

RESEARCH

<https://doi.org/10.15198/seeci.2020.52.49-72>

Received: 28/05/2019 --- Accepted: 17/10/2019 --- Published: 15/07/2020

THE PEDAGOGICAL DISCOURSE IN THE TEACHING OF CONCEPTS IN CHEMISTRY WITH THE USE OF THE SCHOOL TEXT

EL DISCURSO PEDAGÓGICO EN LA ENSEÑANZA DE CONCEPTOS EN QUÍMICA CON EL USO DEL TEXTO ESCOLAR

  **Pedro A. Certad Villarroel**¹. Metropolitan University. Venezuela.
pcertad@unimet.edu.ve

 **Tulio Ramírez**². Andrés Bello Catholic University. Venezuela.
tuliorc1@gmail.com

ABSTRACT

In the present study, it was proposed to analyze the academic scientific discourse in the teaching of a selection of basic concepts of Chemistry using the school text as an encounter point among interactions. From its method it intended an explanatory level under a mixed or combined type design with the use of the content analysis technique that served as a union between quantitative data related to the count of categories and frequency of occurrences within the verbal capital with qualitative information from the record of interactions, recordings and transcripts of the events observed during the use of the school text. At the end it could be concluded that observation during interactions was characterized by the predominance of dialogue units over monologues, using a close focused scientific language, which at times was imprecise and inclusive. The sequences show three different moments and a predominance of the masterful explanation in which some strategies are used with a closing marked by the performance of activities proposed by both: the teacher and the school text. The recognition of learning models was very particular because in no case, it was a pure model that allowed to frame the class in order to identify how it would be carried out, what to expect, what not to expect. In short, to recognize the class and the model by which it was given; it was from the interweaving of the attributes of each learning model that it became possible to characterize the teacher.

KEYWORDS: pedagogical discourse – content analysis – school text – concepts – Chemistry.

¹ **Pedro A. Certad Villarroel:** Faculty of Sciences and Art. Department of Educational Sciences. Venezuela. pcertad@unimet.edu.ve

² **Tulio Ramírez:** Faculty of Humanities and Education, Venezuela. tuliorc@gmail.com

RESUMEN

En el presente estudio se planteó analizar el discurso académico científico en la enseñanza de una selección de conceptos básicos de Química valiéndose del texto escolar como punto de encuentro entre las interacciones. Desde su método pretendió un nivel explicativo bajo un diseño de tipo mixto o combinado con el uso de la técnica de análisis de contenido que sirvió de unión entre datos cuantitativos referidos al conteo de categorías y frecuencia de apariciones dentro del capital verbal con información cualitativa proveniente del registro de interacciones, grabaciones y transcripciones de los hechos observados durante el uso del texto escolar. Al finalizar se pudo concluir que la observación durante las interacciones se caracterizó por el predominio de unidades dialogales frente a las monológicas, uso de un lenguaje científico, cercano, centrado, que en algunos momentos era poco preciso e inclusivo. Las secuencias muestran tres momentos diferenciados y una predominancia de la explicación magistral en la cual se hace uso de algunas estrategias con un cierre marcado con la realización de actividades propuestas tanto por el profesor como por el texto escolar. El reconocimiento de modelos de aprendizaje fue muy particular pues en ningún caso se trató de un modelo puro que permitiera enmarcar la clase para así poder identificar cómo sería llevada ésta, qué esperar, qué no esperar, en fin, reconocer la clase y el modelo por el cual era dada; fue a partir del entretrejo de los atributos de cada modelo de aprendizaje que se hizo posible caracterizar al profesor.

PALABRAS CLAVE: discurso pedagógico – análisis de contenido – texto escolar – conceptos – Química.

DISCURSO PEDAGÓGICO NO ENSINO DE CONCEITOS DE QUÍMICA COM O USO DO LIVRO DE TEXTO

RESUMO

No presente estudo foi proposta uma análise do discurso acadêmico científico no ensino de uma seleção de conceitos básicos de Química usando o livro escolar como ponto de encontro entre as interações. A partir da metodologia que pretendia um nível explicativo sob uma estrutura de tipo misto ou combinada com o uso da técnica de análise de conteúdo que funcionou como uma união entre dados quantitativos referidos a contagem de categorias e frequência de aparições dentro do capital verbal com informação qualitativa que vem do registro de interações, gravações e transcrições dos fatos observados durante o uso do texto escolar. Ao finalizar foi possível concluir que a observação durante as interações se caracterizou pelo domínio de unidades de diálogo frente aos monólogos, uso de linguagem científica, próximo, centrado, que em alguns momentos era impreciso e inclusivo. As sequências mostram três momentos diferenciados e um domínio da explicação magistral nas quais são feitas algumas estratégias com um fechamento marcado com a realização de atividades propostas tanto pelo professor quanto pelo livro de texto. O reconhecimento de modelos de aprendizado foi muito particular pois em nenhum caso se encontrou um modelo puro que permitisse enquadrar a turma para poder

identificar como esta seria tratada, o que esperar, o que não esperar, enfim, reconhecer a turma e o modelo pelo qual a aula era ensinada; foi a partir do entrelaçado dos atributos de cada modelo de aprendizado que tornou-se possível caracterizar o professor.

