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Didactics and interaction: Primary Classroom Oral corpus analysis

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Abstract

In this research paper, we examine the characteristics of the mechanism by which science reaches a discursive culture external to the science sector. In order to help students understand a set of concepts and technological and empirical processes (scientific), we examine the oral discourse developed into the classroom through interaction. The teacher must aim to create small scientists curious about what surrounds them. The school plays a key role in consolidating this cognitive framework of science in the psychological constructions of students, but so do the media and families.We research the interactive mechanisms for the assimilation of said information, based on a compilation of transcripts in the classroom of the oral discourse.

Keywords: *Determinologization, Didactics, Interaction, and Primary Classroom.*

I. Introduction

1.1. Dissemination of scientific knowledge: the academic discourse

The world of science sometimes seems cryptic to those who are not part of a specialized scientific community. With this, the members of these hermeneutical strongholds achieve a power and a social status that resides in knowledge on that subject that is inaccessible to the rest of society. Then appears what is known as the figure of the expert, so socially prestigious and present in the media. However, it cannot be forgotten that access to knowledge and culture is a necessary right in any democratic and advanced society. For this reason, the need arises to make specialty languages accessible, that is, prototypical scientific discourse, so that anyone has access to that knowledge, especially in a society such as the current so-called *information society*. This is possible thanks to the social management of knowledge, which is the process by which scientific knowledge is democratized and reaches the bulk of society.

In order for scientific and specialty knowledge to reach the different discursive communities, the intermediation of what we call knowledge dissemination mechanisms, which participate in the processes of *determinologization*, is necessary. Among these mechanisms we find definitions, paraphrases, exemplifications, metaphors, repetitions, comparisons and analogies, literatures, puns and also questions. These disclosure processes appear in very diverse social spheres (the media, medical discourse, political discourse, educational contexts, etc.) and through equally varied channels and codes. The characteristic features of prototypical scientific discourse are precision, consistency and explicitness. It is true that prototypical scientific discourse only appears in very specific textual genres, such as a fourth-year manual of industrial engineering, or an article in a specialized scientific journal. In contrast, non-prototypical scientific text genres, that is, they are not pure but are hybridized with other types of discourse, are much more common.

The social management of knowledge plays a key role in the prototypical scientific dissemination that, due to its characteristics, is inaccessible to anyone outside the high specialized scientific holdings. In this step from encrypted knowledge to scientific knowledge that is accessible to all of society, three mechanisms come into play: the simplification of conceptual networks, the verbal reworking of discourse, and the re-contextualization.

In this work we look for what are the characteristics of the process by which scientific knowledge reaches a discursive community outside the sphere of science. Specifically, we will focus on the context of primary education classrooms. Apart from the more general mechanisms of determinology that we have just mentioned and that operate in all areas where non-prototypical scientific discourses appear, the academic field has its own specificities. In this sense, it is exclusively in the academic field –and especially in the first levels– where students are taught a series of cognitive operations that are essential to access technical and specialty knowledge.

Furthermore, it is at school that students learn to decipher and, secondly, to use the textual genres typical of prototypical scientific discourse. Students learn to speak in technical language, they know how a definition is made (at least they know what sounds good and what doesn't, intuitively recognizing the right ways), they know that when they speak or write about science at school with correction they have to avoid colloquialisms, words too semantically lax, contradictions, etc.

In summary, as we will see, the non-prototypical scientific discourse of the educational field is characterized by the fact that, in addition to providing cryptic a priori knowledge such as that of science through *determinologization* mechanisms, it will be in the academic field where the Students will learn to consciously and effectively use the cognitive operations necessary to access the most abstract and complex knowledge.

1.2 Investigation methodology

This article derives from a study on oral discourse, which is built in class from interaction, aimed at making students understand a series of concepts and technical and scientific processes. We have focused on the analysis of the linguistic and interaction mechanisms that allow it, based on a corpus of transcripts of oral discourse in the classroom. Specifically, we will analyse two transcripts of the teacher-student interaction that occurs within a globalized work project: the first deals with the heart and is in the second grade of primary school, while the second, sixth year, deals with energy. We have carried out an exhaustive analysis of the transcription in order to identify the mechanisms for the dissemination of scientific knowledge that appear. With this analysis we intend to advance in the knowledge of what these specific mechanisms are and how they are developed in the academic field. Also, from a comparative point of view, we have ventured to analyse the possible differences in the use of these mechanisms at different times in primary education, specifically between the first and third cycles of that stage.

