THE IMPORTANCE OF PRIOR KNOWLEDGE TO SITUATE AND ARTICULATE LEARNING PROCESSES IN A BIOLOGY CLASSROOM

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ABSTRACT

For the Science Education that takes place in our schools, mechanistic teaching, based on the transmission-reception-reproduction of knowledge, no longer fits. Instead, we understand the teaching-learning process through other theoretical-methodological conceptions that aggregate the conceptual and contextual dimensions of biological-scientific knowledge. We assume learning as a process of signification and, in this sense, as a social practice, as it occurs through the engagement of actors from their socio-historical contexts. To this end, prior knowledge is a relevant factor for the elaboration of new knowledge and for learning. In order for previous and new knowledge to relate, it is necessary for the teacher to promote interactive, creative and dialogical spaces, through specific disciplinary practices. In the interactive sequence analyzed, we recorded that previous knowledge is present and is mobilized to organize, relate, order or compare concepts in order to reconstruct new ecological meanings. We also perceive that the mechanisms of signification arise from the students' commitment to social and cultural activities mediated by the other and by language in a socio-interactionist perspective.

Keywords: Meaningful learning. Sociointeractionism. Food webs. Ecology.

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BUILDING LEARNING PROCESSES IN A BIOLOGY CLASSROOM

As teacher-researchers, we have been dedicating ourselves to rethinking teaching-learning processes in Science and Biology, especially those that take place in Elementary and High School, in formal spaces such as in a classroom. Specifically, this study is part of our investigations[2] that were born from our own observation, experienced during Biology classes in high school classes. The students had been presenting many difficulties in understanding biological processes and phenomena, as well as low interest and little ability to relate the concepts worked on in the Biology discipline (conceptual dimension) with concrete situations they face on a daily basis (contextual dimension). Recurring aspects already registered in the scientific literature such as Pozo; Gomez Crespo (2009):

> Often, students are unable to acquire the necessary skills, either to draw a graph from some data or to observe correctly through a microscope, but other times the problem is that they know how to do things, but they do not understand what they are doing and, therefore, are unable to explain or apply them in new situations. This is a very common deficit [...] (Pozo; Gomez Crespo, 2009, p. 16).

This difficulty and inability to relate the conceptual and contextual dimensions of the Sciences reflects the way of structuring and presenting school curricula that, historically, has focused exclusively on the conceptual dimension of the disciplines (Muenchen; Delizoicov, 2014). Consequently, our students tend to express many difficulties when called upon to interpret and make critical decisions in the face of real situations permeated by issues of a biological-scientific nature.

For the Science Education that takes place in our schools, mechanistic teaching, linked to the transmission-reception-reproduction of biological-scientific knowledge, no longer fits. To advance this discourse, we understand the teaching-learning process through other theoretical-methodological conceptions that add such complexity. Learning as a process of signification emerged in the 90s as a viable way for the relations between the conceptual and contextual dimensions to be built in the teaching of Biology, as Coll (1994, p. 148) indicates:

> The student learns any content – a concept, an explanation of a physical or social phenomenon, a procedure to solve a certain type of problem, a norm of behavior, a value to be respected, etc. – when he is able to attribute a meaning to it.

[2] Revised and expanded text from Souza, G. O de; Machado, L. C. F. Previous conceptions about food chains and webs: learning from the sharing and co-constructions of biological meanings. In: VII National Meeting of Biology Teaching / I Regional Meeting of Biology Teaching - North, 2018, Belém do Pará. **Annals** [...]. Belém do Pará: IEMCI, UFPA, 2018. p. 673-679.

From this perspective, we strive to integrate learning processes into curricular scientific content in a meaningful and relevant way for students. To this end, we situate our investigations under two premises:

> 'i. the school space and the classroom as a place where interaction is promoted between the actors involved in the learning process and between them and the curricular contents;'
> 'ii. and how these actors propose meanings when interacting with the other and with the object of study, assuming the learning process as a social practice, as it occurs from the commitment or engagement of the actors from their socio-historical contexts.'

Initially, in the structuring of a scientific and citizen education, we understand that the school space is a place of convergence between all the elements involved in the learning process, that is, it is possible to meet *"*(...) *between teachers and students, between curricula, teaching materials and training processes, which allow us to understand how biology teaching practices are articulated with the various socio-historical elements that constitute them."* (Marandino; Selles; Ferreira, 2009, p. 23).

