be defined as an "attempt to model psychology on evolutionary theory" (Green, 2009, p. 75). In this perspective, intellectual development and learning are assumed to follow the unity of the evolutionary process, so that higher thinking functions grow out of the lowest forms of animal life with the same biological significance, that of adjusting means to ends in contextualized frameworks of action (Angell, 1906, 1909; Dewey, 1938b; Miller, 1915). As will be shown, functionalist assumptions inspire educational thinking that is known as modern or progressive and its many contemporary forms, from (radical) constructivism to various forms of socio-constructivism.

At the "rationalistic" end of vertical axis II, psychologies characteristically involve downward forms of developmental dynamics centered on the role played by the mediation of signs in human thought, and especially organized bodies of knowledge in intellectual and cognitive development. In this upper part of vertical axis II and at the "discovered knowledge" end of horizontal axis I, are noted for the record conceptions associated with the idea of mental or formal discipline. These conceptions date back at least to Plato and Aristotle and dominated European educational thought for centuries, notably through the teaching of liberal arts in medieval schools and universities (see especially Durkheim, [1938] 1990). They are related to the idea of liberal education, in the philosophical sense. According to the doctrine of mental discipline, which played a central role in 19th century teaching, the object of education is the development of general faculties of the mind by their use, based on theoretical or abstract learning as proposed by classical languages and mathematics, the subject matter itself being deemed secondary to its degree of difficulty (Kolesnik, 1958). The assumptions of faculty theory, in their modern form, have been developed by Christian Wolff (Klemm, 1914). On these bases, learning conceptions aimed at knowledge of truths for their own sake and subordinated it to the cultivation of the knowing mind (e.g., Kolesnik, 1958, p. 99; 121; 127). Still in this upper, rationalistic, part of vertical axis II but now at the "invented knowledge" end of horizontal axis I, different approaches of psychology can be associated with the cultural-historical school founded by Vygotsky. In some respects, these approaches tie in with the rationalism of liberal education, to the extent that they assume intellectual development and learning to show a specific human dynamics with the mediation of artificial signs and, especially, the acquisition of scientific or else theoretical, concepts.

Note that at the "discovered knowledge" side of horizontal axis I, the different developmental theories are the oldest, and these have been supplanted by theories that bring into play a subjective or interpretative dimension which is conveyed by the modern constructivist theories, at least in the simple or trivial sense, that are located at the "invented knowledge" side. Moreover, historically, educational conflicts have successively set, first within epistemological foundationalism (covering the left side of the figure), empiricist/associationist learning conceptions against liberal education (Bulle, 2017) and then, as we will see, within psychological naturalism (covering the bottom of the figure), progressivism against classical empiricism, and finally, oppose today – and this is what this analysis especially aims to shed light on – within constructivism in the broadest sense (covering the right side of the figure), rationalistic trends to different types of naturalistic/adaptive ones.

In the two next sections, a brief characterization of the psychological assumptions standing in conflict in the two-dimensional space outlined here is proposed, which also reveals for each of them the existence of a range of pedagogical methods with different degrees of students' own involvement and teacher's mediation.

[7] The major criteria defined for respectively differentiating the types of approaches mentioned in section 1 are of the dichotomous type, so that their place in the quadrants defined by the axes is in theory unequivocal. However, within these quadrants, the continuity implied by the axial representation allows us to envisage a continuous breakdown of the approaches along the axes.

3. Naturalistic trends in psychological conceptions of development and learning

3.1. Mechanical adaptive learning

3.1.1. From association psychology to behaviorism

Developments of the associationist conceptions were proposed by positivist philosophers who were at the origin of the first education sciences, such as the English evolutionist philosopher, Herbert Spencer (1860), and the Scottish philosopher Alexander Bain (1884). Associationism in the 20th century took the form of the connectionist approach of American psychologist, Edward Thorndike (1913), according to which all learning is specific and only influences mental functions that have common neural connections, and behaviorist psychology (see Sandiford, 1942). The path that leads from associationism to behaviorism, where references to conscious content disappear, is a short one, for as William James explains, in associationism, ideas can be held to be "things" the mind links together (James, [1890] 1950, p. 554). These adjusting links between internal relationships in the mind and external relationships in the environment appear in the evolutionary doctrine of Spencer (1855) as a fundamental law of adaptation, which applies to both intellectual life and organic life.[8] Spencer's formulation of the principle that behavior changes in adaptation to the environment is closely related to the version of the law of effect (also mentioned by Bain) propounded some years later by a forerunner of behaviorism, Thorndike, when he stated that a response is more likely to be reproduced if it involves a form of satisfaction for the organism and abandoned if it results in dissatisfaction (Leslie, 2006). According to the "connectionist" theory of Thorndike (1913), which conceives "that all mental processes consist of the functioning of native and acquired connections between situations and responses" (Santiford, 1942, p. 97), learning is always specific: It results from training and the reinforcement of connections between stimuli and behavior. This theory underpins a concept of "self-activity" according to which nothing really counts except as it influences the pupil's own responses (Thorndike, 1906).