II. Analysis of the mechanisms for the dissemination of scientific knowledge in the academic field

2.1. Determinologization mechanisms

a) Prototypical definitions: The definition is a typical mechanism of access to scientific knowledge in the educational field. Textbooks are full of definitions that students have traditionally had to learn and some of which will remain in their memories for a lifetime. For example, the wind is the air in motion, the noun is the core of the subject or a peninsula is a portion of land surrounded by all but one side of water, called the isthmus. Furthermore, dictionaries are full of definitions and are used by students when searching for the meaning of an unknown concept (Shinn, Yun Ho, 1997). However, just because a student knows a definition by heart does not mean they understand a concept. Sometimes the student asks and the teacher defines, without this being the most productive a priori way of taking advantage of the definitions for learning:

Abdul: What is matter?

Teacher: Sorry, I look like I was wrong. Matter is all that things are made of. […]

Learning scientific concepts in the school environment requires a round trip. From the most technical, abstract and decontextualized concept, we move on to the field known to the students, which is none other than that of their own daily experience, to finally return to the initial abstract concept, that is, to the definition, but this time already understood by the students. In other words, the teacher has to help the students to follow this learning path that consists of contextualizing the scientific concept in their own empirical field in order to understand it, but also, it has to guide them on the way back to abstract knowledge, considered out of date. Only in this last stage of decontextualization and abstraction can it be said that the student has finished internalizing the concept. However, there are students who remain in the intermediate phase of contextualization and fail to finish the process. This is demonstrated when students are unable to define the concept in question in a technical or abstract way.

Therefore, we start from the idea that you cannot understand a concept if you are not able to explain it, and you could use your own words to explain it. However, this would not be sufficient in the educational field, since students are being prepared to be able, ultimately, to decipher the prototypical scientific discourse and also to know how to produce it. In this sense, we have observed a procedure by which the student defines a concept in his own words and the teacher corrects it and adds technicalities, which we show in the following example regarding the definition of energy sources (Hashim, et al, 2019: 4):

Nazeer: That's all ...

Teacher: Energy sources are not all that. It’s something concrete, we can’t say all that.

Abdul: It's something in the environment.

Teacher: Yes, it is something in the environment and everything that is in the environment, what where?. Resources like?

Akram: Naturals.

Teacher: Very well! They are natural resources, we put them under a source of energy are natural resources from which we obtain energy sources, of course?

For reasons of fluency of discourse and time constraints, there are times when the teacher does not demand the scientific explanation of the concept from the student and instead allows a more colloquial definition (Rees, S., Kind, V. & Newton, D, 2018: 24):

Teacher: We put renewables on the left, and non-renewables on the right. And what is renewable? Abdul. What are renewables?

Abdul: You tell them not to drop.

Really well! Things that never run out, okay? That they are continuously regenerated. What things, natural resources are not continuously depleted and regenerated?

b) Paraphrase

By paraphrase we understand the process of repeating an idea or concept (which may be a definition) in other words, but with an equivalent meaning is the "explanation or amplifying interpretation of a text to illustrate it or make it clearer or more intelligible". In the sense of paraphrase as an extension, we have seen that in corpus 2012b the teacher reformulates the incomplete answers of the students and contributes the elements that are missing in the verbal formulation of the concept, so that knowledge is built cooperatively and guided by the teacher (Al-Khresheh, M. H. 2015:130):

Teacher: Okay. To save paper, replace the paper with towels that you can bring from home. Because what problem does the use of a lot of paper bring? What environmental problem? ... **Khan:** That the forests cut them down.

Teacher: Very well, that to produce, make paper, that paper that is not recycled, because you can also use paper from recycled paper; if it's not recycled we need a lot of trees huh? Therefore, much is cut down. What else was discussed?

Also in the following example, the teacher paraphrases the definition of the student to complete it, since the metonymic definition procedure used by the student does not provide enough information to explain, in this case, the concept of *climogram*:

Teacher: Let's see, did you remember climograms last year?