Thus, it is important that teachers start from the knowledge already present and brought by students to the school space and use it, either by experimentation, direct or indirect observation of a given phenomenon or biological process so that discussions can be held and that the desire to find explanations to the questions asked is stimulated (Krasilchik, 2016).

Prior knowledge is the most relevant factor for the elaboration of new knowledge and for the process of meaningful learning. When Moreira (2011, p. 26) analyzes David Ausubel's proposal, the mobilization and organization of a group of pre-existing knowledge "*(...) in a given body of knowledge is what most influences the significant acquisition of new knowledge in this area, in an interactive process in which the new gains meanings, integrates and differentiates itself in relation to what already exists".* In this way, these sets of knowledge present in the cognitive structure of students become increasingly complex and capable of relating again to others that are also more elaborate.

Also supported by Vygotsky (2008), we recognize the importance of language to articulate and organize this social context, since it constitutes a mediating instrument. The mediations provided by the teacher, during didactic interactions, can establish in the classroom the 'Zone of Proximal Development', or the

> [...] distance between the actual level of development, which is usually determined through independent problem-solving, and the potential developmental level, determined through problem-solving under the guidance of an adult or in collaboration with more capable companions. (Vygotsky, 2008, p. 97)

In this way, according to Souza; Machado (2023), it is from interactive movements that the real development of the learner can be revealed and, simultaneously, the concepts, phenomena and biological processes can be presented and investigated by the students, providing apprehension and problem solving with the help of the other, that is, students and teacher in a socio-interactive context (Vygotsky, 2008). In the Vigostikian sense, biological-scientific knowledge happens through a conceptual network in which a given concept is established in the relationship it maintains with another concept and, in this way, it is

> (..) the importance of teacher mediation in the didactic process, investing in a pedagogical environment that favors the construction of these relationships so that meaningful learning takes place and, by inference, the cognitive development of the student — since in Vygotsky (2008), learning precedes development due to the appropriation of mediating instruments. (Souza; Machado, 2023, p. 1299)

It is in the interaction between students and between them and the object of study, through specific disciplinary practices, that learning processes will effectively occur. Thus, the "productive disciplinary engagement" will be characterized through increasingly elaborate argumentative constructions, in the approach to issues, in the recognition of conflicts, in the relationship between ideas and concepts and in the planning to achieve established objectives. Consequently, students will show signs of "intellectual progress" (Engle; Conant, 2002).

As proposed by Arca, Guidoni and Mazzoli (1990), we consider that the elaboration of meanings involves three dimensions: thought (or ways of thinking), language (or ways of speaking) and experience (or ways of doing), which can favor and stimulate movements towards the elaboration or construction of biological meanings. Also according to these authors, learning is characterized as a social practice that can promote some tension, some conflict, but also allows sharing and convergence for the emergence of new meanings, which represent collective productions that will ensure some understanding of a given biological phenomenon studied.

Under this scenario, our investigation was in charge of analyzing an interactive sequence taken from a Biology class of the third year of High School that intended to dialectically introduce the conceptual and contextual dimensions of the food chain and web, with the purpose of examining how our students mobilize their previous knowledge in a process of co-construction and sharing of meanings of a biological and ecological nature.

METHODOLOGICAL PATHS

Considering that the relationships between students, teacher and object of study occur in a non-quantifiable dimension, based on the interpretation of phenomena, the

attribution of meanings and the natural environment as a direct source to bring some understanding of the context in which one is inserted, the present work is characterized as a qualitative experience report. Therefore, distinguishing itself as an interpretation and an analysis arising from the compilation of direct and objective data regarding the researched universe and, therefore, the subjective dimension of the professors-researchers inevitably arises in the course of the work because we understand that the context in which this research was developed responds to the

> [...] universe of meanings, motives, aspirations, beliefs, values and attitudes. This set of human phenomena is understood here as part of social reality, as human beings are distinguished not only by acting, but by thinking about what they do and by interpreting their actions within and from the reality lived and shared with their peers (Minayo, 2009, p. 21).

From this methodological perspective, the professor-researchers play an important role in the investigative process and in the structuring of meanings, based on participant observation and direct and personal contact with the investigated universe (Víctora; Knauth; Hassen, 2000). Thus, the experience report should be understood as a narrative that is willing to corroborate the experiences that were materialized, considering and agglutinating aspects such as feelings, perceptions, impressions - subjective level - and/or by direct observation of the participant - objective level (Grollmus; Tarrés, 2015).

