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Analysis of a didactic strategy based on the proposition of mediation in Biology classes

Análise de uma estratégia didática baseada na proposição de mediação em aulas de Biologia[1]

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ABSTRACT
This research aimed to analyze the actions that the teacher-researcher carried out to organize a didactic strategy based on the Vygotskyan proposal of mediation described by Wertsch (2007). Applied research, which used pedagogical research-intervention as a methodological procedure. The subjects were 38 students, aged between 16 and 19, second year of high school; the instruments of data collection were participant observation and document analysis. The procedure of discursive textual analysis led to the results that describe the different verbalizations carried out by the teacher-researcher in dialogue with the students, in order to stimulate the debate and the learning around the content "environmental impacts" in Biology classes. The discussion of the results points out the partial reach of the explicit and implicit mediation strategies.

RESUMO
Pesquisa que visou a analisar as ações que a professora-pesquisadora realizou para organizar uma estratégia didática baseada na proposição Vygotskyana de mediação descrita por Wertsch (2007). Pesquisa aplicada, que utilizou como procedimento metodológico a pesquisa-intervenção do tipo pedagógica. Os sujeitos foram 38 estudantes, de idades entre 16 a 19 anos, alunos do 2º ano do Ensino Médio; os instrumentos da coleta de dados foram observação participante e análise documental. O procedimento de análise textual discursiva suscitou os resultados que descrevem as diferentes verbalizações realizadas pela professora-pesquisadora em diálogo com os estudantes, com o intuito de estimular o debate e a aprendizagem sobre o conteúdo "impactos ambientais" nas aulas de Biologia. A discussão dos resultados aponta o alcance parcial das estratégias de mediação explícita e implícita.

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1 Introduction

Although learning the content of a given subject involves different aspects (CUNHA et al., 2020), it is understood that students talking about the proposed content is fundamental to learning. Vygotsky (2001), for example, considered that "becoming aware of any operation means transferring it from the plane of action to the plane of language, that is, reconstructing it in the imagination in order to be able to express it in words" (p. 203).

It should be noted, however, that not everything students say is considered appropriate for learning specific content. Ausubel, Novak, and Hanesian (1980) warned that if the information necessary for intelligent discussion is not available, it will be "little more than a sharing of ignorance, prejudice, platitudes, preconceived notions, and imprecise generalities" (p. 423). Even when there are no subsumers in the student's cognitive structure, these authors understand that it is the teacher's responsibility to introduce prior knowledge for learning to be achieved: it is the teacher's responsibility to mediate classroom activities, including what students will talk about in order to learn the content (for a discussion of the similarities between Vygotsky and Ausubel's approaches, see Giest, 2020).

The objective of this research was to analyze the actions that the teacher-researcher adopted to organize a didactic strategy based on Vygotsky's proposition of mediation described by Wertsch (2007). When addressing the theme of mediation, we begin with an explanation of the theoretical proposition used to support the study in question.

The understanding of mediation used in this study is anchored in the propositions of L. S. Vygotsky. The theme of mediation intersects several of this author's writings, and in his theoretical formulation, Vygotsky drew on

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the concepts of various authors, including K. Marx, F. Engels, and G. Hegel. According to Wertsch (2007, p. 0179), the notion of mediation presented by Vygotsky did not have a single meaning: “this does not mean that he gave it a single, unified definition. Instead, mediation emerged in his texts in a variety of ways, and in the process, somewhat different meanings arose.” The notion addressed in this study, far from presenting all of Vygotsky's conceptions of mediation, will refer to its possibilities of application in education, more specifically related to the didactic strategies of explicit and implicit mediation: the actions that the teacher-researcher carried out to organize a didactic strategy based on Vygotsky's proposition of mediation described by Wertsch (2007) are analyzed.

According to Vygotsky (1995), the process of forming higher mental functions is a mediated process, with words being the central core of this mediation, the unit of analysis of consciousness. The author understood that man's relationship with the world does not occur directly but is a relationship mediated by signs, similar to the use of a tool at work: "As we have already said, the similarity between the sign and the tool is based on their common mediating function in both. Therefore, from a psychological point of view, both can be included in the same category" (VYGOTSKI, 1995, p. 93). The diagram below was developed by Vygotsky (1995, p. 93) to show the similarity of mediating activity between the use of tools and signs:

Figure 1 – Vigotskian diagram illustrating the similarity between the mediating activity involved in the use of tools and signs.

Source: Adaptaded from Vygotski (1995).

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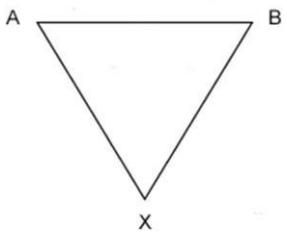
The author argued that the use of signs should be included in mediating activity, since human beings influence behavior through signs. Among these, he stressed language, which, as a means of communication and interaction, is used to influence behavior in its higher motivational forms. According to Vygotsky's conception, human beings appropriate social forms of behavior on two levels: first, on the social level, and then on their internal psychological level. Castro (2014, p. 31) explains that "adults are usually the external agents who mediate the child's first contacts with the world. As they grow, the processes that were mediated by adults also become appropriated by the child themselves." The diagram proposed by Vygotsky (1995, p. 116), presented in the form of a triangle, helps to understand the concept of mediation mentioned above:

Figure 2 – Graphic representation of the mediation concept (VYGOTSKI, 1995, p. 116).