What was represented in the *climograms*? Does anyone remember? They were graphics that represented what?

Student: The degrees and the months.

Teacher: The average temperature of each of the months and the rainfall of each of the months were represented, okay?

In addition, the teacher performs explanatory paraphrases that are not amplification, but consist of explaining the same thing in a different way and closer to the experience of the students to try to get more students to understand the concept, in this case, the calculation of percentages:

Student: Calculate 16% of 50. I would divide 50 by 100, and what I would give I would multiply by 16.

Teacher: That is, with the total, with 50 parts, in this case they would be euros, with 50 euros we would make 100 parts, and of those one hundred parts we would take 16.

Repeating the same thing through synonyms is also a teacher's mechanism to ensure students' understanding of a concept:

Question: In addition to being depleted, they also pollute, okay? Well, okay, let's say "they don't regenerate, they run out, they run out ..." okay? We put it all together

Finally, in relation to the concepts of paraphrase and repetition, if the student knows how to explain a technical concept with his words, that is, to phrase it, it is because he understands it. On the other hand, the mere literal repetition of the concept or its definition does not imply an understanding of it.

c) Repetitions: In the following example, we see how repeating what the teacher or the book says does not necessarily imply understanding by the student, but pure memorization:

Teacher: Energy can change through transformations. What about energy?

Student: Transformations.

We have observed many cases in which the second-grade teacher asks himself a question to manage the information flow in the classroom discourse by repeating an interrogative particle, as in the following case:

Teacher:I propose that we now put as number three how much weight. Because? Why say how much weight is to finish saying how it is.

One of the most recurrent mechanisms used by the sixth grade teacher (Hammond, et al., 2011: 101) is repetition. Specifically, literally repeat the student's answer, if correct, right after answering. It is an evaluative repetition in which the teacher achieves two results at the same time: positively reinforce the successful student and ensure that what is said is officially accepted, institutionalized in some way, and reaches the rest of the students through the voice of expert, that is, the teacher. Sometimes it is accompanied by explicit positive reinforcement:

Student: decreasing

Teacher: Decreasing Very good!

Other times, it does so to demand more information if the answer is incomplete:

Teacher: I have spent less. Why do you think I have spent less? Let's see,Let's think!

Irene: Because you have been less at home.

Teacher: It may be because I have been less at home. But why else.

Akram: Because the day is getting longer.

Teacher: Because each day is longer ... the day?

Phatic repetitions are also abundant, that is, the teacher does them to make sure that the whole class hears the instructions for the exercise:

Student: The percentage of electricity consumption in the second week of March.

Teacher: So, what we are going to represent in the bar chart, what is it? ... the percentage of electricity consumption in the ... second week of March. I repeat, we are going to represent in a sector diagram the percentage of daily electricity consumption during the second week of March, okay?

d) Alternation of registers

The discourse of the primary classroom is characterized by a strong alternation of registers, derived from the teacher's effort to introduce the scientific language, that is, to teach how to use the high register of the language in a context where the receivers only know the colloquial register and a standard register, we could say intermediate, introduced by the media in a chaotic way and often inconsistent for them.

Thus, the classroom discourse becomes a continuous struggle of the teacher to establish the cultured language in the classroom as much as possible, in which the teacher continually corrects the students for the use of language in reference to the records. On the other hand, this gap in linguistic knowledge between the teacher and the students sometimes causes episodes of misunderstanding that tend to go unnoticed when the teacher introduces technical concepts without realizing it and many times the students do not ask what they mean. To illustrate the latter, we can observe the use of the word specular in the sixth corpus (Salloum, et al., 2019: 14). This word appears on three different occasions and on none of the three is it explained by the teacher or questioned by any of the students. The same goes for the word enact:

Teacher: And what is the Ministry in charge of? ... To get the resources to us but also to enact those that affect our education system, you remember, don't you?

In reference to the record and the teacher's effort in the proper use of this, we now show an example where the teacher does not accept the student's proposal, which uses a too colloquial lexicon (mills), and induces it to use a more scientific language (wind turbines) (Meiers,2007)..

Teacher: But let's not pass ... does anyone know how the wind is produced? How is the wind produced?

Khan: For the mills ...

Teacher: Not for the mills.

Khan: No! For wind turbines.

