MEANINGFUL LEARNING: FROM THE CLASSICAL TO THE CRITICAL VIEW [1,2,3]
(Aprendizaje significativo: de la visión clásica a la visión crítica)

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Abstract

The purpose of this paper is to emphasize, in a schematized way, different views of the meaningful learning theory and, by doing this, to approach the subject from a historical and prospective standpoint. Initially, Ausubel's original theory is presented. Then, the views of Novak (humanistic), Gowin (social interactionist), Johnson-Laird (mental models), Vergnaud (complexity and progressiveness), Maturana (autopoiesis) and, in the end, the critical (subversive, anthropological) view of the author, are discussed.
Keywords: meaningful learning, progressiveness, critical view.

Resumen

El objetivo de este trabajo es destacar, de modo resumido y esquemático, distintas visiones de la teoría del aprendizaje significativo y, al hacerlo, abordar el tema de manera histórica y prospectiva. Inicialmente, se presenta la propuesta original de Ausubel. Después, se enfocan las perspectivas de Novak (humanista), Gowin (interaccionista social), Johnson-Laird (modelos mentales), Vergnaud (progresividad y complejidad), Maturana (autopoiética) y, finalmente, la visión crítica (subversiva, antropológica) del propio autor.
Palabras clave: aprendizaje significativo, progresividad, visión crítica.

Meaningful learning in Ausubel's classical cognitive view

The classical cognitive view of meaningful learning is the one proposed by David Ausubel, in the 1960's (1963; 1968), which he has lately reiterated (2000).

The hardcore of this perspective is the nonarbitrary and nonverbatim cognitive interaction between the new knowledge, potentially meaningful, and some specifically relevant knowledge, which Ausubel denominated *subsumer*, already existing in the learner's cognitive structure.
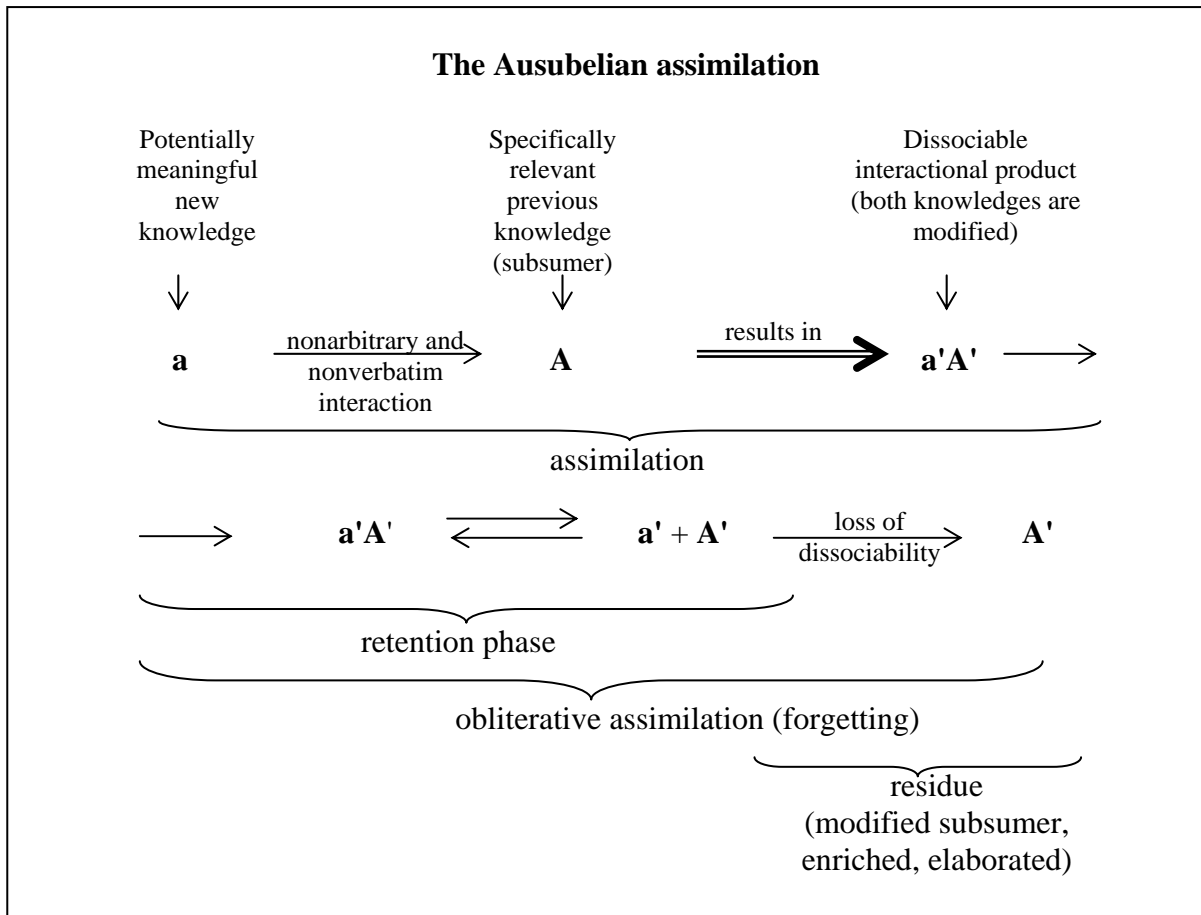
This interaction is schematized in Frame 1, while the theory as a whole is diagrammed in Figure 1.

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[1] This paper is dedicated to Professor Joseph Novak who first introduced me to Ausubel's meaningful learning theory in a seminar at the Physics Department of Cornell, in 1972, and later on was my Ph.D. thesis advisor in the Department of Education of Cornell.