In order to collect and analyze the activation and mobilization of previous knowledge by the students in a dialogical and mediated context, a 'didactic unit' was built to address and articulate the conceptual and contextual dimensions of the main knowledge about food chains and webs, such as: trophic levels, flow of matter and energy, ecological niche, habitat, environmental impact, pollution, preservation, conservation.

We admit 'didactic unit' as being one or a group of theoretical-practical activities that need to be elaborated and developed in a way that is "(...) *ordered, structured and articulated to achieve certain educational objectives, which has a beginning and an end known to both teachers and students.*" (Zabala, 1998, p. 18). In this logic, it is essential that the didactic units prioritize the following aspects: i- rescue and work on previous knowledge and its relationship with the new ones that are being worked on; II- Develop the contents significantly and appropriate to the level of development of the students; iii- motivate learning, stimulating self-esteem, creativity and providing each student with autonomy during the learning process (Zabala, 1998).

The didactic unit was applied to two third-year classes of High School/Technical (in Food and Chemistry), totaling 15 students from the Celso Suckow da Fonseca Technological Education Center - CEFET/RJ, located in Valença, RJ, Brazil and held in

October 2017 during Biology classes. To start the process, we follow the following sequence:

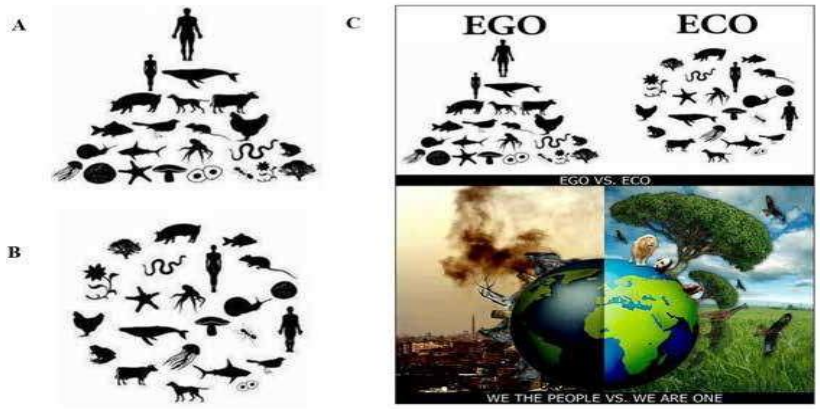
1st Stage: in the first moment of the class, the students were randomly presented with a set of illustrations that characterized different ecosystems with different degrees of disturbances (anthropic or not).

2nd Stage: to adapt to the objective of this study, the first illustration (Figure 1A) was shown; then the second illustration (Figure 1B) was presented by the Professor, who mediated the discussion so that the Students could compare it with the first, starting the dialogues about food chains and webs.

3rd Stage: the complete illustration (Figure 1C) was also shown at the end of the class to answer any questions.

We emphasize that the application of this material is justified because we consider that the use of figures, illustrations and schemes as visual information in the teaching of Science and Biology is recurrent whenever it is not possible to directly observe or analyze the object studied (Krasilchik, 2016).

Figure 1: Group of illustrations used for data collection and discussion.



Source: Available at: htcp://blogecoando.blogspot.com.br/2012/06/relacao-homem-x-natureza-interesses-e.hcml. Accessed on: October 17, 2017.

To collect and analyze the previous knowledge of our students, the classes were audio-recorded and an analytical matrix was structured (adapted from Mortimer et al., 2007). It records categories such as the theme, the content of the teacher's discourse, the interactions and the communication approach carried out during the activity. In this way, it helps in the delimitation of interactive sequences that are presented through the enumerated speeches or turns and are established as the smallest units of analysis. This allows us to highlight epistemic practices or the mediations of the teacher and the movements that the students carry out during the process of constructing meanings. For

ethical reasons, in the presentation of the transcripts of the speeches, the names of our Students were replaced by fictitious names.

MOBILIZING AND SHARING KNOWLEDGE ABOUT FOOD CHAINS AND WEBS

We transcribe below an episode (Table 1), based on the dialogical and mediated space built and shared between the Teacher and the Students when they begin the analysis of illustration B compared to illustration A. We analyze this episode through three sequences of discourses.

Table 1: Presentation of the transcription of the interactive sequences.