Teacher: The wind turbines.

In the corpus of the second grade of primary school (2019), we observe that, unlike what occurs in the corpus of sixth, the high register of the properly scientific language comes mainly from the textbook, since the teacher remains in an intermediate register:

Teacher: Grams. Now I'm going to read some other information. "The form — it is formed by a type of striated muscle, the myocardium, covered externally by a silky double-walled membrane; the layer attached to the muscle, constitutes the pericardium and the outer, the pericardium, which fixes the heart to the structures - to the neighbouring structures, but allows the contraction". Who understood, what I said? / Salma.

Salma: That ... the heart weighs between three hundred and five hundred grams. (2010: 74-75)

In addition, it is noteworthy regarding the record that, throughout the sequence, this teacher uses the expression would look good and would be bad to make the students reflect on whether or not what they are writing is correct from two points of view: the theme matching and style. The fact of being good or bad is from a clearly colloquial or unscientific record, but in this context it serves so that students, who still intuit rather than reason by writing rules, begin to develop that linguistic intuition in a logical way:

Teacher: Let's see ... it's a muscle bomb that sends blood.

Boy: Yes

Teacher: Let's see. Let's see, what would it look like? Through the veins and arteries, all over the body? Would it look good?

Boy: Yes.

Boy: All over the body, eh–.

Teacher: Saul, answer me, would it be okay or not? Saul: Yes. (2010: 106-107)

e) Phraseology: Although phraseological expressions are found in all registers and fields of use, in the colloquial register and orally they are especially important. Using these kinds of expressions as easy to remember slogans is a typical resource in the educational field when explaining content that students want to remember in the long term. For example, in the field of environmental education, we can find statements as slogans of the type water is scarce: reuse, as in the following fragment:

Teacher: Very well! We need to save water. No, let's just say I've seen someone turn off the tap. So we have to save water, huh? It is very important, water is a scarce commodity.

Or as in the following example, mnemonic rules that allow us to memorize certain advisable behaviours:

Teacher: So you have to make responsible use of water, energy and you have to apply the rule of the three ‘r’s, what are Ainoha?

Student: Reduce, reuse and recycle. (2012b: 104)

With regard to colloquial phraseological expressions, in the following example we see how the teacher who uses a colloquial expression such as fear is the one who plays to paraphrase the definition of responsibility that the student had offered in colloquial terms, and then raise the record again with a new paraphrase (“advise a better environment”).

Teacher: What is the responsibility?

Student: What we need to do.

Teacher: Do whatever it takes! In this case, do it to achieve a better environment. (2012b: 104)

f) Exemplifications: Sometimes a concept is co-constructed through the examples of the students, coordinated by the teacher. We can see that among the examples, there are also paraphrases and co-constructed definitions (2012b: 106-107):

Teacher: What things, natural resources are not continuously depleted and regenerated?

Waseem: Biomass.

Teacher: Biomass! Really well! Biomass. What is biomass? Because I'm not too clear on that. I don't know what biomass is, do you know what biomass is? What is?

Student: These are ... the remains of dead animals...

Teacher: Val, however, says that they are the remains of living beings that can then, by burning them, produce heat, produce ... okay! However, tomorrow look for tomorrow what biomass is, which is not too clear to us. Come on, other natural resources, Abdul.

Abdul: The wind ...

Teacher: The wind.

Abdul: The water.

On the one hand, we have observed that students, sometimes, when they do not know how to define a concept, do so through an example, a fact that confirms a deficit in the understanding of said concept or in the language of abstraction:

Teacher: Does anyone know what combustion is? What is?

Student: When, for example, oil ignites.

Finally, we have observed that in the two corpus, a mechanism for the construction of knowledge is repeatedly used, which consists of the teacher resorting to examples close to the student's experience in order to find an abstract concept. It is about contextualization through examples as a mechanism for the construction of knowledge. For example, when the sixth grade teacher tries to explain what the waste is, talking about the remains of lunch that litter the schoolyard:

> **Teacher:** And do you realize? Me last year, when we saw the wastebaskets, it was strange the day we didn't see seven or eight balls of aluminium foil, if you realize now there isn't any. Why? Because from school we train children to bring lunch to them in plastic bags that can be reused or on paper, okay? But the council is trying to see if someone subsidizes some cloth bags, huh? To bring the sandwich in them and be able to reuse them constantly, when they get dirty they wash and that's it. What else was discussed?

g) **Narrativization**: In the previous example, we observed that, rather than describing scientific facts, a situation is narrated, a story is told. The preferred textual sequences of prototypical scientific discourse are descriptive, expository, and argumentative, but not narrative. Therefore, we can affirm that in the transition from prototypical scientific discourse to popularization, genres and textual sequences change, and it is in this process that narrative sequences appear.