[2] A preliminary and reduced version of this paper was presented in the I National Meeting on Meaningful Learning, Campo Grande, MS, Brazil, April 2005. A new version of it was presented in the closing conference of the V International Meeting on Meaningful Learning, Madrid, Spain, September 2006, and in the I National Meeting on Mathematics Teaching, Tandil, Argentina, April 2007. In all these instances the corresponding text was published in the proceedings of the event. The present article (2011) is a revised and expanded version of previous ones.

[3] Complete Spanish and Portuguese versions of this paper are avaliable at http://moreira.if.ufrgs.br

Frame 1. Meaningful learning in Ausubel's classical cognitive view (1963; 1968; 2000)

The Ausubelian assimilation

Potentially meaningful new knowledge

Specifically relevant previous knowledge (subsumer)

Dissociable interactional product (both knowledges are modified)

$$\downarrow \qquad \qquad \downarrow \qquad \qquad \downarrow$$

$$\mathbf{a} \xrightarrow[\text{nonverbatim interaction}]{\text{nonarbitrary and}} \mathbf{A} \xRightarrow{\text{results in}} \mathbf{a'A'} \longrightarrow$$

assimilation

$$\longrightarrow \mathbf{a'A'} \underset{\longleftarrow}{\longrightarrow} \mathbf{a' + A'} \xrightarrow[\text{dissociability}]{\text{loss of}} \mathbf{A'}$$

retention phase

obliterative assimilation (forgetting)

residue
(modified subsumer, enriched, elaborated)

The conceptual scheme proposed in Frame 1 corresponds to *subordinate meaningful learning* and it represents the most common occurrence of meaningful learning. Nevertheless, when a potentially meaningful concept or proposition, which is more general and inclusive than the ideas or concepts that have been already established in a person's cognitive structure, is constructed based on those that are already there, and then it assimilates them, this learning process is called *superordinate meaningful learning*. Finally, the learning of concepts or propositions, which are not subordinate to any subsumer and are unable to subordinate them, is considered a *combinatorial* one.

Meaningful learning of some scientific laws or principles, for example, might imply a combinatorial form of meaningful learning, since the understanding of the scientific relation underlying a linguistic or mathematical expression of these laws requires a more in-depth knowledge of that specific area. Interaction does not happen with a specifically relevant knowledge, such as it occurs in the subordinate instance, but with some *background knowledge* in the area at hand. It is necessary to observe that, as it has been indicated in Figure 1, forgetting is a natural follow-up of meaningful learning. However, there is still a learning residue, that is, the presence of a modified subsumer. New knowledge chunks end up being obliterated, or subsumed, although they *are*, someway, inside, the subsumer, and this can facilitate "relearning".

In the classical view the single most important factor influencing learning is what the learner already knows. Thus, instruction must necessarily be organized taking into account the student's previous knowledge.

According to this perspective, the *conditions* for meaningful learning are: the *meaningful potentiality* of the educative materials (that is, they must have logical meaning and the learner must have specifically relevant subsumers) and the *subject's willingness* or *predisposition to learn* (that is, subjects have to present an *intentionality* to transform the logical meanings of educative materials into psychological meanings).

These conditions can be seen at the top of Figure 1. In it, one can notice that meaningful learning can be *representational* (of representations), *conceptual* (of concepts), or *propositional* (of propositions).

Progressive differentiation and *integrative reconciliation* constitute, at the same time, processes of the cognitive structure dynamics and programmatic principles of the teaching organization of the subject matter, as well as the *consolidation* of what one is studying and learning. Besides, we have to add to them the *sequential organization* as a fourth programmatic principle, according to which we have to take advantage of the natural sequential dependencies that exist in the teaching matter. Finally, at the bottom of Figure 1, there are the concepts that were considered secondary in the structure of this theory. *Derivative* subordinate learning is the one in which new material that has been learned does not cause great changes or improvements in the subsumer, whereas the *correlative* is the kind of learning that extends, increases, modifies, or qualifies the anchoring idea.

Meaningful learning in Novak's humanistic view

Joseph Novak (1977; 1981; Novak y Gowin, 1984) Ausubel's partner and coauthor of the second edition of the basic reference book on meaningful learning (Ausubel, Novak and Hanesian, 1978, 1983) gives to meaningful learning a humanistic connotation, proposing that it is subjacent to the constructive, positive, integration of thinking, feeling, and acting, leading to human empowerment.

This integration of thinking, feeling, and acting might be positive, negative, or shaded. According to Novak's perspective, it is when learning becomes meaningful that the learner grows, while having a satisfying experience, and predisposes him/herself to new learning events in a given area. However, on the other hand, when learning is always mechanical, the individual tends to develop a rejection towards the learning subject and he/she does not show any disposition to learn meaningfully. Quite often teaching and learning situations happen between these two extremes of a continuum. Novak's view is relevant because this willingness to learn stands as one of the two necessary conditions for meaningful learning to take place, and this certainly has to do with the integration of thinking, feeling, and acting.

Novak's view is presented in Figure 2, in which the so-called commonplaces of educating also appear — *student* (learning), *teacher* (teaching), *knowledge* (curriculum), *context* (social medium), and *evaluation* (added by Novak) — since they would also be integrated in meaningful learning.