Source: Adapted from Vygotski (1995).

The triangle was used by Vygotsky (1995, p. 116) to explain that the relationships between connections A and B are not established immediately, but rather mediated: “Stimulus A provokes a reaction that consists of finding stimulus X, which in turn influences point B.”

In the field of education, Castro (2014) proposes that the teacher act as a mediator between the content to be learned and the students. This idea can also be understood in other aspects of Vygotsky's theory. One of them refers to the teacher's mediation in the student's completion of activities: depending on how this mediation is carried out, it can be a source of development for the student. The idea that learning in collaboration with a more capable adult interferes with the development of the subject's intellect is that which refers to the zone of proximal

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development[5]. According to Vygotsky, "at school, children do not learn to do what they are capable of doing on their own, but rather to do what they are not yet capable of doing, but which is within their reach in collaboration with the teacher and under his or her guidance" (2001, p. 241).

From this understanding of the role of speech and of the teacher in teaching practices, it can be inferred that "the central aspect of all instructional psychology lies in the possibility of rising to a higher intellectual level through collaboration" (VYGOTSKI, 2001, p. 241). For a good learning process to occur, one that is capable of motivating active student participation and is structured by a theoretical and practical understanding of the concept of mediation, we take as a reference Vygotsky's observation that "[t]eaching is only valid when it precedes development. Then it awakens and engenders a whole series of functions that were in a state of maturation and remained in the zone of proximal development" (VYGOTSKY, 2001, p. 243).

Sforni (2008) points out that Vygotsky's school emphasizes social interactions, but their value in the school environment is not restricted to relationships between people "but to the object that is present in this relationship—knowledge. In other words, it is only in the relationship between subject-knowledge-subject that mediation becomes a fundamental concept for human development" (p. 2). The author also points out that the system of signs, "as a language on the external plane, makes possible the transition from the interpsychological to the intrapsychological, as it constitutes a form of thought for those who appropriate it" (p. 04).

Wertsch (2007) highlighted two types of mediation in his research on Vygotsky: explicit and implicit mediation. Vygotsky's writings that bring together the works in which the author described what explicit mediation would be involve notions in which mediation is clearly observed, such as in his research involving the process of double stimulation (VYGOTSKI, 1993). According to Wertsch

[5] To use the expression suggested by Blanck (Vygotsky, 2003).

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(2007), explicit mediation involves the intentional and concrete introduction of signals into a continuous flow of activity. In this type of mediation, the sign tends to be introduced by an external agent, such as the teacher, and this sign can assist in the reorganization of the activity in progress.

Implicit mediation is probably more difficult to detect, rarely considered as an object of conscious reflection by the observer: it is part of an ongoing communicative flow and involves signs, mainly spoken language. Wertsch (2007) argues that Vygotsky proposed addressing

> it is part of an already ongoing communicative stream that is brought into contact with other forms of action. Indeed, one of the properties that characterizes implicit mediation is that it involves signs, especially natural language, whose primary function is communication. In contrast to the case for explicit mediation, these signs are not purposefully introduced into human action, and they do not initially emerge for the purpose of organizing it. Instead, they are part of a preexisting, independent stream of communicative action that becomes integrated with other forms of goal-directed behavior (Wertsch, 2007, p. 180-181).

Implicit mediation involves signs in the form of *spoken language*. In relation to classroom work, Wertsch (2007) emphasizes that the teacher's goal should be to help students become fluent in the system of signs involved in the curriculum component in question. He stresses that it is essential for teachers to engage students in talking about what they often only partially understand. He gives the following example:

> This has to do with a teacher speaking to a group of students about organizing and presenting data from observations they had made about what conditions foster the most growth in plants. Specifically, they had grown plants under various conditions of light. By discussing the data the students had collected in this exercise, this teacher introduced both explicit mediation and implicit forms of mediation. The explicit mediational means he introduced was a piece of graph paper that the students were to use for presenting their data. The

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> implicit mediation in this case arose in connection with his use of a few basic terms. In addition to telling the students "to organize the data in some way," he asks the students to "try to determine what's the typical fast plant," using the term "typical" on several occasions, and he tells them that they should ask "how spread out" the data are (188-189).

According to Wertsch (2007), implicit mediation therefore involves spoken language, with transitional materiality intensified in communication. Vygotsky (1993) argued that speech is preceded by the emergence of its motive: the situation of spoken language creates, in its flow, the motivation for each new flow of speech, conversation, and dialogue.

2 Methodological procedures

This investigation was based on an applied research model, which used the methodological procedure of intervention research (PICHETH, CASSANDRE, and THIOLLENT, 2016; STETSENKO, 2016), of a pedagogical nature, which, as a research procedure, should describe the method and form of intervention evaluation (DAMIANI et al., 2013). The intervention method consists of an action plan (which, in this research, was developed by the teacher-researcher). This plan should describe the actions taken in the teaching process, which were planned prior to the process. The intervention evaluation method involves exposing the scientific procedures adopted to "capture the effects of the intervention" (DAMIANI et al., 2013, p. 62). Both processes in this research will be presented below.