In the corpus analyzed, we have detected several examples of a resource that consists of a narrative sequence of an example close to the students. We consider it to be narrative because characters appear and because the verb tenses are not timeless or present, but past, as in the following example from the corpus of second year (Aina Monferrer, 2014: 96):

> **Student :** "The heart, a hollow muscle. Surely on more than one occasion you have felt, when placing your hand on your chest, the beating of your heart and you have wondered why your palpitations, we are going to study what it is like [now continue with a more scientific language, enumeration in technical terms: aorta, ventricle, atrium ...]".

h) Comparisons and metaphors: From a linguistic perspective, we can define the metaphor as an implicit comparison. In the three interventions of second-year students that we show below, where we try to define the heart, we observe that comparison, definition and metaphor are closely related elements:

> (a) [Reads] "The heart is a fist-sized muscle bomb."
>
> b) Child: The heart is - is like a - a shape of a clenched fist.
>
> c) Child: The heart, the heart is shaped like a fist.

Although the metaphor is one of the most powerful tools for understanding scientific concepts, not all metaphors are valid in all contexts. For a metaphor to function as an effective cognitive tool, it must be part of the receiver's universe of prior knowledge. In the corpus of second course (2010), we observed a mismatchin the metaphor underlying the basic definition of the heart: the heart is a muscle bomb.

Of the various meanings of the signifying bomb, the most elemental and famous among children is that of an exploding object. On the other hand, the meaning behind this definition is the mechanism to mechanically and continuously propel a liquid, and this second, more complex meaning, is not usually part of the encyclopaedic knowledge of a second-grade child. Therefore, at this point there is a mismatch between teacher and students that prevents understanding, a fact that we have verified in two ways.

On the one hand, because students do not find other words than those in the definition of the book to explain this concept:

Teacher: See, from everything I've read about Azeez, what did you understand? / Salma. **Salma:** I understand that they have said that the heart is a muscle pump that circulates blood.

On the other, because a student affirms that the heart is a muscular pump that "pumps" (2010: 97) the blood throughout the body, to which a colleague corrects him saying that he sends blood. The fact that confusing pumping with bombing clearly indicates that the metaphor of the heart as a pump is not working as an explanatory element, but as an element that adds confusion and further complicates the understanding of the term. It is an example of how the application of a metaphor that is not adapted to the level of the students makes understanding difficult rather than easier.

In the same corpus of second grade, the oral discourse of a didactic activity on the heart is collected, where the teacher guides the students to write a hierarchical text explaining what the heart is. With this process it is achieved that, at the same time that the student assimilates some contents, they become familiar with the ontological metaphor of physical space by the conceptual space necessary for the understanding of complex scientific concepts. Thus, the student learns to mentally visualize the complex conceptual networks that serve to understand the functioning of the heart and that serve as the basis for future abstract knowledge (Hayes, & Kraemer, 2017: 7):

Sameer: I said- by- by- I said / what do you do? Per- because if yes- have- if we have- **Teacher:** Let's see, why? Why did you put what fA?

Sameer: Because if we put both one up and one two down, we would have to go, what would we do?

Teacher: That's it! / Okay, Almudena! Why, how much does it weigh?

Almudena: Because, I want to know how much blood it has - because, if it has little, I couldn't distribute it and if it has a lot I could distribute it to the whole body.

2.2. The guided construction of knowledge

2.2.1. Metacognitive reflection

In relation to this last example, we can see that students internalize this scientific way of relating concepts and hierarchizing them, as in the following case, where a student reflects aloud on this type of abstract organization. And it is that learning to classify and hierarchize is essential for the understanding of abstract concepts (Mary Helen Immordino, et al., 2019: 201):

Teacher: How does it work? Go, explain to your classmates why after how it is? You want to propose what you propose.