3.1.2. From the students' own involvement to the teacher's leadership in receptive learning approaches

Approaches derived from associationism inspire learning styles that may be considered "mechanical" because they are based on implicit inductive processes, or on transmissions of "content" – that is, knowledge as information, that do not rely on reflexive understanding on the part of the subjects. The teaching methods associated with them may call more for the teaching of specific procedures and a factual type of knowledge, or more for learning by experience (according to the satisfaction or dissatisfaction felt as a result of action taken). For instance, psychologists who are linked to behaviorism, such as Thorndike or Frederic Skinner, were supporters of "active learning" methods, in which children had to learn mostly by themselves, with varying possible degrees of teacher's guidance (see Skinner, 1948, pp. 119–120; Thorndike, 1906).

3.2. Reactive adaptive learning

3.2.1. The biological model of evolution and educational progressivisms

The second major set of approaches in developmental and in educational psychology came about as a reaction against the image of the mind as a receptacle in the model stemming from classical empiricism. Within psychologies inspired by naturalistic or evolutionist thinking, we thus find the epistemological tension defined by axis I. The American educational psychologist, Charles Judd (1939, p. 59), explains that early psychology almost exclusively considered the contents of consciousness, which led it to put exaggerated emphasis on those elements of experience that are mainly conditioned by sensory processes. In this way, it neglected the driving role of the subject's action. Psychology came then to recognize that its main interest lay in the active, rather than receptive, side of life, and centered on the category of *behavior* as a fundamental active category that opposes the passivity of psychology based on sensory impressions. Judd also makes it clear that these changes rely on the theory of natural selection which involves commitment to the idea of thought as an instrument of behavior, and intellectual development as associated with a vital request for adjustment, thats is, adaptation. This adaptive point of view, linked to the Darwinian theory of evolution, is at the root of functionalist psychology (Angell, 1907, 1909; Green, 2009; Miller, 1915). As Green (2009, p. 81) states, functionalism, which James and Dewey contributed to with founding texts, was the "nest", in which many different branches of psychology were "hatched" and grew to adulthood, including child/educational psychology, psychological testing, clinical psychology, industrial/vocational psychology, and also behaviorism. Its major assumptions in educational psychology help clarify the tension created on psychological axis II between naturalistic and rationalistic conceptions.

First of all, the adaptive point of view of functionalism underlies holistic representations of behavior. The subject as a whole is viewed as the center of coordination between interconnected internal processes and environmental factors. This holistic interpretation putting the acting subject into play underpins a new conception of the students' activity. The activity of thought is supposed to emerge from problematic situations to which a solution must be provided. Therefore, learning is most effective in situations which, by their very nature, require the organization of conscious processes to meet a need felt as relevant by the individual. Furthermore, and in connection with the previous assumptions, intellectual development follows upward driving dynamics "through a continuous

[8] Note that Spencer defended the autonomy of the student with arguments conflating the humankind and the individual levels: "In following the process of nature, neither individuals, nor nations ever arrive at the science *first.* (…) Children should be led to make their own investigations, and to draw their own inferences. They should be *told* as little as possible, and induced to *discover* as much as possible. Humanity has progressed solely by self-instruction" (Spencer [1860] 1929, p. 68).

reconstruction of its (the growing mind's) modes of activity in actual experiences" (Miller, 1915, p. 112). Finally, adaptation is conceived of as both an individualizing and socializing process, involving mutual readjustments between individual desires and social institutions, one aim of education being the development of a socially integrated personality (Carr, 1934).

These premises explain very general conceptions, in learning theory, which are characteristic of forms of progressive education and derive from functionalist psychology (see for instance Cremin, 1962; Graham, 1967; Hayes, 2006; Krug, 1964). They challenged not only the old association psychology that overshadows the driving role of behavior in learning, but also mental discipline and faculty psychology, on the basis of the inseparability of thought and "action", knowing and "doing": Ideas should not be seen as "objects of contemplation" but as instruments of action (Graham, 1967, p. 6). Accordingly, the conception of learning no longer relied on the teaching subjects and even less on "disciplines" – conceived of as specialized knowledge without particular developmental impact – but primarily on methods that help students learn how to transfer experience into cognitive growth.