1. Teacher:	*So now I'm going to show you this drawing again, but in a different way.*
2. Marcelo:	*Ai is an ecosystem!*
3. Gabriel:	*That's a bunch of randomly matched images.*
4. Peter:	*No, no... that's... kind... one thing depending on the other.*
5. Isabela:	*The woman is still in the middle!*
6. Thiago:	*The woman depends on the man.*
7. Peter:	*It's like a cycle*.
8. Matheus:	*I think it was easier for the woman to be on her husband's side! But it's on the side of the rat, on the side of the snake, on the side of the spider...*
9. Leticia:	*And why would a whale there depend on a dog?*
10. Thiago:	*Is it symbiosis when one depends on the other, Professor?*
11. Camila:	waves to the Professor requesting speech.
12. Teacher:	*It could be Thiago. Camila, tell yours.*
13. Camila:	*No, it's just that... I think the ones around are the most... kind... those in the middle depend... They do not depend on the ... but those around seem to be more common than those in the middle.*

Source: Survey data. 2024.

The teacher shows the illustration (Figure 1 B) and relates it to others previously presented, in order to identify and record the students' previous knowledge about the concepts of webs and food chains (Turn 1). Marcelo and Gabriel quickly present explanations for the illustration and are immediately questioned by Pedro, who incisively presents his perception, indicating that dependence is the main element between the images that compose it (Turns 2 to 4).

In the first sequence, three distinct proposals are observed for what the illustration could represent. Two of them approach each other and one escapes the concepts that the Professor intends to work on. Even if one of them distances itself (*That's a bunch of randomly combined images.)*, the movements carried out by Gabriel, Marcelo and Pedro suggest the mobilization and presence of previous knowledge about the interdependence relationships of the elements that make up a web or a food chain in a natural system.

These movements are used to give shape to the analyzed object. They are characterized, therefore, as a group of ideas, concepts or mental constructions that are activated with the intention of giving some form, some understanding to the world around us

(Giordan, 1996). Processes of inference, some abstraction, some representations or discoveries may involve encounters of the subject with the object of study, with some event or with concepts through the interaction between what is new and previous to them (Moreira, 2011).

In the second sequence, Isabela shows uneasiness with the positioning of the female silhouette and Thiago interferes indicating that there is a relationship of dependence between the feminine and masculine images contained in the illustration (Turns 5 to 6). Peter completes his previous explanation a little further by saying that it may represent something cyclical (Shift 7). Concomitantly, Matheus contradicts the explanation of dependence of the feminine image on the masculine image given by Thiago, probably because the images in question are not positioned in such a way as to suggest pairing or to portray a possible "marital relationship" between them (Turno 8).

In the process of building new formats, tensions emerge in the second sequence, now with one of the images in particular. The students follow the idea started earlier of dependency relationships between the images in the illustration. Apparently, Isabela and Thiago are trying to activate some knowledge about inequalities between women and men (social, economic, gender or others), adding a contextual dimension to the interpretation of these images. Pedro tries to deepen his analysis by bringing more information to his initial description, but Matheus intervenes incisively in Turn 8 (*I think it would be easier for the woman to be on her husband's side! But it's on the side of the rat, on the side of the snake, on the side of the spider...*), contradicts Thiago and tries to convince him and Isabela otherwise while giving a new outline to the same image.

The tensions and discussions presented up to this moment also characterize learning processes, as they are responsible for giving understanding to the images in the illustration. Through tensions and conflicts, sharing, convergences and new resignifications also emerge that can characterize constructions and/or productions carried out collectively, ensuring some understanding of contexts, processes, concepts or even biological phenomena (Arca; Guidoni; Mazzoli, 1990).

Leticia presents doubts about the discussion of the relationship of mutual dependence and seems to suggest that there are not only relations of dependence between the images (Turn 9). Thiago presents a new term and requests confirmation from the Professor on its definition (Shift 10). The Teacher promptly confirms to motivate him, but needs to give voice and stimulate Camila, who timidly suggests a new explanation (Turns 11 to 12). Camila then presents her explanation by bringing new elements through a classification of the images in the illustration (Turn 13).

In the third sequence, Leticia may be suggesting that there are not only direct relationships between the elements (*And why would a whale there depend on a dog?*), but apparently the Teacher does not notice if the Student understands that there may be indirect relations or other forms of relations between the images. At this moment, the Professor is more concerned with motivating Thiago and provides a space for Camila to express herself. Camila, then, proposes in Turn 13 a new description for the illustration as a whole when she says: "[...] *They do not depend on the ... but those around seem to be more common than those in the middle*", although with little certainty, reformulates the image.