Teacher: Salma.

Salma: Did I propose how it works? Because I think it would have to go after how it is? how does it work? / I think it should go as it works?

The most important characteristic of the peripheral scientific discourse that is generated in the primary classroom is the interaction and co-construction of knowledge. We have said before that the school is the main person in charge of, in addition to disseminating science, providing students with the cognitive tools necessary to do science and to be able, ultimately, to consume and produce prototypical scientific texts. In this sense, Neil Mercer speaks of educated discourse (2004: 160), which is what students use when they are in this process of learning how to speak of science. Students have to learn that science uses certain textual genres, expository, explanatory and argumentative textual sequences, formal registration, zero moralization, etc. But in addition, to do science, certain cognitive mechanisms that are also worked in the classroom and that are made explicit through the lexicon (mainly verbs) as well as through metacognitive reflections are necessary.

Regarding the lexicon, we observed, especially in the sixth grade corpus, the insistent use of verbs and verbal locutions related to the field of research and search in general. It is the repeated use of verbs such as finding out, searching, investigating, discovering, daring to think, how it is such, etc. It is about presenting the exercises as small tasks of inquiry that the teacher entrusts to the students; small investigations that put the student in the role of scientist. In this way, the teacher does not put homework in the classic sense of tasks of repetition or consolidation of knowledge, but requires tasks of searching for information at home, much more constructive and meaningful, as well as more useful for the learning.

The following example is a sequence where the scientific concept of cogeneration appears. The teacher avoids saying what it means and prefers that each student discover it on his own at home. Furthermore, the example is interesting because it includes a metalinguistic reflection on how one of the students deduces the meaning of the word from the prefix it carries (co-). The teacher explains this mental process of a student so that the rest of the class becomes aware of the usefulness of this deduction process:

Teacher: [...] does anyone know what cogeneration is? I do know because I have been informed but do you know? ... Well, homework for tomorrow to try to find out what cogeneration is, you write it down.

Anna: Mix ...

Teacher: Cogeneration, mixtures. The "co-" has given you the idea of the mixture, right? Something. That's where the cogeneration goes, a little bit. There you put it, in the white part you put "find out what cogeneration is."

Student: Mix of ...

Teacher: Ssh! You find out, okay?

In the following example we see how the teacher demands more precision from the student when explaining the content of a sector diagram, since one of the characteristics of science discourse is precision.

Teacher: We were analyzing a sector diagram about what?

Salma. About what we had consumed ... in the diagram we represented what we had consumed each day.

Teacher: But I want you to be more precise.

Abdul: We were representing kilowatts in percentages.

In this other example, we observe that the teacher explains the fact that the student has made a mental relationship between concepts from different areas, since this type of synoptic relationships are those that enhance creative scientific thinking and, therefore, the Progress of science.

Salma: There are times when nature ... for example, air and water belong to nature and can help us to produce energy.

Teacher: Seeing, for example, the inexhaustible air and water that we have there can produce energy. So you've already linked something about the environment to energy.

And in this other one, the teacher talks about the complexity of a concept that he is explaining, and gives students the opportunity to investigate it, making evident the complexity of science, which makes the dosing of information necessary.

> **Teacher:** [explaining how geothermal energy is obtained] Well, this is complicated. We could also investigate this, eh?

On the other hand, the sixth grade teacher is continually motivating students to achieve autonomy in these mental processes that science needs and that are learned above all in school. It does so by means of motivational expressions that it includes in the statements of the tasks it asks for. For example, when it says: Would you be able to open the bar chart corresponding to the daily consumption of the first week?; or in the following case, where you are promoting the autonomy of the students when carrying out a calculation exercise on their own:

> **Teacher:** Divide by 3.6 OK? I repeat, 100% is the whole circle, 360 degrees. Now what do we have to do? Find out the degrees that each circular sector will have for each of the percentages, okay? Well, you guys do that to me already, from now on. You pass the percentages to the degrees multiplying it by what Anna said, 3.6.