3.2.2. Contextual understanding and upward driving developmental dynamics in contemporary adaptive approaches

The dominant constructivist currents of contemporary educational theory inherit the adaptive interpretation of functionalist psychology and, congruently, a line can be drawn to them from Dewey's works (see for instance Bereiter, 1997; Bredo, 1994; Garrison, 1995; Prawat & Floden, 1994; Reich, 2007; Wineburg, 1989; see also, especially, Dewey, 1929; 1938b). A basic assumption is that understanding that develops deeply involves the context as well as the goals of the learner (Brown, Collins, & Duguid, 1989; Greeno, 1989; Lave, 1988; Lave & Wenger, 1991; Resnick, 1994; Rogoff, 1990).[9] In one way or another, these constructivist currents share a situative standpoint – made explicit in the concept of situated cognition or that of situated learning – maintaining four interrelated claims: (1) Action is grounded in the concrete situation in which it occurs; (2) knowledge does not transfer between tasks; (3) training by abstraction is of little use; and (4) instruction must be done in complex, social environments (Anderson, Reder, & Simon, 1996, 1997; see also; Bjork & Druckman, 1994, p. 33; Kirshner & Whitson, 1997).

This "new transactional contextualism" appeared at the turn of the 1990 decade as the second historical movement leading to marginalizing the more classical trends of learning theory, after the cognitive revolution of the end of the 1950s. Starting from the idea that human action is not uniquely the product of intrapsychic dispositions and processes, this view develops far reaching assumptions, considering the situated action as "continuous with a cultural world", and developed within a social context which is neither "in the head" nor objectively "out there" (see Bruner, 1990, pp. 104–105). It involves a corollary "principle of embodiment" where action underpins understanding. The mental is explained "as a development out of our primitive capacity for action", and "there are irreducibly collective actions" (Taylor, 1985, p. 90; 93). These views entail the transactional interpretation of experience as "the result, the sign, and the reward of that interaction of organism and environment which, when it is carried to the full, is a transformation of interaction into participation and communication" (Dewey [1934] 2005, p. 22; see Woodward, 2000).

The transactional or situative standpoint today represents mainstream development of research in the field of cognitive science. As Katherine Nelson (2007, p. 37) states it, "the many proposals for 'fixing' the contemporary field of cognitive science all tend toward a situated, embodied pragmatics." It can be described as distributed between interrelated trends of research requalifying cognition as embodied/"in the flesh", embedded/situated, and distributed/social (Falikman, 2014, p. 476). These approaches are currently described as marking a "shift" in scientific thinking or modelling from internal views of cognition to more integrative or interactive ones. In embodied and situated cognition approaches "cognition is no longer modeled as the creation of agent-independent representations of the world, but as the embodied, evolving interaction of a self-organizing system with its environment", so that the focus is shifted "from abstract intelligent behavior to simpler, physical living behavior" (Almeida e Costa & Rocha, 2005, pp. 5–7; see especially Lakoff & Johnson, 1999; Maturana & Varela, 1987; Varela, Thompson, & Rosch, 1991). These trends revive forms of ecological dynamics and the latter, which reemerges also today, "views conceptual development as the spontaneous, situated adoption of symbolic artifacts as action tools". For instance, in the case of mathematics, it "shifts the site of critical mathematical learning away from the symbolic semiotic register toward situated sensorimotor engagement with manipulation problems" (Abrahamson & Sánchez-García, 2016, p. 225). In distributed cognition approaches (introduced by Cole & Engestrom, 1993, Pea, 1993, and Salomon, 1993), the resources that shape and enable activity are viewed as distributed in configuration across people, environments and situations (Pea, 1993, p. 47), so that the shift marked by this system-level cognitive view is from "the cognitive properties of individuals to the properties of external representations and to the interactions between internal and external representations" (Hutchins, 1995b, p. 287; see also for instance Giere, 2002; Hollan, Hutchins, & Kirsh, 2000, Hutchins, 1995a & b; Salomon, 1993). A landmark article, "Beyond the Flesh: Some Lessons from a Mole Cricket", proposes that we study the mind as an embodied system where symbols are action tools that multiply our basic cognitive faculties (Clark, 2005).