The movements made by Leticia and Camila raise new doubts about the meaning that was being constructed. Apparently, both rethink the illustration and analyze it in a more particular, more specific way. Once again, movements of readjustment of the observed object are perceived, and it is not an inert or exempt search for what already exists, but characterizes a process of attributing meanings, new constructions, or even the choice of one among some alternative meanings (Sutton, 1996; Moreira, 2011).

From the three sequences, we also observe that the movements of signification, doubts and uncertainties are readily explained to the group, in a shared movement, making us infer that the establishment of a Zone of Proximal Development begins (Vygotsky, 2008). Considering learning as a process of signification, even though the meanings have been altered during the course of teacher mediation, it is worth noting that for Vygotsky (2008) a higher psychological function (such as memory, perception, attention, speech, thought, concept formation and emotion are exchanged in a network of connections forming a psychological system in which these functions are interrelated) emerges first on the social plane (interpsychological) and then on the psychological plane (intrapsychological).

In view of this, we reaffirm the importance of teacher mediation for structuring dialogical, self-esteem-stimulating, creative, proactive and (re)constructive spaces so that students could mobilize and articulate their previous knowledge to dynamically relate the conceptual and contextual dimensions of the ecological knowledge that was intended to be worked on. For the Teaching of Science and Biology today

> [...] The teacher needs to become a professional with an integrated view of reality, to understand that a deeper understanding of his area of training is not enough to handle the entire teaching process. He also needs to appropriate the multiple conceptual relationships that his area of training establishes with the other sciences. Knowledge will not cease to have its character of specialty, especially when it is deep, systematic, analytical, meticulously reconstructed; however, the educator will have the role of dialectically reconstructing it in the relationship with his students through truly productive methods and processes. (Thiesen 2008, p. 551-552)

Finally, when the students were allowed to position themselves in front of a situation, to question in order to seek solutions and explanations, signs of intellectual progress tended to emerge in this classroom because they participated, actively and collaboratively, in the construction of more elaborate arguments and in the structuring of interconnections between concepts and contexts that were also more complex (Engle; Conant, 2002). Therefore, we reaffirm the importance of considering the previous knowledge of our students to situate and articulate learning processes in a Biology classroom.

FINAL CONSIDERATIONS

Our investigation was in charge of analyzing a discursive sequence obtained in a Biology class that aimed to dialectically introduce the conceptual and contextual dimensions of the food chain and web, with the purpose of examining how our students mobilize their previous knowledge in a process of co-construction and sharing of meanings of a biological and ecological nature.

Therefore, the way in which the teacher used the illustrations and mediated the discussions in the Biology classroom revealed themselves as possibilities for the construction of an important space for learning processes to take place in the classroom. It is a fact that there is some inherent difficulty in relating illustrations or a symbolic representation to reality or a natural system. This transition requires some time and training, but it will be overcome as our students become familiar with the symbols and illustrations conventional, for example, in textbooks (Krasilchik, 2016). This implies considering specific conditions such as those of a Biology classroom for the construction of meanings.

It was possible to observe that previous knowledge is present and is readily mobilized to organize, relate, order or compare concepts and contexts in order to reelaborate and reconstruct new meanings. In other words, the new knowledge could interact with some other pre-existing and specifically relevant knowledge, promoting an anchoring in which "*the new knowledge acquires meanings and the previous knowledge acquires new meanings*" (Moreira, 2011, p. 29). Thus, the mechanisms of signification tend to arise from the commitment of our students to social and cultural activities mediated by the other and by language in a socio-interactionist perspective as indicated by Vygotsky (2001).

By providing spaces such as the one presented in this study, the teacher was also able to establish and agglutinate the two premises initially established and develop a Biology teaching that integrates more relevant learning processes at the same time that the mandatory curricular proposals are presented and worked on in the classroom (Zabala,

1998). The Teacher, as a co-constructor, provides Students not only with a more meaningful learning, but also develops other skills and values inherent to a range of competence for reading and coping with the world (Gamez et al, 2015). Therefore, we must understand that the teaching of Science and Biology must consider and promote other investigative activities so that ways of thinking, speaking and doing can be developed, providing a more complete and assertive perception and understanding of the world and, consequently, a scientific and citizen education (Arca; Guidoni; Mazzoli, 1990; Souza; Machado, 2023).

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