2.2.2. The questions

Questions are the key element of the guided construction of knowledge, since they are the most direct verbal resource to request the interlocutor's interaction. In addition, questions are a key element that, used in the classroom, allows the teacher to manage the information flow in a balanced way and control it to adapt it to the level of their students. The questions allow to recapitulate, open new topics, encourage the participation of the students in each case, close points, control the attention and reception of the students, point out, exemplify, etc.

For all this, we consider that questions are the fundamental tool to manage the effective acquisition of scientific knowledge by students. Due to the characteristics of the analyzed corpus, which are oral transcripts that show sequences of teacher-student interaction, and also for reasons of space, we will focus on the classification of the different functions of the teacher and student questions in the process of disseminating scientific knowledge in the primary classroom, leaving aside other questions not related to scientific content.

2.2.2.1. Teacher

We have identified eight different types of questions asked by the teacher related to the guided construction of knowledge: phatic, imperative, rhetorical, recapitulative or investigative questions (which may be of pretended ignorance), to encourage participation, about previous knowledge, questions closed on content and open questions on content. Next, we will briefly explain each type with some examples from the corpus.

The phatic questions, as the name implies, serve the teacher to make sure that the students are listening to him and understand what he is explaining. Questions like ok? and agree? they are very common in the two corpus analyzed. These are phatic questions, which are used by the teacher to verify that the students attend to their explanations. They are usually placed at the end of a theoretical explanation or an instruction, as we can see in the following example:

> **Teacher:** Okay. And the results of that survey in the green week have to be exposed, okay? So, those responsible for representing in sector diagrams, the percentages in each of the answers, are we, the sixth graders. Sixth grade students will take care of collecting all the data from all classes, eh? And make sectional diagrams about the percentages, huh? From each of the answers to each of the questions Do you want to read the questions, please? First section, you read the first section.

The last of the questions that appear in this example is imperative, since it demands a task from a student. In this case, read the questions. There are also more developed phatic questions, such as: P. “Why are you pouting, Carlos?”, R. “Why don't you understand almost res”. In addition to the tactical questions, which sometimes become the phrase of some teachers, rhetorical questions are also very abundant and are used to manage information. In fact, with these types of questions, one advances to the hypothetical doubts that he deduces that his students will have about the content explained:

> **Teacher:** And do you realize? I last year, when we saw the bins, it was rare the day we did not see seven or eight balls of aluminium foil, if you realize now there is none. Why? Because from school we train children to bring lunch to them in plastic bags that can be reused or on paper, okay? But the council is trying to see if someone subsidizes some cloth bags, eh? To bring the sandwich in them and be able to reuse them constantly, when they get dirty they wash and that's it. What else was discussed?

In this fragment we see different types of questions: a “why?” rhetorical, a “do you realize?” also rhetorical because he does not expect an answer, two phatic questions and, finally, a recapitulation question. The recap questions and probing questions serve the teacher to stimulate student participation: “What else was discussed?”, “Estaria tot?”, “Why more?”, “Can we think of something else?” , “Does anyone propose another? Almudena? ”.In the latter case, a student is directly questioned to participate. Sometimes, in these types of questions, the teacher pretends that he does not know something, as in the following example with the concept of biomass:

> **Teacher:** Biomass! Really well! Biomass. What is biomass? Because I’m not too clear on that. I don't know what biomass is, you know what biomass is? What is it

There are also questions to check previous knowledge. In this case, the teacher looks for examples in real context: “Who has seen diagrams somewhere besides school?”. There are also questions that encourage participation, such as “would you dare to ...?”.

Finally, there are the questions about declarative knowledge, which in principle do not admit doubt. They can be closed, like "But is the blood blue?" or open, such as “Why is it looking bluer? ” (same). The function of these questions that the teacher addresses to all the students or to one of them is to make them reflect on a content to check if they have understood it.

We have said before that the process of acquiring a scientific concept consists of a round trip. During the round (when the concept is contextualized through the *determinologization* mechanisms) the student deciphers the concept. On the way back (when he is able to understand the abstract concept), the student internalizes the concept. The teacher can check if the student has followed this two-way path if he is able to explain the concept in a technical way but without tracing the definition of the manual. This abstract and technical language that the student has acquired is what Neil Mercer calls educated discourse (2014: 202).