As a *method of intervention*, the research took place in a public school in Dom Pedrito, Rio Grande do Sul. The research subjects were 38 students, aged between 16 and 19. The subjects were 2nd-year high school students. Their names were kept confidential, and code names represented by flowers were used. Authorization for the research was obtained from the school, the parents (through a free and informed consent form), and the students (consent form).

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The course of action was organized as follows: during the Biology component of the curriculum, there was a sequence of twenty-six classes, each lasting fifty minutes. These lessons focused on environmental impacts, with an emphasis on the generation and disposal of solid waste, deforestation, silting, and the introduction of exotic species into the environment, as well as other related topics such as sustainability and the promotion of social and environmental justice.

The classes included a series of practical activities, which were carried out in constant collective discussion with the students and guided by the proposed content. The sequence of these meetings was as follows: two classes consisting of diagnostic assessment, which included contact with the class to verify prior knowledge related to the content to be worked on; two classes for the presentation (and discussion) of the documentary "The Age of Stupidity" (2009), which also included debates on the generation and disposal of solid waste, sustainability, and social and environmental (in)justice; two expository-dialogued classes on the theme of "environmental impacts" (generation and disposal of solid waste, deforestation, silting, and introduction of exotic species into the environment); two classes to teach the use of photography (photographs that would be taken by students in subsequent classes involving practical insertion into socio-environmental contexts selected by the teacher-researcher); two classes for field trips, which allowed students to take photographs; one class for the exhibition of photographs taken by students on solid waste disposal, with debates on topics such as consumer culture, the power of the media, social (in)justice, planned obsolescence, reverse logistics, and sustainability; two classes that included a new field trip, with the same purposes as the previous one; one class for the exhibition of photographs taken by students, with debates on topics such as consumer culture, media power, social (in)justice, planned obsolescence, reverse logistics, and sustainability; two classes for field trips, with an ecological trail to Parque das Acácias, aimed at providing students with the

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opportunity to record impacts such as deforestation, silting, and the introduction of exotic species into the environment; two classes with a digital exhibition with debates and exercises taken from university entrance exams and the National High School Exam (Exame Nacional do Ensino Médio - ENEM), related to environmental impacts; three classes for exhibition and explanation to the school of the photographic records made by students during field trips; three classes for creating a blog with the aim of sharing what they have learned; two classes for final assessments.

The collective discussion of the content with the students was carried out using a didactic strategy called the question and answer game. This question and answer game was presented as a didactic strategy based on Vygotsky's theory of mediation, supplemented by Wertsch's (2007) analytical and reflective descriptions. When discussing the topic of mediation in schools, Sforni (2008) points out that

> the primary focus is on the content to be taught and how to make it relevant to the student. This implies recognizing that teaching mediation begins long before the actual class. It begins with the organization of the teaching activity, when situations of practical and verbal communication between teacher and students, and between students themselves, are planned around actions related to the object of learning (p. 08).

Using the game as a teaching resource, the teacher-researcher asked questions about the experiences over the course of the theoretical-practical classes and used the students' answers as a "hook" for further inquiries, using theoretical support material in addition to dialogue. A major motivator for implementing this intervention (which was scientifically evaluated) was the desire to move away from practices that merely transmit knowledge in science teaching. Manfredo and Lobato (2020, p. 67), for example, are of the opinion that "science teaching is being called into question and now requires different approaches (...). This requires joint action by educational agents, with emphasis

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on teachers, who play a fundamental role in this context and, above all, assume the responsibility of building a different model of teaching practice."

As a *method of evaluating the intervention*, the following instruments were used for data collection: participant observation and document analysis. In this study, natural participant observation was used (GIL, 1989). The information collected followed an observation guide, which varied for each meeting, especially because the classes took place in different locations. The guideline that united all observations was "the description of students' reports and questions about the topic proposed in class."

To facilitate data collection through observations, filming was used during part of the process (BITTNER, 2019), more precisely in expository-dialogued classes, in the debate after the video, and in digital exhibitions with debates. The images were recorded because they offered a more limited record, after the event, of "the power of temporal actions and real events—concrete, material" (LOIZOS, 2007, p. 137). These images were used only to describe what happened, even though no images of the participants' faces were taken: as soon as the speeches were transcribed, all images were deleted. It was believed that, in this way, the possibility of not observing something important, something that could be lost, was minimized. The filming was done in classes 2, 3, 6, 8, and 10, totaling five hours and forty-five minutes of recordings, which are indicated as follows: film 1 corresponds to observation 2; filming 2 corresponds to observation 3; filming 3 and 4 correspond to observation 6; filming 5 corresponds to observation 8; and filming 6 and 7 correspond to observation 10.

Document analysis is a "valuable technique for approaching qualitative data, either by complementing information obtained by other techniques or by revealing new aspects of a topic or problem" (LÜDKE and ANDRÉ, 1986, p. 38). The following were used in the document analysis: 223 photographs taken by students, three blog posts, 37 pre-tests, and 34 post-tests.

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The data was processed using Bardin's (2009) content analysis technique. The results gave rise to the following category: *question and answer game*.