The computational model of the mind from which cognitive science emerged suffered from the difficulty of dealing with the question of subjective meaning.[10] Its revision through the system-level cognitive view, which exceeds the cognitive properties of individuals and includes elements of the physical and social environment, may be seen as a search for enriched meanings. But this search does not correct its prior and major problem, and in a sense reinforces it: It loses the fundamental level of the active individual

[9] The exemplary learning model for certain of these approaches is apprenticeship with settings imitating learning in everyday situations (Kirshner & Whitson 1997; Lave, 1988; Wineburg, 1989).

[10] As Jerome Bruner (1990, p. 4) explains, referring to the intellectual history of the cognitive revolution, and evoking its fragmentation and technicalization: "Very early on, for example, emphasis began shifting from 'meaning' to 'information', from the *construction of meaning* to the *processing* of information. These are profoundly different matters. The key factor in the shift was the introduction of computation as the ruling metaphor and of computability as a necessary criterion of a good theoretical model."

mind where the subjective demand for coherence and meaning is located (see for instance Hatano, 1994's critics of "collectivist" approaches). The tools of thought, which evoke the Vygotskian approach, are deviated from the specific role they play in Vygotsky as internal tools of thought control (used by the subject to "act upon himself"), and reductively assimilated to work tools (see Vygotsky [1930–33] 1978, p. 53). As Arievitch and Stetsenko (2014, p. 223) put it:

> "Without the integrative concept of meaningful activity, the concepts of culture and tools take on a different meaning. When being related directly to the brain, culture and mind-tools, including language, inevitably get reduced to just another set of external stimuli (labels) that initiate or participate in complex patterns of behavior."

In correlation with the developments of cognitive science evoked here and on a recurring basis, education literature mentions learning that involves the active participation of the learners in the social contexts that surround them. The nowadays dominant characteristic of constructivism is the multifaceted "social constructivism", including "sociocultural" approaches. Sociocultural approaches nevertheless mark a shift from social constructivism's focus on individual development and learning via interpersonal processes, in which the collective is part of the learning context (Gergen, 1995; Goodnow, 1990; Resnick, Levine, & Tensley, 1991). They place emphasis on the inherently social nature of mental processes, which means that learning principally develops within the participation framework, rather than in the individual's head (Cole, 1996; Confrey, 1995; Lave & Wenger, 1991; O'Connor, 1998; Rogoff, 1990; Wertch, 1991). Highly social environments are thus encouraged, with cooperative learning as an instructional tool. Congruently, these approaches tend to focus their primary educational interest on the group, the link between knowing and doing referring to activities and interactions within learning groups. Accordingly, what counts is not the development of the individual as such but the cognitive growth of the community as a consequence of activities and interactions (Greeno & Van de Sande, 2007). It may be noted that despite the various psychological and philosophical points of view involved (Lerman, 1996; Packer & Goicoechea, 2000), social constructivism and sociocultural perspectives are in continuity with (radical) constructivism in terms of broad psychological assumptions (see, for instance, Bredo, 1994; Prawat & Floden, 1994; Anderson, Reder, Simon, Ericsson, & Glaser, 1998). At the extreme, the opposition between, basically, mental activities and cultural practices of learners is an artificial one, given the complementarity of the two perspectives (Bereiter, 1994).

The importance these sociocultural issues have taken on is illustrated in a thought-provoking way by the article of Anna Sfard (1998) who observes the replacement of the "acquisition" metaphor (evoking an approach that is individual, and an external standard to be assimilated) by the "participation" metaphor (evoking an approach that is collective, and "on-going learning activities"), to characterize the change in ideas guiding educational thought. This replacement does not lead to the opening up of completely new pathways but the recurrence of the functionalist perspectives and biological metaphors they convey: "Just as different organs combine to form a living body, so do learners contribute to the existence and functioning of a community of practitioners" (Sfard, 1998, p. 6).

