

# Indigenous Intercultural Physics Teaching Based on David Ausubel's meaningful Learning theory

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**Abstract**— This work presents a proposal for implementation of Physics teaching that interacts with culture and the natural phenomena studied by it, based on David Ausubel's Cognitive Theory to aggregate substantial factors to pedagogical facilitation. Therefore, through an educational practice using contextualized material and teaching, whose subjects interact with environment and apply knowledge from daily life, it is possible to understand and interpret from interdisciplinarity and actions not fragmented or mechanic. In other words, developing an accessible and intercultural learning it becomes effective (meaningful).

**Keywords**— Cognitive theory, Contextualized learning, David Ausubel, Interculturality, Physics teaching.

## I. INTRODUCTION

In the state of Bahia, both Physics teaching and indigenous school education are object of research, however the methodology applied at classroom and beyond it lack further deepening. The educational practices developed in indigenous schools of Bahia continue fostering the mechanical learning. This is portrayed by the classical model whose teacher presents the content on the chalk board and the student, in its turn, just copy, in the common attempt to merely memorize to answer a test, memorizing content without any meaning and applying it mechanically to familiar situations and repeated several times, without questions to its relation with the community day-to-day or even on the labour market (practical use).

In indigenous school education of Bahia the most part of Physics Teaching is configured by fragmented actions and out of the daily context and indigenous culture. Unfortunately, it turns to the reproduction of knowledge and expertise imposed by contemporary society through textbooks rooted in cultural or ideological values that do not represent them,

In other words, reproductions that reflect the dominant culture desire of spread knowledge conveniently to a certain reality. They are books that do not show to indigenous students that the Physics studied

by them is derived from an historical building emerged of various cultures. They do not show that, many times, it occurs paradigm break on the science and that evolution of knowledge do not require a culture more important than the other, but that complete each other, because the cultural and social contextualization is relevant to the knowledge development. [1]

It is worth mentioning that it is unquestionable the importance of the textbook on the historical process of school education. However, according to our perspective, its value in the development of indigenous school education request some modification, including with regards to the textbook of Physics, and it is worrisome the lack of contextualization in the indigenous culture in the themes covered. In other words, they do not bring an intercultural perspective of teaching.

[...] Physics teaching in indigenous schools is still characterized by excess of attention given to repeated exercises, problems solved mechanically by a series of formulas, often decorated literally and arbitrary to the detriment of a deeper analysis aiming the comprehension of the involved physical phenomena. [1]

Other major factor observed in the classroom is the lack of context and meaning of Physics Teaching in the student daily, because Physics is being presented just as a mathematical formalism or, many times, through examples that occur only on the big cities. In addition, the language not accessible to the student is a concerning and essential factor, bearing in mind that language has a facilitating role on a meaningful learning.

It is fact that the indigenous teachers claim the elaboration of new curricular proposals applicable to their schools to replace the general model of current educational system. The reason, according to register from RCNEI/MEC (1998), is that “such models never corresponded to their politics interests and pedagogies of their cultures” (p. 11). [2]

Other concerning in Physics Teaching in indigenous schools of Bahia is the lack of proper training of the teacher. It is very common to find teachers teaching Physics in indigenous schools but with degree in Biology, Mathematics, Pedagogy or only Magisterium. [1]

In this context, we bring as issue the possibility of a meaningful learning in Physics by the indigenous student from Bahia. From that issue it is derived specific goals that unfold in analysis of the high school Physics textbook prevailing approach, with regard to the guidelines recommended by RCNEI and its interdisciplinary or intercultural perspective about Physics teaching.

## II. CONCEPTIONS ABOUT MEANINGFUL LEARNING

The meaningful learning was influenced by Jean Piaget's Genetic Epistemology Theory which is based on the idea that the knowledge occurs based on an interactive process between the subject and the medium. Piaget searched to understand the capability of knowing and learning of the child, treating the subject as a systematic being always on the search for knowledge, studying the child's thinking and how it is developed still achieve the mature reasoning. [1]

Nonetheless, although Piaget's Theory dwell on the child development and have information about the adult functional learning, when we deal with the learning without any age restriction of the student, we glimpse the theory of Meaningful Learning by David Ausubel as the most suitable to this work.

According to Moreira (2001) [3], Ausubel concentrated himself on a question that any researcher had worried about until that moment: the learning that occurred in the

classroom, valuing the learning by discovery, which incited the lecture as the big focus of his research.

In our conception, Ausubel achieves a fundamental point on the teaching-learning process, on which the individual is the subject of its learning, that depends of its previous knowledge and interactivity with the medium, what cause new meaningful knowledge.

The distinction between Rote Learning and Meaningful Learning is one legacy from the Cognitive Theory of David Ausubel whose application in teaching practice aggregate considerations about the traditional and the focus class, through the search for effective learning. The meaningful learning depends of three essential elements: the new logical structured knowledge and the previous knowledge that can be associated and the comprehension design of the intended knowledge. [3]

The individual's cognitive structure, to Ausubel, is the organized content of ideas that in terms of learning of particular themes and issues, refers to the content organization of that area the individual wants to learn. In other words, the emphasis is given to the ideas acquisition, storage and coordination in the individual's brain. Based on this, we think that the cognitive structure is the set of cultural references that the subject has, since the culture guides the individual's perception and cognition codes, favoring acquisition, organization and anchoring of new knowledge. [1]