3 Research findings

The presentation of the content and thoughts that came up during the *question and answer game* will be shown based on the data collected and selected excerpts that are highlighted as well as commented on, with the aim of later presenting the analysis of the mediation processes. It should also be reiterated that the *question and answer game* was based on the theoretical support material designated for the study of the Biology curriculum component and enabled both the formulation of questions about the experiences that arose during the theoretical -practical classes and also made possible a process of dialogical learning, in which the students' answers acted as a "hook" for further inquiries.

The *inquiries about the experiences and the students' answers* are grouped together with the findings related to the debates mediated by the teacher-researcher, which indicated the moments when she questioned the students about the content being worked on. Often, other students contributed to their classmates' responses. These moments were recorded throughout all observations. Starting from an overview of the documentary *The Age of Stupidity* (ARMSTRONG, 2009), a *question and answer game* began, asking students about their perceptions in this regard:

> Teacher – "What do you think will happen to reverse this situation?"
> Canela – "People should have been aware of this long before, you know? I don't think there's any chance now... not that it's impossible to change anything, I think it is possible when... it starts... I think it's like a whole thing. Like this: it's no use thinking about change, and just thinking without acting. You know? That's how it is."
> Violeta – "It all starts with ecological thinking [interruption by Canela]."
> Canela – "I think that nowadays people are very hypocritical when they say that it's only the other person who thinks it's only about money, you know? And they don't think about protecting it. I think

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> most people are hypocrites when they say that."
> Lírio – "It's just that everything revolves around consumerism. And power too! So no one cares about what they have. People just want something, so they go and buy it."
> Violeta – "And everything they do, everyone thinks about benefiting in one way or another. It's already, like, a person's instinct, it seems, you know? That you can... there's no one, I think... if I speak, I'll lie, who has never done something, knowing it's wrong, but you go and do it. Like, sometimes it seems stronger, you know? Because making a mistake blindly is one thing, but making a mistake knowing you're doing wrong is another... And there are a lot of people who do things knowing it's wrong, but there's a benefit, and you want that benefit."
> Canela – "Do you think that benefit will be greater than that little mistake?" (FILM 1).

In this excerpt, as the teacher-researcher questioned the group, the students showed that they understood that, in order to change the direction the planet is taking, it would be necessary to think in a more collective way, rather than individually. As student Canela pointed out, the act of traveling frequently by plane, as shown in the video, may be enjoyable and necessary for individuals, but it is bad for the community due to the enormous amount of pollutants released into the atmosphere. It should be noted that, at the end of the debate, the students jointly concluded that knowledge implies responsibility and that this also applies to environmental issues. In this context, the teacher-researcher sought to broaden the limited (common sense) view of Environmental Education (EE), which summarizes its role as throwing waste in the appropriate trash can and preserving the environment.

Referring to the documentary, the teacher-researcher asked the students several questions (FILM 1), seeking a critical reflection on the responsibility of corporations for the environment and the need for work for human subsistence:

> Teacher – "What do you see there?"
> Orquídea – "It's oil."
> Teacher – "Exactly. Can you imagine how much oil is spilled and how many lives how many species are harmed? Now tell me: is it the fault of the guy working in the ship's hold? [Jasmine shakes her

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> head no].
> Teacher – "If you had to earn your living like that, would you do it? [Some say yes].
> Teacher – "Yes. But who should be responsible for that? Let's remember the video."
> Camomila – "(inaudible)... who went there (inaudible)... rubbed powdered soap on the fish..."
> Teacher – "Exactly! And who was harming the environment?"
> Pinheiro and Camoatim – "The company." Teacher – "More specifically?" Camoatim – "Shell."
> Teacher – "Large corporations. They need to be held accountable in such a way that they feel they are harming the environment."
> Pérola – "They are thinking more about profit than the environment."
> (FILM 1).

During observation 2 (FILM 1), in which the topic of planned obsolescence was brought up for discussion, there were also moments when the teacher-researcher questioned the students and other students interrupted:

> Teacher – "Have you ever heard your parents say, 'Oh, I used to buy such-and-such, and it lasted so long'?"
> Jasmim – "True." Lírio – "Yes."
> Teacher – "True, right?"
> Jasmim – "Now it doesn't even last that long."
> Teacher – "Technology itself! How long do you guys use your cell phones on average?"
> Jasmim – "Until they break. Or until they break and can't be repaired."
> Teacher – "Until they break? And what does 'until they break' mean? How long?"
> Feijão – "A year, a year and a half."
> Teacher – "A year, a year and a half."
> Girassol – "A month. The phone I had lasted a month, then I broke the screen."
> Camomila – "Teacher, it depends, right? Some people ruin them... They scratch it and say, 'Oh, I want to go and exchange it,' or they break the screen and go and want to exchange it, but in fact the phone is working..."
> Teacher – "So, for them it's become trash, but for someone else it's a luxury."
> Camomila – "Yeah, it can be useful; it can be useful" (FILM 1).

Another topic discussed was the differences between organic and inorganic waste, which, despite being widely publicized by a wide range of sources, still

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raised questions among students (FILMS 2, 4, and 6). For this reason, we sought to ascertain which students were aware of these differences, with the aim of collectively building this knowledge:

> Teacher – "(...) what is organic waste and what is inorganic waste, let's see if you know..."
> Águia – "Organic is leftovers (inaudible)."
> Violeta – "... from food, things like that."
> Teacher – "Organic is... food scraps..."
> Águia – "And inorganic..."
> Violeta – "Is anything that isn't food."
> Teacher – "It's anything that can be recycled, right, everyone? Or, at least, anything that isn't edible... it won't decompose easily..."
> Camomila – "But organic, organic can also be reused like fruit (sic), we can (inaudible)."
> Teacher – "In the case of composting, yes, yes."
> (FILM 4).