3.2.3. From the students' own involvement to the teacher's leadership in adaptive approaches

Within the theoretical framework defined by the functionalist conceptions, relayed today by the dominant constructivist currents, there lies a set of educational methods that can be differentiated by the importance they accord to the students' own involvement or the teacher's leadership. For instance, the aim of *The Child and the Curriculum* was to defend, against the radical "child-centered" tendencies of the time especially emphasizing children's relative independence in learning, that guidance, supposing a deep knowledge of the subject taught, was necessary, "to see what step the child needs to take just here and now" (Dewey, 1902, pp. 16–17), and that instruction should involve "a continuous reconstruction, moving from the child's present experience out into that represented by the organized bodies of truth that we call studies" (Dewey, 1902, p. 11). On such bases, the various educational methods aiming to contextualize learning – "inquiry", "discovery", "problem-based" or, else "project-based" learning and competence-based approaches – involve teacher guidance at various degrees even if this guidance has principally to be exercised on the educational environment in an indirect manner, or else "at a meta-level" (Goodnow, 1990; Herman & Gomez, 2009; Rogoff, 1990; Schmidt, Loyens, van Gog, & Paas, 2007; Taber, 2011; Zhang, 2016).

4. Rationalistic trends in psychological conceptions of development and learning

4.1. The internal use of mediating cognitive tools

The alternative broad perspective of developmental and educational psychology opposes all the functionalist currents of psychology by rejecting the adaptive model of development and learning in the name of human rational specificity. It can, in a very general way, be associated with the work of Vygotsky. A basic assumption is that the semiotic mediation of thought involves the use of artificial signs to act upon oneself. The internal use of mediating cognitive tools in Vygotsky's psychology is assumed to change all psychological processes (Vygotsky [1930–1933] 1978, pp. 54–57). It is at the basis of higher order forms of thinking and underpins voluntary action. Intellectual development and learning depend notably on the progressive appropriation by the individual of scientific or theoretical concepts whose meaning depends on the systems they constitute. This appropriation correlates to a structuration of thought, so that scientific concepts play an underlying logical role. For instance, the need to avoid contradictions supposes a hierarchical structure of concepts so that two contradictory ideas can be assessed against a unique general concept (Vygotsky, [1934] 1986). Because the meaning of scientific or theoretical concepts depends on their links to other scientific or theoretical concepts, understanding involves a logical linking of ideas. Scientific or theoretical knowledge thus plays a meaningful mediating role related to the organization and hierarchical structure of conceptual systems.

On these bases, the gradual building of conceptual networks is assumed to underpin the reflexive capacities of individuals, that is to say their understanding potential. In David Ausubel's psychology of meaningful verbal learning, the learner's cognitive structures represent a dynamic framework where the new elements of knowledge are interpreted with the help of concepts having an appropriate level of inclusiveness. Without such a framework, rote learning occurs instead of meaningful learning. Due to the role played by conceptual structures in understanding, central or key ideas, which have the strongest explanatory power, must, in the main, be transmitted before concepts and further peripheral information (Ausubel, 1961a; 1961b; 2000).[11] Correspondingly, according to cultural-historical approaches, ideas are within the grasp of pupils because they are implicitly based on more general ideas that pupils can develop consciously and understand with the help of someone more advanced than them. The developmental dynamics depends on their progressive appropriation of these elements, which are located at a higher level than the one they have already reached intellectually.

Therefore, abstract, scientific or, else, theoretical concepts drive the processes of thinking and development characterizing higher forms of thought. This defines a specific (cultural-historical) line of development which involves the internal reconstruction of structured bodies of concepts. The assumed driving developmental dynamics thus moves downward. It fosters in Vygotsky the interrelated, adaptive, upward dynamics associated with individuals' experiential knowledge. Vygotsky ([1934] 1986, pp. 109; 185; 193-194) explains:

> The inception of a spontaneous concept can usually be traced to a face-to-face meeting with a concrete situation, whereas a scientific concept involves from the first a 'mediated' attitude towards its object (…) Scientific concepts grow downward through spontaneous concepts; spontaneous concepts grow upward through scientific concepts.

Thought finds its reality and form in speech and develops according to its proper structuration. This is manifested in the "the interdependence of the semantic and the grammatical aspects of language" (Vygotsky [1934] 1986, p. 221).

It should be noted here that major misconceptions regarding Vygotsky's psychology pervade education research literature (see for instance Duncan, 1995, Gredler & Shields, 2004; Gredler, 2007 and, for overall views, Toomela & Valsiner, 2010; Yasnitsky, van der Veer, & Ferrari, 2014). Especially, social constructivism is often presented as rooted in Vygotsky's works emphasizing the social dimension of thought. Nevertheless, the "social" stance in social constructivism serves an adaptive view on development and learning: Social interactions are supposed to underpin knowledge construction and growth. In Vygotsky, the social dimension of thought relies on cognitive tools as such which represent social constructs. This social dimension of knowledge engages the simple version of epistemological constructivism: Artificial (social) constructs have to be internally reconstructed by the subjects and underpin structural or conceptual understanding. Therefore, the current, socio-constructivist, interpretation of Vygotsky's contribution to developmental psychology overturns his central argument, involving a downward driving developmental dynamics.