Notwithstanding the fact that they have been much disseminated by Novak (2000), concept maps (Moreira, 2006) are only a facilitating strategy for meaningful learning, just like V diagrams (op.cit.). For this reason, they stand at the bottom of the figure.
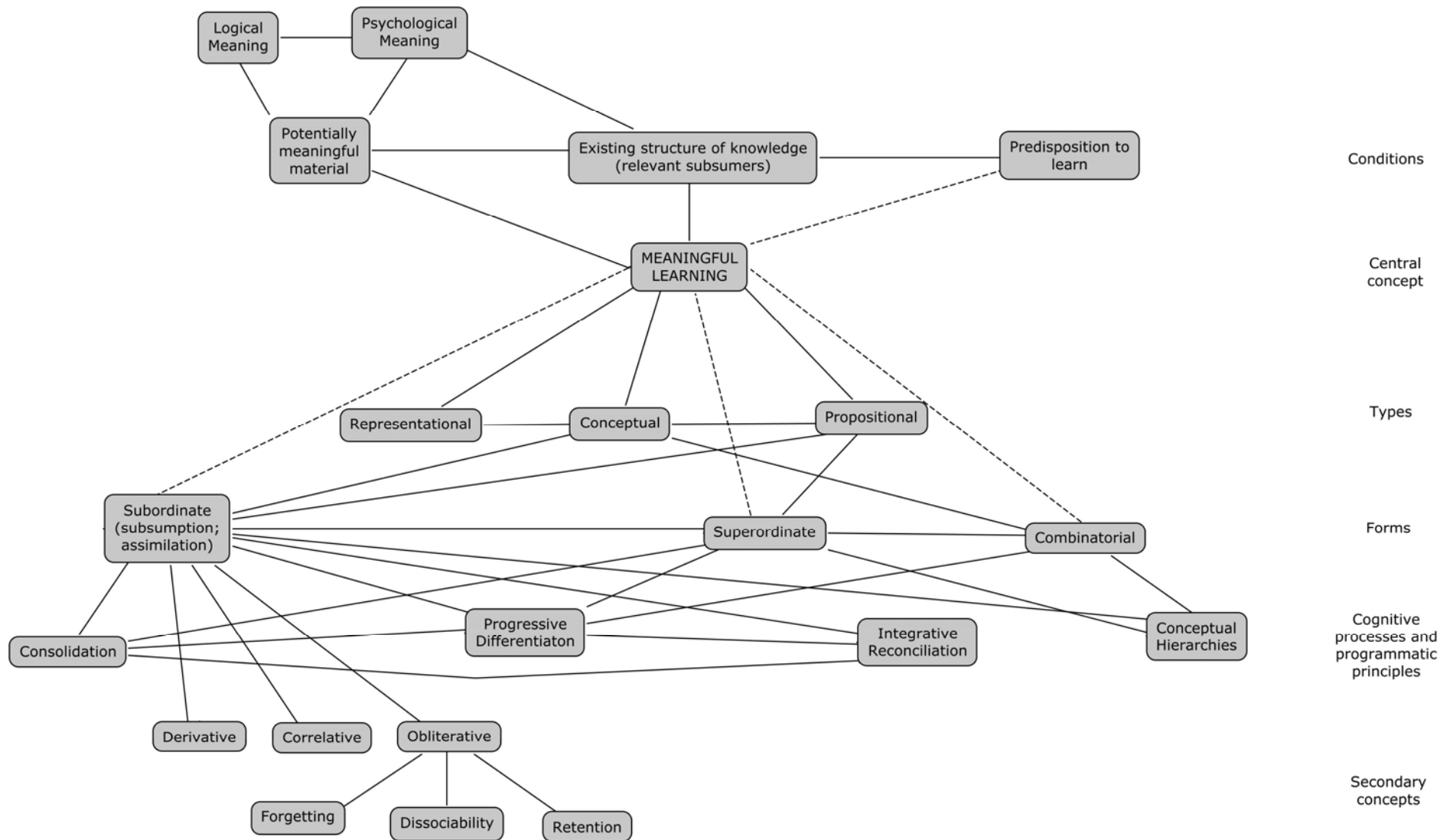
Figure 1. A concept map for the meaningful learning theory in Ausubel's classical view.
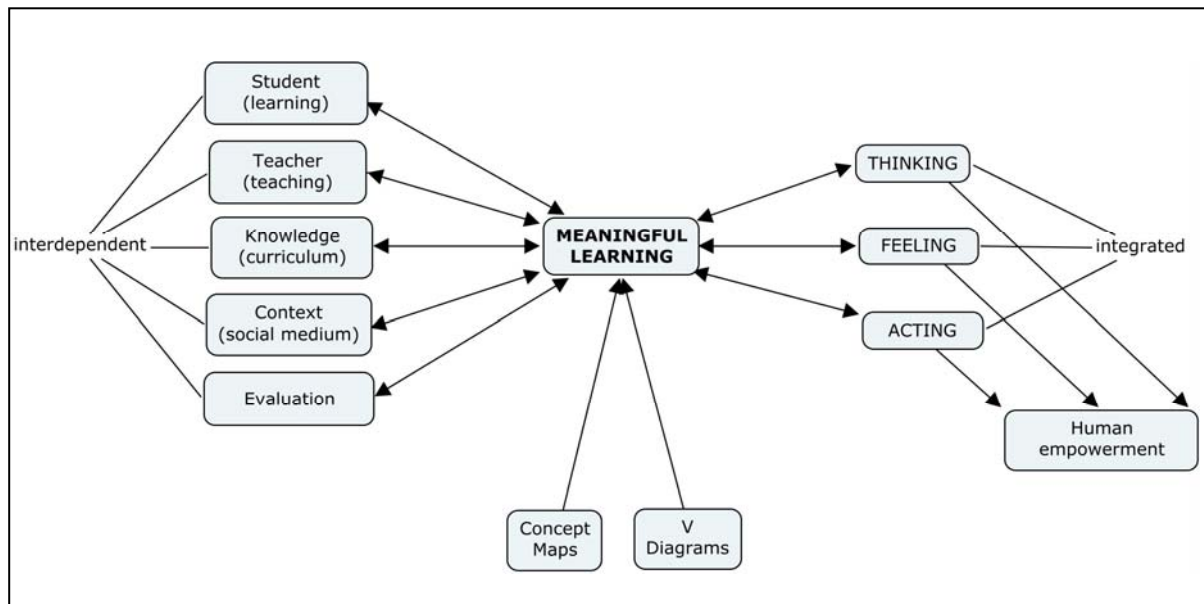
Figure 2: A concept map for meaningful learning in Novak's humanistic view (1977, 1981).