At a later stage, after the last field trip (VIDEO 6), classroom activities began, asking students about their impressions after visiting Parque das Acácias. They were asked what environmental impacts discussed in class they were able to observe at the site. Several students responded simultaneously that the impacts they noticed were the incorrect disposal of waste, silting, deforestation of riparian areas, and the introduction of exotic species into the environment, thus demonstrating their knowledge of the theoretical topic (environmental impacts) covered in class.

In *use of support material*, we highlight the moments when students were encouraged to use, during class, the theoretical (written) support material distributed by the teacher-researcher. In her opinion, this material would constitute an important milestone for understanding the proposed learning process. These moments include the content covered in class that was captured in videos 3, 4, 5, 6, and 7. The excerpt below illustrates how the teacher-researcher asked students to use the theoretical material during the *question and answer game*:

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> Jasmim – "Are you going to comment on the article?"
> Orquídea: "The one you told us to read."
> Teacher – "What did you read?"
> Jasmim – "About a man who... he collected plastic and did experiments, experiments to build Lego blocks..."
> Jasmim – "...to build houses."
> Orchid – "Yeah... he is... he collected plastic, and then he started a company that turned plastic into..."
> Jasmine – "Blocks..."
> Teacher – "They made a kind of block to build what, girls?"
> Jasmine and Orchid – "Houses."
> Teacher – "Houses..."
> Jasmim – "For those who needed them, I think..."
> Teacher – "Houses, schools, health clinics, right... everything to improve the lives of people living in poverty."
> Jasmim – "And it's earthquake-proof..."
> Orquídea – "They were, um... updating, so to speak, the project. They even won awards, and with those awards they increased..." (FILM 5).

In another situation, regarding composting, the students were asked questions (VIDEO 1) to check whether they understood what it was and how many of them used this practice in their homes. During the mediation process, some students demonstrated knowledge of what types of waste could be used for this purpose. Jasmim (FILM 1) stated that organic waste "can be used to make fertilizer." Lavanda, Lírio, Orquídea, Camoatim, Jasmim, Camomila, and Pinheiro reported having compost bins. In subsequent classes, the teacher-researcher asked student Violeta (VIDEO 3) to read the concept of composting that appeared in the slides: It is the transformation of organic waste into a compost that can be reused as fertilizer.

In another class, dealing with the same topic (composting), the teacher-researcher continued the practice of the question-and-answer game, asking students about the possible destinations for organic waste, making positive statements, and also encouraging them to consult the text made available previously (Footage 4).

The use of technological resources (COMMENTS 2, 3, 6, 8, 10, 11, and 12) was useful and took advantage of the fact that students had access to the

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complementary theoretical material that was made available to them. These resources included laptops, tablets, netbooks, data projectors, digital cameras, and cell phones. This material served as a basis for debates on sustainability and social justice issues. According to Molon (2003), experiences (social, historical, and duplicated) constitute the subject in a given historical time and culture, which means that social relations impose new forms of mediation, depending on the culture in which they are inserted, implying the need to understand the different mechanisms and processes that constitute the subject in their time.

4 Discussion of results

For Vygotsky (1993), questions and answers, misunderstanding and explanation (aspects that were present in the question and answer game) influence speech. The author also argues that speech is conditioned by a dynamic situation, which arises from it and unfolds according to the situation. These elements, which are fundamental to the establishment of speech and should be well incorporated by teachers in the classroom, were included in the classes of this intervention study, now under analysis.

Although Wertsch (2007) made a distinction between explicit and implicit mediation, it is possible to observe that, during the classes in this investigation, the teacher introduced both mediation propositions. Explicit mediation was fundamentally characterized by the decisions made by the teacher-researcher for the organization of the classes. These decisions, in an intervention project, are characteristic of dual stimulation. Damiani et al. (2013, p. 61) suggest that pedagogical intervention research, which includes the process of dual stimulation as one of its epistemological principles, brings together characteristics that can be considered as auxiliary stimuli, "which teacher-researchers use in order to resolve problem situations, such as dissatisfaction with the level and quality of learning of their students/subjects in certain pedagogical contexts."

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Mediation in the classes analyzed was implicit, especially in the way the teacher-researcher used speech during the classes. The question and answer game was, above all, an insistent dialogue that the teacher-researcher engaged in with her students: she introduced the word, through speech, to develop this game. The use of this sign can be seen throughout all the excerpts, but we would like to highlight some points for discussion. First, when the teacher-researcher made a connection between what had already been presented during the curriculum component and the present moment. For example, in Film 1, the teacher-researcher said, "Let's remember the video again." This is an important aspect when considering Vygotsky's concepts. The word, introduced by the teacher-researcher, was the guiding sign that helped the subjects reorganize their thinking during the learning process: remembering the video to help students become aware of the content covered so that they could establish connections between the present moment and the video (past), in an attempt to better understand the proposed content.