In this sense, we have analyzed the ways of answering the questions: what is x? and what does x mean? that appear in the corpus, and we have identified five types of answers: a) not knowing the answer (“Nazeer: Eh ... number of people ... I don’t know”, b) give an example ([the combustion is] when for example oil ignites) , c) make a comparison (“the heart is like a shape of a closed fist”), define the concept of colloquially (“renewables are things you don’t get it,), and e) technically define the concept (“energy is all that changes around us causes”,).The last type of response is the one that most closely approximates the prototypical scientific discourse, which is the language model used to speak scientifically.

The students

Regarding the types of questions about scientific content that the students ask the teacher, we have been able to identify four different types: interrogative answers (which denote insecurity in the student's response), questions to situate themselves, questions to clarify concepts and, by Lastly, questions that go beyond the contents that are explained and that relate these to other spheres of knowledge or to daily experience. Placing questions are asked by students when they have lost the thread of the teacher's explanation. They are open questions of the type where do we go? or closed:

> "We're talking less energy, aren't we?". Another type is the questions about the content of what is explained: “Is the dirt all over your body that you come from is vegan blue?”, “**Student:**What is nuclear energy like? or “**Student:** How is that heat? [from geothermal energy] ”. There are questions from the students that go beyond the content that is explained. These are usually the most interesting questions and those that denote a greater understanding of the contents, since the student is able to go beyond basic understanding and relate them to the real world (eg: “Is this good or bad?”.

Another type of student question is what we have called interrogative answers. These are the occasions when the student answers a question with the answer but with interrogative intonation. These interrogative answers take place when the student answers the teacher with a question because he is not sure of his answer, so the student waits for the teacher's subsequent reaffirmation of the answer:

Teacher: The City Council, very good! Who is responsible?

Student: The mayor?

Teacher: Mayor! The mayor is the maximum responsibility

III. Conclusions

In the sixth grade corpus, we have seen how learning was conceptualized through the metaphor of scientific knowledge. It is important to make students see that life is full of experiments and discoveries that we can all reach from the scientist's perspective, to see science as something close as early as childhood. Students need to be empowered for science and shown that small learning discoveries are small-scale metaphors for the long road of science. For this reason, it is useful for the teacher to lead the students to learn about science from the metaphor of the scientific student.

We have also verified that the teacher must know in depth the level of knowledge from which the student starts in order to effectively apply determinologization. Otherwise, we have seen that barriers to understanding can arise, such as when certain technicalities are not explained or when an image-based metaphor is used that the students do not yet know.

On the other hand, one cannot fall into the error of excessive simplicity. Scientific knowledge must be dealt with in depth at school and students must be aware of its complexity, but not for that reason remain on the simplistic surface of the concepts. It is necessary for the teacher to use the scientific language and to teach the students to use it also, with the ultimate goal that the students will someday use the prototypical scientific language autonomously.

Scientific knowledge is represented in the mind within frameworks or conceptual modules. These mental places have plasticity and change as we learn in order to process more abstract and complex concepts like those of science. In fact, according to the Karmiloff-Smith representational description model, development consists of a process of representational change (1992: 28). That is why it is essential to value the role of the school in the development of cognitive frameworks and procedures that allow access to science.

In order to reach scientific knowledge, in addition to the contents and the language, it is necessary to know certain cognitive abstraction procedures: the ability to interrelate, extrapolate, compare, rank, synthesis, deduction, induction, etc. It is especially at the initial levels of formal education where these types of cognitive and metacognitive functions are essential for access to scientific knowledge in all its complexity.

Among the main differences when teaching scientific concepts between the two primary levels (second and sixth grade), of the two corpus analyzed, it should be noted that in the second corpus there is an interest in working the language at the same time as science that decreases markedly in the sixth corpus, in addition to working from the point of view of the organization of information on the scientific concept in a text, knowing how to organize it from more to less important. On the other hand, in the sixth grade corpus, there is more interest on the part of the teacher in specific mathematical operations and in the fact that students handle scientific language appropriately, at a much more specific level than in the second grade of primary school. , where there is more concern for a global understanding of science and the scientific concept from writing.The teacher should strive to create in her students an attractive and accessible mental construction of science and the figure of scientists, offering them tools so that they can face science Carlos autonomously. That is why it is so important to work along the lines of meaningful learning and to handle real texts such as reports, files, surveys, invoices.

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