Meaningful learning in Gowin's social interactionist view

The social interactionist view of meaningful learning comprises the triadic approach (*learner ↔ teacher ↔ educative materials of the curriculum*) of D.B.Gowin (1981) displayed in Figure 3. It is a basically social-interactionist perspective, in which the teaching-learning process is understood as a negotiation of meanings that aims at the sharing of meanings in relation to the educative materials of the curriculum.

The teacher (human mediator) is the one who masters the accepted meanings within the scope of the teaching subject, while the learner is the one who attempts at grasping those meanings. The teacher's role is to present, in the most diverse ways and in as many times as necessary, those meanings and to look for evidences that the learner is grasping them. The learner's role is to verify whether the meanings he/she is grasping are those that are accepted in the context of the teaching subject. This is what comprises the negotiation of meanings that happens in a different locus, which is the social context.

In this model, a teaching episode happens when the student grasps the meanings the teacher expects him/her to grasp, which are those accepted in the subject matter context. It is in this sense that there is an action of sharing meanings.

In accordance to this thinking mode, the learner is able to decide whether he/she wants to learn meaningfully when he/she grasps the meanings as they are accepted within the scope of the teaching subject matter, deciding to share meanings linked to the educative materials of the curriculum with the teacher. That is, Gowin introduces the idea of grasping meanings as something that precedes the happening of meaningful learning.

In the process of negotiation of meanings, which is characteristic of the approach, language (semiotic mediation) plays a crucial (Moreira, 2004) role.
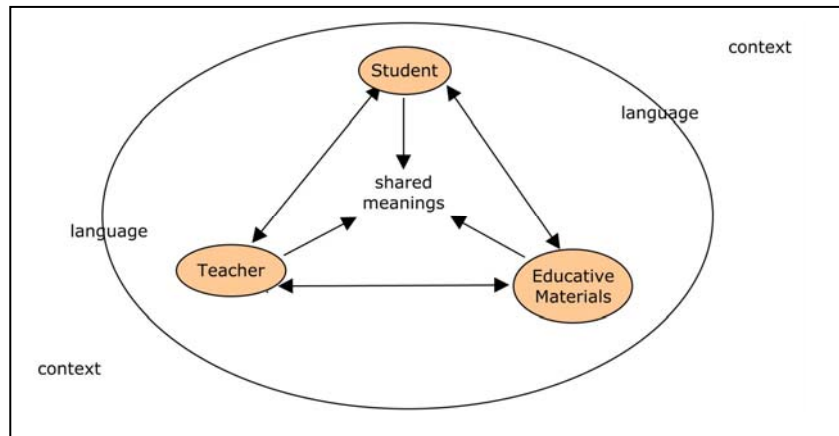
Figure 3. Meaningful learning in Gowin's social interactionist view (1981).

Meaningful learning in a contemporary cognitive view

Ausubel's classic idea according to which meaningful learning promoted the interaction between new and prior knowledge is, for sure, quite adequate. Nonetheless, little has been said about how the interaction happens.

Johnson-Laird's mental models theory (1983) offers an explanation on how this cognitive interaction might happen: **when facing a new knowlege, a new situation, the first mental representation the subject constructs, in his/her working memory, is a mental model (a structural analogue of the situation).** Depending on the circumstances, this representation can get stabilized and can evolve to a Piagetian assimilation scheme (Moreira, 2002; Greca & Moreira, 2002). Figure 4 shows this in a schematized way.
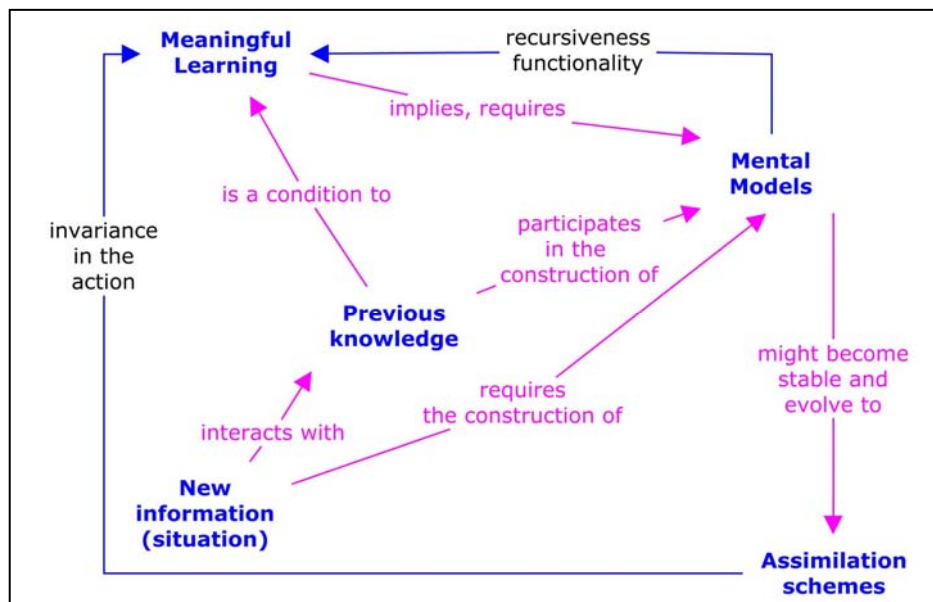

Figure 4. Meaningful learning in a contemporary cognitive view.