According to the introduction of a series of questions, one after another, which helped students think about the content presented. The process commonly known as classes by simple transmission of knowledge, through which the teacher provides the content and the student needs to mobilize, alone, to understand it, does not use this open dialogue between students and teacher. This dialogue seems to be much more complicated to achieve than conducting a class through mere transmission of knowledge, since dialogue in the game requires, in addition to the extra-class activities coordinated by the teacher (which were used for the *question and answer game*), a rapid discourse between teacher and students that mobilizes the content in the learning process. This discourse tends to be based on what students have seen as empirical, as the first way of relating to the activity (among which, in this investigation, are field trips and the documentary). During the game, students tend to be led to use their perceptions (again, such as those from field trips or videos), but now in contrast to the dialogue with the teacher and other

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students, helping the latter to have a new perception of the observed reality, which makes that situation perceived now thought out, increasing their level of improvement in the subject studied.

The third point to be stressed within what was considered implicit mediation was carried out by the teacher-researcher as she introduced some basic scientific terms during the classes, using the support material. Wertsch (2007) emphasizes that, in implicit mediation, it is important for the teacher to make connections, during the debate, between the students' experiences and some basic terms. The author indicates that, although students often only partially understand the content being presented, it is important for the teacher to help students increase their level of understanding of the content in question, going beyond their level of knowledge. During the intervention, the researcher used both the term "garbage" and the expression "solid waste," despite the current conceptual difference. According to Rogers and Kostigen (2009, p. 12), "garbage is everything we don't want." It can also be defined as "(...) the remains of human activities, considered by those who generate them as useless, undesirable, (sic) or disposable" (JARDIM and WELLS, 1995, p. 23 apud MUCELIN and BELLINI, 2008, p. 113). According to the National Solid Waste Policy, Law No. 12,305 (BRAZIL, 2010), solid waste is understood to be all,

> (...) material, substance, object, or discarded item resulting from human activities in society, whose final destination is, is proposed to be, or is required to be, in solid or semi-solid form, as well as gases contained in containers and liquids whose particular characteristics make it unfeasible to discharge them into the public sewage system or water bodies or require technically or economically unfeasible solutions in view of the best available technology (BRAZIL, 2010).

Despite the aforementioned differences, both terminologies share space in didactic textbooks (BANDOUK et al., 2013; LINHARES, GEWANDSZNAJDER, and PACCA, 2016), on the website of the Ministry of the Environment (OLIVEIRA, 2013) and in the document that, together with the

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Basic Sanitation Plan, guides the Municipal Environmental Policy of Dom Pedrito: the Municipal Plan for Integrated Solid Waste Management (DOM PEDRITO, 2014). The term "garbage," even though it appears to be in disuse, is also cited in questions extracted from the ENEM (INEP, 2010, 2012), which were administered to the classes involved in the research.

Although these considerations regarding the introduction of some basic scientific terms during classes when using the support material were relevant to demonstrate the use of implicit mediation as a teaching strategy, it appears that the use of implicit mediation can be evaluated as a limitation of this research, given that the teacher-researcher could have introduced the scientific content with more emphasis. The teacher-researcher worked with the concepts of sustainability, planned obsolescence (and others), but no further theoretical exploration of these concepts was observed in classroom discussions. Scientific content was little used during classes. This aspect partially detracts from achieving the goal of working with implicit mediation.

Regarding the evaluation of the intervention, it is believed that the 26 classes, which involved field trips, expository-dialogued classes, and the use of new technologies by students in class, synthesized by the question and answer game for content learning, were fundamental for student learning. The results of the tests in the last class showed that there was an improvement in the understanding of the topic of environmental impacts: ten activities were applied, including multiple-choice questions with varying degrees of complexity (some from college entrance exams and the ENEM). The objective (with this more traditional practice) was to expand the possibility of verifying student learning beyond the dialogical findings observed in class. At the end, the following percentages of errors and correct answers were obtained in the activities:

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Chart 1 – Percentages of errors, correct answers, and blank questions in the exercises.

Exercise (Nº)	Error Percentage	Percentage of Correct Answers	Percentage of Blank Questions
01	31%	69%	0%
02	20%	80%	0%
03	9%	91%	0%
04	49%	51%	0%
05	6%	94%	0%
06	20%	80%	0%
07	43%	57%	0%
08	9%	91%	0%
09	31%	69%	0%
10	3%	94%	3%

Source: authors

As for the pre-test and post-test outcomes, the results obtained in each of the twenty-two questions showed that there was an improvement in understanding the various aspects covered in EA, as well as the topic of environmental impacts. During the process of creating the *blog* and presenting the Ecoalbums, the teacher observed that, when reporting on their experiences, showing their photographs, and explaining the environmental impacts they had noticed, the students demonstrated knowledge of the topics covered. The young people did not just focus on conveying concepts but sought, through their writing and speeches, to raise awareness among others about the various points discussed in class. Furthermore, after the intervention, it was possible to verify that there was a small (but important) improvement in the students' final performance compared to the 2015 results: from one year to the next, 9% of the young people moved from the CPA/CRA categories to the highest grade, CSA[6], according to data provided by the School Supervision Service (SSS).