This theoretical misappropriation is not new. As explained by Alex Kozulin (1986), the role of signs as the chief mediators of thought, which is at the heart of Vygotsky's theory, was played down by his disciples, led by Alexis Leontiev. The latter developed a theory of activity more in line with Marxist philosophy, according to which practical and social activities toward objects lead the individual to cognitive mastery of a situation.

4.1.1. Conceptual understanding and downward driving developmental dynamics in contemporary rationalistic approaches

The rationalistic trends of developmental and educational psychology involve the logical and meaningful role of theoretical or scientific concepts in human understanding. Contemporary theories of conceptual change, when developed as non-adaptive forms of constructivism,[12] fall within this perspective (see especially Vosniadou, 2013 for a comprehensive overview). They represent a group of works broadly rooted in the paradigm shifts interpretation of science development proposed by Thomas Kuhn. These constructivist approaches consider the role of conceptual structures in understanding and the role of systematic instruction in the acquisition of new concepts. The research frameworks involved may be distinguished around the impetus of some leading works, respectively under the ideas of "theory theory", "framework theory", "ontological" or "classical" view and "knowledge in pieces". Basically, the first three approaches consider that students' naïve conceptions present a tendency toward coherence and distinguish themselves according to their interpretation of it, whereas the latter see naïve conceptions as fragmented in a great number of ideas or "pieces" (see Carey, 2009; Chi, 1992; DiSessa, Sherin, & Levin, 2016; DiSessa, 2017; Vosniadou, 2007; 2013).[13]

We may add to conceptual change approaches the important body of cognitive science research in mental modelling, developed since the 1980s, which nevertheless cannot be grouped under any unified theoretical framework and do not aim at studying conceptual structures as such. "Organized units of mental representation of knowledge" (mental models) are assumed to serve as tools for

[11] Accordingly, verbalization plays an intrinsic role in learning: "Contrary to Piaget's position, language, therefore, plays an integral and operative (process) role in thinking rather than merely a communicative role. Without language meaningful learning would probably be only very rudimentary (e.g., as in animals)" (Ausubel, 2000, p. 5).

[12] Methodological problematics inspired by *conceptual change* approaches tended to be reinterpreted in the mid-1990s by using the frameworks of adaptive conceptions (after the publication of Pintrich, Marx, & Boyle, 1993). These new orientations do not conceive change "in terms of modifications to conceptual structures, but rather in terms of a change in embedding of these structures. Differentiation of contexts and discourse practices, as well as successful participation in the contexts, becomes the essence of conceptual learning" (Mason, 2007, p. 3).

[13] More precisely, whereas the "framework theory" approach shares with the "theory theory" approach the notion that concepts are embedded in theory-like structures, it does not focus on the natural background of human conceptual understanding (i.e., the assumption of "systems of core cognition" in Carey) so that its domain of interest concerns the higher levels of conceptual development. Besides, it takes a less normative view on students' misconceptions than the ontological or classical view.

thought and may contribute to accounting for conceptual change and understanding meaning in learning and cognitive development (see for instance Nersessian, 2013).

The naive intuitive theories, constructed on the basis of everyday experiences under the influence of secular culture, Stella Vosniadou (2007) explains, have to be supplanted by scientific education. For instance, when an external representation, such as a map or a globe, is proposed, individuals tend to reason on the basis of the external model rather than by creating their own model. These cultural artifacts allow them to correct their representations based on everyday experience. According to the psychologist, resorting to experience − that is, to the *bottom-up* type of learning mechanisms − is not effective as a way of engaging the conceptual transformations necessary for scientific learning programs. Such transformations require systematic forms of learning. Concepts such as those of force, energy, heat or photosynthesis require many hours of explicit teaching to be understood because the scientific knowledge has been developed over centuries to form elaborate and counter-intuitive theories, differing by their concepts, their structure and the phenomena they explain, from explanations developed on the basis of daily experience. The conceptual change invoked here brings into play the recursive abilities of human thought: It is a matter of opening the conceptual space by developing meta-conceptual forms of consciousness.