That is, the construction of a mental model may be understood as the first step for meaningful learning. Such construction reflects an intentionality of the learner because if he/she constructs a mental model it is because he/she wants to solve the situation and to assign meanings to the new knowledge.

However, a mental model has a single commitment, and it has to do with the functionality it has to the subject. Thus, this does not imply meaningful learning in the sense of the sharing meanings, since a mental model might be contextually *wrong*, though it may work pretty well for the individual. On the other hand, mental modeling is recursive so that the mental model can be changed as much as it is necessary along the negotiation of meanings, and it should constitute an essential step to meaningful learning, as it might even evolve to assimilation schemes.

Meaningful learning in a view of complexity and progressiveness

This perspective, which is clear in Vergnaud's theory of conceptual fields (1990; 2009; Moreira, 2002), is relevant to avoid thinking that meaningful learning takes place in an abrupt manner, or that learning is either meaningful or mechanical, that is, dichotomist.

According to Vergnaud, knowledge is organized in conceptual fields, whose mastering, in relation to the person who learns, happens along a broad period of time. Conceptual field is, above all, a set of problem-situations, whose domain requires the subject to have mastery of various concepts of distinct categories. Students' knowledge is modeled in accordance with the situations they encounter, and, then, can progressively master them. These situations are, nonetheless, increasingly complex. A concept field is a complex field. The only way a person can master it is by, progressively mastering increasingly complex situations.

As the individual progresses in mastering a conceptual field, he/she needs new conceptualizations, so that he/she can continue developing cognitively. Nonetheless, this trajectory is slow, progressive, and non-lineal, with ruptures and continuities.

The situations are the new knowledges that attribute meanings to concepts, though, in order to master these situations, a learner needs concepts, that is, previous knowledges. Nevertheless, these previous knowledges will become more elaborate, richer and more differentiated when used to master these situations. This interaction characterizes meaningful learning, however, from a perspective of complexity and progressiveness.

This perspective of progressiveness and complexity is expressed in Frame 2 as well as in the concept map displayed in Figure 5. Ausubel 's new knowledge would stand for the new situations. Pre-existent knowledges (subsumers) could be concepts under construction. Meaningful learning, in a progressive way, would result from the interaction (dialectic relation) between the two of them.

Meaningful learning theory also involves concept acquisition, that is, it comprises the internal reconstruction of explicit and formalized concepts, in teaching situations. It actually proposes, for facilitating purposes, programmatic principles, such as progressive differentiation and integrative reconciliation.

Frame 2. Basic propositions of the complexity and progressiveness view of meaningful learning.

> **The acquisition, or domain, of a body of knowledge (that is, a conceptual field) is a slow process, nonlinear, with ruptures and continuities.**
>
> **Thus, meaningful learning is progressive.**
>
> **New knowledges are molded by the situations (in increasing levels of complexity) previously dominated.**
>
> **There is a continuum between rote learning and meaningful learning.**

This means that one of these theories gets involved with conceptualization as the nucleus of cognitive development, while the other deals with the learning of concepts in the classroom. There is, then, a complementarity. Vergnaud's theory of conceptual fields seems to supply an adequate theoretical framework for the analysis of the fine structure of meaningful learning, and it clarifies that this learning is progressive, which might require much time (and many situations) to achieve a high degree of meaningfulness.
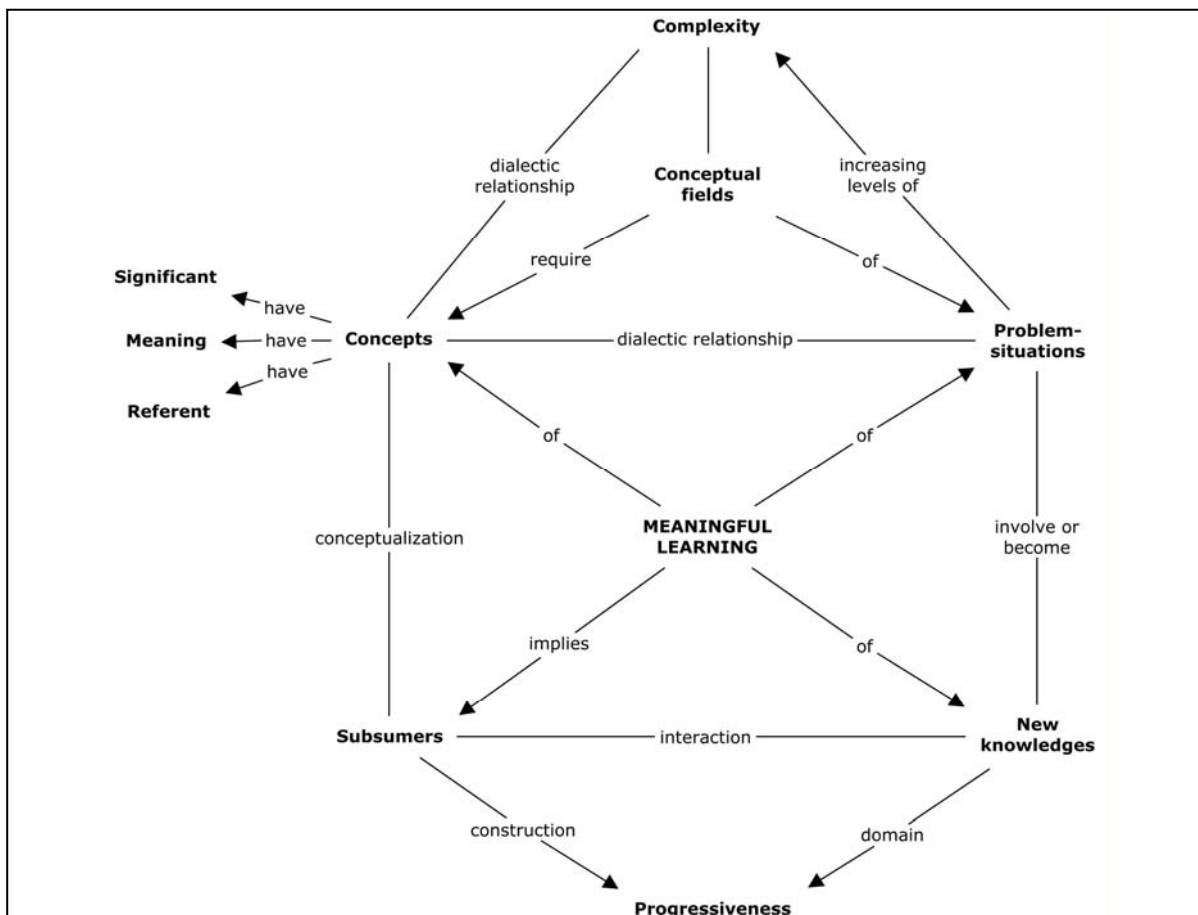