With regard to the written expression *question and answer game*, it was constructed within the logic attributed by Kishimoto (2017) to the extension of the use of the word game. For the author, the game can be seen as the result of a

[6] High school results were expressed using the concepts "Satisfactory Learning Construction" (CSA), "Partial Learning Construction" (CPA), and "Restricted Learning Construction" (CRA).

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linguistic system that functions in a social context. Its concept is not limited to board games, play, or make-believe games, but rather, "each social context constructs an image of play according to its values and way of life, which is expressed through language" (p. 17). Thus, it is argued that the didactic strategy, through which the teacher-researcher asked questions about theoretical and practical experiences and debated with all students, using support material, was a game. The creation of this expression aimed to unify the idea of what was conducted by the teacher-researcher in this investigation.

Could the *question and answer game* have been a strategy that represented explicit and implicit mediation? In part. It can be inferred that collectivity is a Marxian-Vygotskyan principle that underlies the explanation of psychic development, which was present throughout the research-intervention. Thus, initially, it is noteworthy that there was collective discussion, through which the teacher-researcher introduced (a few) theoretical concepts of the content playfully, simultaneously presenting other (colloquial) expressions. These collective discussions, organized in such a way as not to cause any embarrassment to the students in the face of some of their mistakes, helped the students to think about the content of the work. However, the limited use of theoretical material did not necessarily help the students to abandon their view of empirical reality, which was problematized by the statements, but which could have been better anchored in theoretical content.

The analysis and discussion of the results indicate that, in order for there to be meaningful dialogue in the classroom, students need to have everyday concepts, which are discussed in conjunction with scientific concepts introduced by the teacher, with these dialogues being constantly guided by the teacher's actions. Furthermore, it is also acknowledged that "working with activities that prioritize students' direct experience, which contribute to their autonomy in the pursuit of knowledge, should be a commitment to be assumed by schools" (PULH; MARCHI, 2020, p. 185).

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5 Final considerations

In this article, we analyzed the actions taken by the teacher-researcher to organize a didactic strategy based on Vygotsky's proposal of mediation described by Wertsch (2007). The results pointed to the fact that the teaching proposal helped students to become more familiar with concepts related to environmental impacts, especially when the mediation strategy called "*question and answer game*" was used in conjunction with the other activities described in the intervention process of the 26 lessons (explicit mediation) proposed and carried out.

The debates that took place were motivating factors for the students, as there were episodes in which the other students interrupted each other in their eagerness to contribute to the discussion. In addition, the teacher presented herself as "available" and "concerned" to the students, factors that, according to Cunha et al. (2020, p. 9), constitute important motivational resources for student involvement in their learning processes.

Finally, although the work shown by the teacher went a step forward in using a series of extra-class activities, which were discussed during the teaching process, few written support materials were incorporated into the question and answer game during the classes, which contributed to the implicit mediation being partially achieved.

References

ARMSTRONG, Franny. *A Era da Estupidez.* Reino Unido: Spanner Films, 2009.

AUSUBEL, David; NOVAK, Joseph; HANESIAN, Helen. *Psicologia educacional.* 2. ed. Rio de Janeiro: Interamericana, 1980.

BANDOUK, Antônio Carlos. et al. *Ser Protagonista:* biologia, 3º ano: ensino médio. São Paulo: Edições SM, 2013.

BARDIN, Laurence. *Análise de conteúdo*. 4. ed. Lisboa: Edições 70, 2009.

BITTNER, Martin. Interruption as a crisis. Discourse and practices of progressive education. *Revista Educar Mais,* Pelotas, v. 3, n. 2, p. 282-296, 2019. DOI: https://doi.org/10.15536/reducarmais.3.2019.282-296.1550.

BRASIL. Lei nº 12.305, de 02 de agosto de 2010. Institui a Política Nacional de Resíduos Sólidos; altera a Lei nº 9.605, de 12 de fevereiro de 1998; e dá outras providências. *Diário Oficial [da] República Federativa do Brasil*, Brasília, DF, 03 ago. 2010. http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Lei/L12305.htm.

CASTRO, Rafael Fonseca. *A expressão escrita de acadêmicas de um curso de pedagogia a distância:* uma intervenção Histórico-Cultural. 2014. 238f. Tese (Doutorado em Educação) – Programa de Pós-Graduação em Educação, Universidade Federal de Pelotas, RS, 2014.

CUNHA, Rosário Serrão; RIBEIRO, Luísa Mota; SEQUEIRA, Cristiana; BARROS, Rita de Almeida; CABRAL, Leonor; DIAS, Teresa Silva. O que facilita e dificulta a aprendizagem? A perspectiva de adolescentes. *Psicol. estud.*, Maringá, v. 25, p. 1-17, 2020. DOI: http://dx.doi.org/10.4025/psicolestud.v25i0.46414.

DAMIANI, Magda Floriana; ROCHEFORT, Renato Siqueira; CASTRO, Rafael Fonseca; DARIZ, Marion Rodrigues; PINHEIRO, Silvia Siqueira. Discutindo pesquisas do tipo intervenção pedagógica. *Cadernos de Educação*, Pelotas, v. 45, p. 57-67, 2013. DOI: https://doi.org/10.15210/caduc.v0i45.3822.