According to these views, the internal reconstruction of knowledge (conceptual systems, models and ideas etc.) is a major aim of formal learning. This internal reconstruction leads children to logically develop ideas and understand the relationships between elements that structure knowledge. Moreover, the meaning of scientific or theoretical concepts does not directly refer to concrete experience, but depends on the conceptual frameworks which have been constructed to understand the relationships that link elements of reality together, that is why theoretical learning necessitates conscious and explicit approaches.[14]

The relevance of rationalistic types of approaches is confirmed by studies showing that the scientific learning of students aims at a progressive understanding of the rational structure of the discipline studied (Kirschner et al., 2006; Sweller, 2009) and that scientific education, aiming at a long-term mastery of scientific knowledge, is enhanced when relationships between concepts, theories and models are made explicit (Allen & Reif, 1992; Hiebert, 1997; Richland, Stigler & Holyoak, 2012).[15] This does not mean that intellectual education can only focus on the development of organized bodies of knowledge. Firstly, very young children need to apprehend the meaning of simple concepts through experience. This does not apply to complex notions but to the most basic concepts, like that of number or of “smaller than” and “larger than” (Aharoni, 2005). Secondly, the progressive understanding of organized bodies of knowledge requires the student to grasp the hidden rational structure of the subjects taught, which assumes that a consistency, or in other words a certain inherent logic, can be found, or can be taught on a basic level. This rational basis of learning is necessarily incomplete for epistemological reasons (Arievitch & Stetsenko, 2000, p. 86).

Finally, the recurring distinction made in education literature, echoing the evolution of its major trends, between cognitive and sociocultural perspectives overshadows the more fundamental opposition evoked here between two different driving developmental dynamics and, in correlation, between contextual/functional and conceptual/structural forms of understanding (see in particular Cobb, 1994; Cobb & Yackel, 1996; Packer & Goicoechea, 2000 and the special issue of *Educational Psychologist* 42, 2007). For instance, Paul Cobb (1994, p.13) observed that considerable debate in education research divided, on one side, those who thought that development and learning were individual processes of cognitive self-organization and, on the other side, those who thought that they represented processes of “enculturation into a community of practice”. This opposition can be compared with the distinction made by Sfard (1998) between the educational approaches where knowledge is an aim (acquisition metaphor) and those where knowledge is supposed to develop through students’ interaction with their social environment (participation metaphor). It does not allow to distinguish the naturalistic and rationalistic types of approaches, and sets the assimilationist conceptions derived from empiricism, the cultural-historical theory, and radical constructivism itself in opposition to situative approaches of the sociocultural and social-constructivist type.

4.1.2. From the students' own involvement to the teacher's leadership in rationalistic approaches

From a teaching methods perspective, rationalistic developmental trends can be placed on a continuum according to whether importance is given to the teacher's leadership or the students' own involvement. In this regard, the objection that minimal guidance is in conflict with our knowledge of human cognitive architecture relies on the observation that various forms of discovery learning approaches inefficiently resort to problem solving when learners have not sufficiently high prior knowledge to provide “internal” guidance (Kirschner et al., 2006, p. 79; Karpov, 2003). Alternatively, the conceptual understanding that underpins rationalistic types of approaches may use to its educational benefit the knowledge mastery it develops in students and their interest in carrying out inquiries, research and problem-solving activities (see for instance Furtak, Seidel, Iverson, Briggs, & Derek, 2012).

[14] Davydov (1988, p. 187) notes that Bruner, by his approach of a “sort of symbolic concept”, the content of which is not subject to direct sensory grasping, acknowledges “the need for a special logical interpretation of concepts” but lacks the necessary “conscious and explicit use” of the characterization of theoretical concepts.

[15] On the basis of a meta-analysis of instructional improvement in algebra, Rakes, McGatha & Ronau (2010) observe the positive effects of teachers' focus on conceptual understanding. For examples situated in this framework, see Schmittau (2003; 2004) regarding the mathematics curriculum; see also Crew (1900) and Aharoni (2005) for interesting testimonials regarding, respectively, the teaching of physics in secondary school and the teaching of mathematics in primary school. A basic example of learning applied by the Russian follower of Vygotsky, Piotr Galperin, to writing the letters of the alphabet may also be cited here. Instead of showing the letters and explaining how to trace each element of them, the teacher shows the students how to analyse the contours of the letters and construct a model of these contours from a number of dots. Therefore, pupils acquire the concept of contour and are led to master their gesture intellectually, so that they progress more rapidly (see Haenen, 1996 for more detail, see also; Arievitch & Stetsenko, 2000).