Figure 5: A conceptual scheme for the complexity and progressiveness view of meaningful learning.

Meaningful learning in an autopoietic view

Humberto Maturana (2001) considers all living beings as autopoietic autonomous systems that subordinate their changes to the conservation of their own organization. They can be disturbed by external elements, but they suffer internal changes that compensate for such disturbances.

In order to explain the act of knowing, it is necessary to explain the knower, who is a human being, an autopoietic system. This explanation happens through the use of language, though its validity depends on the one who accepts this explanation.

According to this view, the student is an autopoietic system, while the teacher and educative materials are disturbing agents. It is this student, in his/her cognitive structure that determines his/her changes in face of such disturbances.

Students' prior knowledges are explanations that are, in fact, reformulations of their experiences. Such clarifications might be accepted, or not, within the scientific context. In the first case, they are valid since they comply with scientific validity criteria; in the second case, they can be valid once they have been accepted in the context of everyday life. Thus, both are valid depending on where they are accepted, and these clarifications occur through language.

Meaningful learning takes place, then, in the domain of disrupting interactions that generate changes of state, that is, structural changes that do not modify the autopoietic organization and maintain identity.

New knowledges are perturbations that acquire meanings in the course of meaningful learning and, at the same time, in a disturbing interaction modify, to some extent, the structure of previous knowledges without changing their organization.

Figure 6 presents a concept map for meaningful learning according to the autopoietic view. In it, organization and meaningful learning appear as the most relevant concepts. The idea here is that the subject, as an autopoietic system, determines meaningfulness of his/her learning, while always keeping his/her cognitive organization. This seems coherent with Ausubel's original proposal that emphasized that the subject's willingness to learn is one of the essential conditions for the occurrence of meaningful learning. Prior knowledge is the other necessary condition.

Meaningful learning in a computacional view

This view, on the other hand, has a lot to do with what we call contemporary cognition, that is, the perspective of mental models, which has to do with the computer as a learning tool.

In the vantage point of today's cognitive psychology, the human mind is considered as a computational and representational system. The mind receives sensorial information from the world, which it processes, that is, computes and generates representations of the state of objects in the world. These mental representations are ways to internally re-present the external world. People do not grasp the outside world directly, but they construct mental

representations of it (internal representations). When the student receives[4] new knowledges and he/she is predisposed to learn, he/she constructs mental representations of these knowledges, such as mental models (when the situation is new) or this student activates assimilation schemes if this situation seems, in a greater or lesser extent, familiar to him/her.
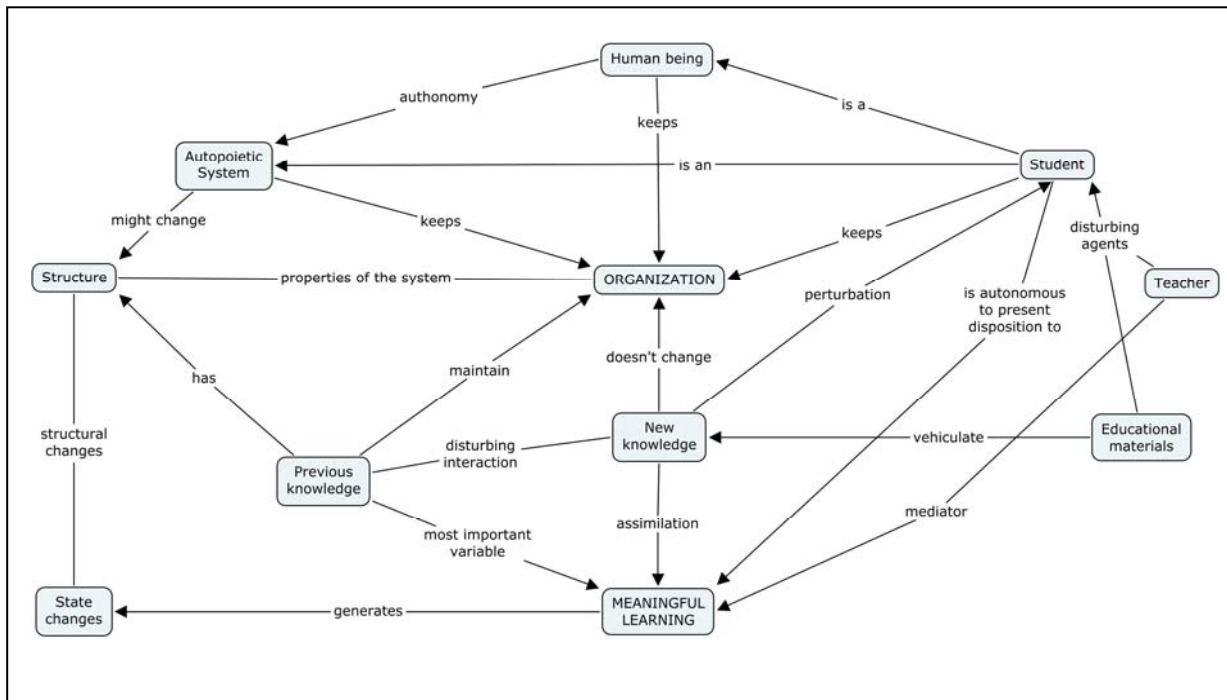