In this perception, the individual's cognitive structure to Ausubel (2003) is structured and organized, and the new ideas are articulated according to the relations established between them. Furthermore, it is in the individual's cognitive structure that new ideas and concepts are being fixed and organized gradually, in other words, learned. [4]

According to his theory, the continuous incorporating of new ideas in the individual's cognitive structure provides the learning due to modifications that occurs in that. The apprenticeship can be mechanical or meaningful, in which the meaning factor is the relation that the individual will make with the new proposed idea and the previous knowledge existing in its cognitive structure. In other words, if the new idea is meaningful to the individual, it will occur the meaningful learning, otherwise, it will be a mechanical learning. [3]

However, it is not possible to discuss about meaningful learning without expatiate on comments about rote learning – opposite sides and, unfortunately, it is the most common learning in the indigenous schools, in other words, that one practically without meaning, merely memorial, that serves to a particular purpose, normally a test, that after some time will be deleted, forgotten from the student's cognitive

structure. In this case, the new ideas are not logically and clearly related to the previous knowledge on the student cognitive structure, but they are merely memorized and reproduced, what do not ensure flexibility even longevity on its use. It impairs the learning of Physics by the indigenous student, because on our conception it is so much used by the students because it is still encouraged by the school.

The negative consequence of the rote learning in Physics teaching in indigenous schools of Bahia is that there is not substantivity, so the student is not able to express the new content with a different language from that with which the material was first presented. Therefore, the indigenous student will not be able to connect his culture and community reality with the content presented in the classroom and beyond it. It is worth mentioning that the rote and the meaningful learning are not separated, because they are along a fine. [5]

According to Moreira (2001) [3], the transition from the rote learning to the meaningful learning is not natural or automatic. It is an illusion to think that the student can learn initially on a rote way because at the end of the process the learning will be meaningful. It can occur but it depends of proper subsunctors, student predisposition to learn, potentially meaningful material and teacher's mediation.

### III. INTERCULTURAL FACTORS TO PEDAGOGICAL FACILITATION

The substantive factors of pedagogical facilitation, as the name says, are that that promote the action of learning and they are related to selection of the most relevant themes that will be worked with the students. Hence, it is important to select basic ideas not to overburden the students with unnecessary information, hampering the acquisition of a proper cognitive structure. [3]

With regards to intercultural factors associated to Physics Teaching and the Meaningful Learning Theory as a process to pedagogical facilitation, the teacher must associate daily cultural processes of the community as a trigger to the indigenous student. In other words, through their previous knowledge (rituals, cosmology, religious ideas, art and other aspects of life) they will be able to formulate ideas and conceptions to new knowledge through these subsunctors, predisposing them to a meaningful learning. [1]

We believe that human thinking is developed through the lived cultural background. In other words, culture is what characterizes man, and not the man that characterizes

the culture. This conception inserted in school context, production of didactic material and in the community is fundamental to develop the indigenous student thinking and to a meaningful learning.

To David Ausubel (2003) [4], the concepts should be preferably presented to students in a wide format, in other words, from more general ideas to specific ones, because learning by subordination is easier to the individual than by superordination. Therefore, when the concepts are being worked, they will be able to be connected on a subordinated way – when apprenticeship occurs by subordination, the key concepts that are necessary to allow a meaningful learning are denominated subsunctors.

In this respect, when the teacher select general ideas/concepts about certain content linked to the students' cultural context, they will serve as an anchor to future apprenticeships. Otherwise, if the teacher's choice is for unique ideas/concepts, in other words, concepts not associated to their culture, probably it will not be meaningful to them, because it would be missing previous concepts on the cognitive structure of the student. [1]

It is possible to remark that the big and common difficulty presented on the Physics apprenticeship by High School indigenous students is that the teachers link the content taught to examples only from the textbook, that do not bring the indigenous context, in other words, do not portray their culture. Other factor is that there is a lack of proper information of the indigenous and not indigenous teacher at school, as we previously quoted.

### IV. MATERIAL AND METHODS

This work was a theoretical-exploratory research that aimed to construct strategies to implementation of an intercultural Physics teaching at Indigenous School of Coroa Vermelha (Escola Indígena de Coroa Vermelha), as well to create proposals of alternative intercultural didactic material buoyed on David Ausubel's Meaningful Learning Theory.

Bibliographic studies were made to characterize the fundamental concepts of Meaningful Learning in diverse contexts of an intercultural epistemological approach, as well as a detailed study of their main characteristics in the indigenous reality.

Next, the studies were centered around a conceptual exploration and use of interculturality to organize the concepts studied in Physics within an alternative model of intercultural education.

## V. CONCLUSION

The study brings as a great didactic-conceptual advantage the use of cultural knowledge of indigenous students, in other words, their previous knowledge as subunits to represent and model the main Physics concepts. This is mostly due to the existent capacity for dialogue between indigenous culture and the natural phenomena studied in Physics. The relation of cultural valorization in indigenous context is fundamental to pedagogical practices of the teacher in the classroom as well to the possibility of an alternative intercultural didactic material of Physics.

We believe that the local conceptions, pedagogical practices of the teachers and the process comprehension are crucial to obtain a significant answer from the indigenous students in the classroom and beyond it. Therefore, it is crucial to a meaningful learning of physical processes to High School students the compatibility between didactic material and local context, having as proposal the cultural enhancement of indigenous people in Physics study. At the same time, the relationship between teacher, student and community presented itself as a differential of an intercultural education in the indigenous education process.

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