In these rationalistic types of approaches, students have access to knowledge sources allowing them to progressively construct, with the aid of explicit bases, the conceptual foundations of knowledge. At one extremity, students progress more or less autonomously on the basis of other means of conceptual understanding than the teacher himself. One example in this respect is the experience of the French teacher, Joseph Jacotot, who managed to make Flemish students, whose language he did not understand, learn French without his help but using a bilingual edition of the *Adventures of Telemachus* by Fénelon (Rancière, 1987). At an intermediary level could be placed mathematics teaching in East Asia, in which the teacher is described as a mediator between the mathematics and the students (Hiebert & Stigler, 1999). Finally, from this point there is an array of other different forms of "explicit teaching", and at the extreme, "direct instruction", aiming to develop the students' rational understanding and involving the teacher to varying degrees as a "transmitter".

5. Conclusion

This article has aimed to show that the contemporaneous evolution of educational thought conveys constructivist biases regarding the idea of student's activity which exacerbate secondary oppositions and overshadow major theoretical options. One illustration is the trend, observed by Sfard (1998), of abandoning the metaphor of "acquisition" in favor of that of "participation". The new metaphor expresses the inappropriate combination of politico-moral concerns, associated with teaching methods and psychological issues, given that this linguistic shift is supposed to replace "the talk about private possessions with discourse about shared activities" and epitomize "the democratic nature of the turn toward the PM (participation metaphor)" (Sfard, 1998, p. 8).

The renewal of ideas in education is in reality very weak, with the same basic conceptions reemerging periodically in new forms. Especially, the "overall trend of the past decades to naturalize human development" (Arievitch & Stetsenko, 2014, p. 228) has contributed to the enhancement of new versions of functionalist or adaptive approaches of knowledge development. Correlatively, constructivist conflations of epistemological, psychological and politico-moral issues have prevented fundamental debates from taking place and maintained the rationalistic psychological assumptions in a broadly marginal position. This is a curious situation as the opposition between contextual or functional understanding on one hand, and conceptual or structural understanding, on the other hand, highlights fundamental divergences of views on students' activity and development.

According to the rationalistic conceptions, the heart of the matter for education issues is the internal reconstruction of organized bodies of knowledge. This reconstruction represents a top-down structuring process, driving human intellectual development and meaningful learning. It requires school programs and curricula to foster understanding of the logical features of the disciplines, in other words, their "logical grammar" (Hirst [1967] 1974) through, for instance, forms of systematic-theoretical instruction. This refers to a progressive – student-centered in the simple constructivist sense – and downward learning dynamics.

With respect to the aim of an individual's mastery of thought and genuine understanding of the disciplines and subjects studied, the major issues in education concern not so much methods as such, but programs and curricula. They primarily relate to the logically meaningful development of a program of study. Therefore, the tendency of contemporary educational thinking to enhance thematic and integrative units, or to focus on specific competencies to be acquired,[16] and to consider learning at group level, appears deeply misguided.

Finally, comparative studies tend to reveal the superior efficiency of some of the rationalistic educational principles (see for instance Bissonnette, Gauthier & Richard, 2005; Bulle, 2011, 2019; Chall, 2000; Mann, 1992; National Mathematics Advisory Panel, 2008; Rosenshine, 2009; Zhang, 2016), especially for students from underprivileged backgrounds who are most in need of sound, explicit and structured educational support, and are the first victims of misconceptions in education. However, comparative studies mainly focus on teaching methods, neglecting the crucial issue of programs and curricula. Moreover, the low level of exploitation of the rationalistic assumptions in education, past or present, does not allow us to empirically assess today the full relative efficacy of the educational principles they can inspire. The perspective developed here suggests that contemporary educational thought should take such assumptions into full consideration and develop avenues of research, as they have been little explored to date. Of the many subjects that should be explored further in light of rationalist hypotheses, we can cite, in a simple way and as an illustration: the role of signs in the mastery of thought; the psychological reality of meaning and understanding; the role of conceptual structures in logical reasoning and mastery; and, in each teaching discipline, the nature of the "grammar" that underpins, at a given moment, its deployment, and the progressive stages of understanding to be defined in a meaningful program.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.edurev.2018.12.004.

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[16] Note that the PISA (Programme for International Student Assessment) survey, conducted by the OECD, influences the philosophy of world educational policies through an international competitive process which acts normatively upon the definition of national educational aims. The PISA survey promotes competences-based approaches through the implicit vision of the good lifestyle in our societies developed by the spirit of the tests.

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