Figure 6. A concept map for meaningful learning in the autopoyetic view (Moreira, 2006).

In the construction of these representations, the most relevant variable is the student's prior representations, that is, his/her internal representations with some degree of stability. These representations can change as they incorporate new pieces of information. The idea is the same as the one proposed by Ausubel more than four decades ago. However, instead of talking about subsumers, which often are interpreted as discrete knowledges, it focuses on mental representations that stem from mental computations, which are not conscious. It is not the intention here to make Ausubel's proposal more complex in relation to the great influence of prior knowledge in the learning of new knowledge, but to provide a clearer and more contemporaneous view of the structure of these prior knowledges.

But, how does meaningful learning happens in this case? Probably the hard core of meaningful learning, that is, the non-arbitrary and non-verbatim interaction between the potentially meaningful new knowledge and some specifically relevant previous knowledge remains unchanged. However, in this case this interaction that characterizes meaningful learning is now being mediated not only by the teacher (human mediation) and by the language (semiotic mediation) but by the computer (machine mediation), as well. Then, will the mental representations constructed by the

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[4] Receiving here is related to receptive learning, in the sense that the one who learns does not have to discover in order to learn. Though the new knowledge might get to the learner through modern multimedia resources, if learning happens, it still is receptive learning. However, receptive does not mean passive since the learner has to process the new information.

learner be different? Will meaningful learning be promoted, if most of the students' interactions – or anybody's interactions – with the computer are trial-an error?

These questions will remain without answers. Contending for them without the support of research findings would stand for mere speculation. Instead, Figure 7 suggests that the triadic relation proposed by Gowin (Figure 3) becomes quadruple. The student interacts not only with the teacher, or his/her peers, but also with the computer.
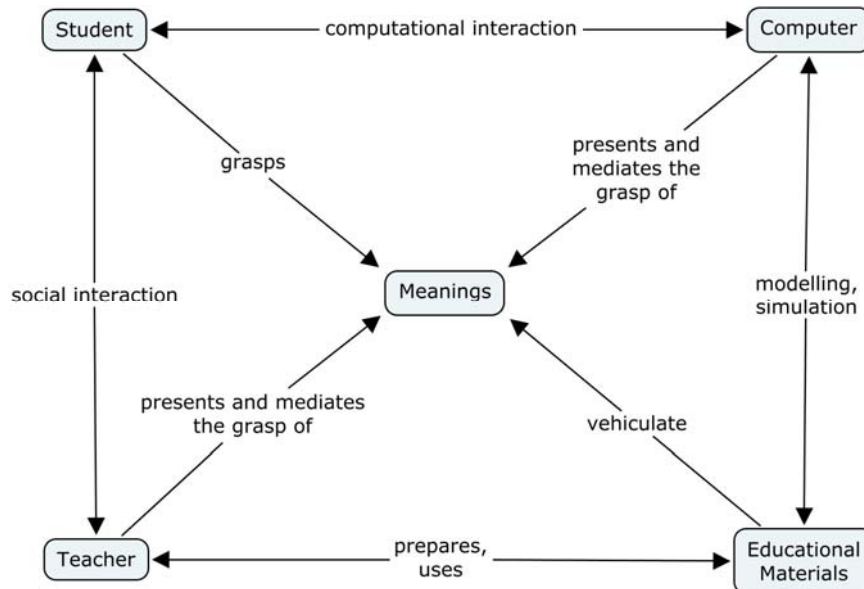

Figure 7.Meaningful learning (grasp of meanings) in the computational view.

The main objective of teaching continues to be the grasping of shared meanings, though mediation also takes place through computer use. Activities such as simulation and computational modeling integrate today teaching, not only as pedagogical resources, but as well as mechanisms that lead to another kind of cognition, to new cognitive processes, and perhaps to another kind of meaningful learning. This is an issue that deserves further inquiry, or it might be already under research scrutiny.

Meaningful learning in a critical (subversive, anthropological) view

In a contemporary view learning must be meaningful as well as critical, subversive, anthropological. That is, in contemporary society it is necessary to acquire it critically. At the same time that one must live in this society, as a part of it, it is also necessary to be critic of it, and to stay apart from it and of the knowledges it yields if those lead an individual to nowhere.