DOM PEDRITO. Departamento de Meio Ambiente. *Plano Municipal Integrado de Gestão de Resíduos Sólidos (PMGIRS).* Dom Pedrito, RS. 2014. 377 p. em: https://portal.tce.rs.gov.br/pmsr/PMRSU/Dom%20Pedrito/PMGIRS_Dom_Pedrito.pdf.

GIEST, H. Didática histórico-cultural e teoria da educação. *Revista Educar Mais*, 4(2), 237-260, 2020. DOI: https://doi.org/10.15536/reducarmais.4.2020.237-260.1784.

GIL, Antônio Carlos. *Métodos e Técnicas de Pesquisa Social.* 2. ed. São Paulo: Atlas, 1989.

INEP - Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira. Ministério da Educação. ENEM 2010 – Exame Nacional do Ensino Médio. http://download.inep.gov.br/educacao_basica/enem/provas/2010/dia1_caderno1_azul_com_gab.pdf.

INEP - Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira. Ministério da Educação. ENEM 2012. Exame Nacional do Ensino Médio. http://download.inep.gov.br/educacao_basica/enem/provas/2012/caderno_enem2012_sab_azul.pdf.

KISHIMOTO, Tizuko Morchida. *Jogo, brinquedo, brincadeira e a educação.* São Paulo: Cortez, 2017.

LINHARES, Sérgio; GEWANDSZNAJDER, Fernando.; PACCA, Helena. *Biologia Hoje*. 3. ed. São Paulo: Ática, 2016.

LOIZOS, Peter. Vídeo, filme e fotografias como documentos de pesquisa. In: BAUER, Martin; GASKELL, George. *Pesquisa Qualitativa com Texto, Imagem e Som*: um manual prático. Petrópolis: Vozes, 2007. p. 137-155.

LÜDKE, Menga; ANDRÉ, Marli. A. *Pesquisa em educação:* abordagens qualitativas. São Paulo: EPU, 1986.

MANFREDO, Elizabeth Cardoso Gerhardt; LOBATO, Sílvia Cristina da Costa. Análise da própria prática no ensino de Ciências por meio de sequências investigativas (sis) envolvendo noções de Física com alunos dos anos iniciais do Ensino Fundamental. *Revista Contexto & Educação*, v. 35, n. 110, p. 66-85, 2020. DOI: https://doi.org/10.21527/2179-1309.2020.110.66-85.

MOLON, Susana. *Subjetividade e constituição do sujeito em Vygotsky*. Petrópolis: Vozes, 2003.

MUCELIN, Carlos Alberto; BELLINI, Marta. Lixo e impactos ambientais perceptíveis no ecossistema urbano. *Sociedade & Natureza*, Uberlândia, v. 20, n. 1, p. 111-124, 2008. DOI: http://dx.doi.org/10.1590/S1982-45132008000100008.

OLIVEIRA, Tinna. *O que fazer com o lixo*. In: AUDIÊNCIA PÚBLICA NA CÂMARA DOS DEPUTADOS, 2013, Brasília. https://www.mma.gov.br/informma/item/9364-o-que-fazer-com-o-lixo.

PICHETH, Sara Fernandes; CASSANDRE, Márcio; THIOLLENT, Michel. Analisando a pesquisa-ação à luz dos princípios intervencionistas: um olhar comparativo. *Educação*, Porto Alegre, v. 39, n. esp. (supl.), s3-s13, 2016. DOI: https://doi.org/10.15448/1981-2582.2016.s.24263.

PUHL, Neiva Mara; MARCHI, Miriam Ines. Feira de Ciências: Abordando Relações entre Termodinâmica e Corpo Humano. *Revista Contexto & Educação*, v. 36, n. 113, p. 183-194, 2021. DOI: https://doi.org/10.21527/2179-1309.2021.113.183-194.

ROGERS, Elizabeth; KOSTIGEN, Thomas. *O livro verde*. Rio de Janeiro: Sextante, 2009.

SFORNI, Marta. Aprendizagem e desenvolvimento: o papel da mediação. In: CAPELLINI, Vera Lúcia; MANZONI, Rosa. (Orgs.). *Políticas públicas, práticas pedagógicas e ensino-aprendizagem*. Bauru: Cultura Acadêmica, 2008. p. 1-9.

DOI: http://doi.org/10.14393/OBv6n2.a2022-65930

STETSENKO, Anna. Vygotsky's theory of method and philosophy of practice: implications for trans/formative methodology. *Educação*, Porto Alegre, v. 39, n. esp. (supl.), s32-s41, 2016. DOI: http://dx.doi.org/10.15448/1981-2582.2016.s.24385.

VIGOTSKI, L. S. *Psicologia Pedagógica*. Porto Alegre: Artmed, 2003.

VYGOTSKI, Lev Semiónovich. *Obras Escogidas*: Problemas de psicología geral. Madrid: Visor, 1993.

VYGOTSKI, Lev Semiónovich. *Obras Escogidas*: Problemas del desarrollo de la psique. Madrid: Visor, 1995.

VYGOTSKI, Lev Semiónovich. *Obras Escogidas*: Problemas de Psicología General. 2. ed. Madrid: A. Machado Libros, 2001.

WERTSCH, James. Mediation. In: DANIELS, Harry; COLE, Michael; WERTSCH, James. *The Cambridge Companion to Vygotsky*. New York: Cambridge University Press, 2007.

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