Teaching, because of this, has to follow the principles (Moreira, 2000, 2005, 2010) displayed in Frame 3.

Frame 3. Critical meaningful learning facilitating principles (Moreira, 2000, 2005, 2010)

- **Previous knowledge** (we learn from what we already know)
- **Questions instead of answers** (stimulate questioning instead of providing ready answers)
- **Diversity of educational materials** (abandonment of the manual, of the unique textbook)
- **Learning through the error** (it is normal to err; we learn by correcting our mistakes)
- **Student as a representationist perceiver** (the student represents what perceives)
- **Semantic conciousness** (the meaning is in the person, not in the words)
- **Uncertainty of knowledge** (the human knowledge is tentative, evolutionary)
- **Unlearning** (sometimes previous knowledge works as an epistemological obstacle)
- **Knowledge as language** (all that we call knowledge is a language)
- **Diversity of strategies** (abandonment of the chalk board)
- **Disclaiming the narrative** (relying just on the narrative does not stimulate comprehension)

The first principle deals with the essence of meaningful learning: prior knowledge is the most influent variable in the acquisition—with meaning—of new knowledges.

The second principle has to do with social interaction and with questioning as focal elements to facilitate the occurrence of critical meaningful learning: it is far more relevant to learn how ask questions than to learn "right answers" to questions. It is equally important to learn from a variety of educative materials: the single book—the one known as the textbook—steers students to a limited range of perspectives, does not motivate questioning, and supplies 'the right answers'.

Learning through error is natural in human learning outside the school limits. We continually make mistakes and we can learn from them. However, in school, error is punished. Furthermore, school sees the student as a receiver of correct answers, which have to be memorized and reproduced without errors, but, actually, the one who learns is a perceiver, that is, he/she is a subject that perceives and represents what he/she is being taught.

Another important principle aiming at the facilitation of critical meaningful learning states that meaning resides in the persons, and not in words. The teaching-learning process implies presentation, reception, negotiation, and the sharing of meanings, for which language is crucial. So, it is necessary to be always aware that meanings are contextualized, and arbitrarily attributed to objects and events by the subjects. These subjects also ascribe idiosyncratic meanings to the state of things in the world. Thus, meaningful learning demands the sharing of meanings though it also implies personal meanings.

The issue about the uncertainty of knowledge does not mean relativism and indifference, but that it does not make sense to teach dogmatically. Human knowledge evolves. The best models we have today will generate others that might be richer, more elaborate, and better. We need, thus, to learn them from a critical perspective, and not from a dogmatic one.

As it has been said before, prior knowledge is the variable that has the most influence in the learning process. Its effect is highly facilitating of meaningful learning, though sometimes it can inhibit meaningful learning. This means that it does not allow the subject to perceive new meanings and new linkages. In this case, it is necessary to learn not to use such knowledge. It is in this sense that unlearning is used, that is, not using the anchoring idea. Certainly, this is a difficult task, however, we have, at least, to attempt to apply it.

The two last principles—disclaiming the chalkboard and the narrative (monologue)—might be the first ones since, someway, these two include all the others. The chalkboard symbolizes that sort of teaching in which the teacher writes, the student copies, then he/she memorizes and reproduces what has been copied. It has to be rejected since what we want is to promote a critical meaningful learning. Nowadays, the chalkboard has been replaced by colorful and animated *Power Point* presentations. The effect is the same as when the chalkboard is used. The next to the last principle proposes a diversification of strategies together with the active and responsible participation of the student in his/her own learning. The last one follows the same direction: the teacher must not be a narrator and should start teaching with his/her mouth shut, as Don Finkel (2008) suggests. Instead, students should be the narrators, that is, the ones who talk.

Concluding remarks

Thus, it is clear that meaningful learning is a very actual concept, in spite of having proposed more than forty years ago. It is also clear that this concept has precise original meanings that are subjacent to all the views presented in this paper. Approaching meaningful learning from different perspectives does not mean that everything is meaningful learning. On the other hand, since more than forty years have passed, new approaches are needed, specially those of complexity, progressiveness, and criticalness.

The phenomenon of interest of Ausubel' s original theory (1963, 1968) was the meaningful acquisition and retention of knowledge in a formal situation of teaching and learning. In his last book (2000), he reinforces this preoccupation in the title of his work, and he reiterates most of the conceptual and propositional aspects from his previous works.

This means that he has aimed at demonstrating that his theory is up-to-date. However, in this 21st century it does not suffice to restate that prior knowledge is the most influent variable when we consider meaningful acquisition of new knowledges; or that meaningful learning results from the nonverbatim and non-lineal cognitive interaction between new and previous knowledges; that the learner has to have intentionality to learn meaningfully; that progressive differentiation and integrative reconciliation are cognitive processes and, at the same time, programmatic principles that can facilitate meaningful learning. All these principles are important, but we must have in mind that both the attribution of meanings to new knowledges and the construction of meanings are progressive. Meaningful learning depends on the grasping of meanings that results from the negotiation of meanings between the learner and the mediator. This is not an immediate process. Quite the opposite, it is usually quite slow-paced, and it presents continuities and discontinuities. When it is forced upon the learner, it will motivate rote learning.

On the other hand, even when the acquisition of knowledges happens meaningfully this is not enough anymore. This kind of learning must be critical as well. In the contemporary society it does not make sense to learn meaningfully some new knowledges without questioning those knowledges. The human knowledge is constructed and nowadays such construction happens in large scale and changes quickly. To learn meaningfully and critically would allow the learner to deal not only with the large amount and uncertainty of knew knowledges but also with the uncertainties and changes of the contemporary life.

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