PALAVRAS CHAVE: discurso pedagógico – análise de conteúdo – livro de texto – conceitos – Química.

How to cite the article:

Certad Villarroel, P. A. & Ramírez, T. (2020). The pedagogical discourse in the teaching of concepts in chemistry with the use of the school text. [El discurso pedagógico en la enseñanza de conceptos en química con el uso del texto escolar]. *Revista de Comunicación de la SEECI*, (52), 49-72.
doi: <http://doi.org/10.15198/seeci.2020.52.49-72>
Recovered from <http://www.seeci.net/revista/index.php/seeci/article/view/599>

1. INTRODUCTION

A class is nourished in the explanation, and by explanation we mean the action that tries to make a concept or a situation understood by means of an explanatory sequence (D'Avolio, 2013), also called by Zuev (1988) the *basic text*, which is nothing, but an oral and written structure, in which the fundamental knowledge is presented to achieve the proposed objectives in teaching (D'Avolio, 2013).

When an explanation is produced in the classroom, it carries with it some type of didactic strategy and various actors take part in it, such as: the teacher who explains with support, both in his knowledge and in the school text, the student who asks, attends, works and investigates in his school text, and the school text itself as a teaching vehicle. Among these actors is that general and conceptual explanation, teaching strategy and the activity that promotes learning materializes. It is in this real dynamics in which interactions occur in the classroom for which Castro (2007) states that:

Interaction is something that exists once there are two or more behaviors of two or more individuals, and they are the behaviors and something else, that something is the sense of the relationship between both *actions*, and such sense is the basis of the relationship that exists between one and another individual for a given moment or period. (p. 4)

And, in this case, two or more behaviors establish a relationship, that of the teacher and the students with the school text, either individually or in groups, and that established within the classroom with the role that play in it the participants.

As a complement to the above, Bruner (1998) adds that the activity carried out by the teacher, takes place in a game of exchanges, discussions, dialogues and agreements that allow the implementation of individual and collective reasoning, conceptual training and material handling where the contents or learning objects

should be assumed not as ends in themselves, but as inputs to stimulate inquiries and questions from the students.

The role played then by the teacher and by the school text, in the case of this study in the teaching of chemistry is marked by paramount importance. As actors involved and as discourse entities construct within the specific dynamic kind of communication, establish relationships and in turn determine the addressing of the focal point through the explanation and selection of certain strategies presented in the school text, on which the teacher leans for the planning and execution of the class.

In this sense, since 1960 there have been different research that take as an object of study the interaction in the classroom focusing on the dynamics that are generated in it (Bellack, 1966; Doyle, 1977) for example in the formulation of questions and answers (Barnes, Britton and Rosen, 1971; Sinclair and Couthard, 1975 and Titone, 1986). From inter-structuring pedagogical positions such as those of Not (1983) or Perret-Clermont (1984), the need to promote strategies that generate interactions, where the student can participate in this dynamics according to his intellectual characteristics, is pointed out. It must be adjusted the level of support to his level of competence and his cognitive construction times must be respected. Thus, the structure of the academic task and the exchange between the teacher-school text and the student-school text would move away from the marked evaluative intention that usually characterizes the check of the achievement of eminently behaviorist objectives that in the search for observable attitudes leave out high value internal processes.

Vygotsky (1979) from psychology, bases the place that mediation holds in learning, in this case the school text as a pedagogical vehicle. The author shows the need to understand the distance that the student must travel between what he already knows and what he can come to know with the help of this mediator, processes that can take place inside and outside the classroom. In this sense, Bruner (1998) argues that the importance of the construction of own meanings by the student is no longer discussed, and this construction can be carried out not only in the dynamics of the classroom but also asynchronously, when the student interacts with the text or with their peers outside the classroom.

Later, in the early eighties of the last century, the main concern of researchers in the teaching of sciences was linked to the analysis of students' learning, their conceptions, the teaching materials, and those of teachers. Having just ended this decade, learning began to be related to the social context in which it is immersed, as shown in studies of Fentemacher (1986), Edwards and Mercer (1987) and Seeger (1991), context that contributes to the results of the process and that are determining as a strategy in the scientific explanation when managing concepts. This way, the responsibility of the teacher and the school text in the teaching process is established implicitly as facilitators of the student's learning process. These theorists have generated some categories of analysis that served as orientation in this study for the choice of the elements to observe in the interaction in the classroom.

This article then focuses on the explanation of the teacher that with the use of the school text gives to teach measurement concepts, matter and energy, and takes into account the contributions of Calsamiglia and Tusón (1999) who state some peculiarities that are worth addressing, among them, the detection of inaccuracies in the explanation, the impossibility of crossing out and starting again, and the alternative of the teacher in this case to continue speaking, hence the discourses are tinged with repetitions, paraphrases and flourishes or limitations that the teacher has in his communicational scheme, aspects to consider when the teacher makes the explanation and whose act is based on the explanation existing in the school text.

2. OBJETIVE

For this study was raised as main objective to analyze the scientific academic discourse that occurs for the teaching of a selection of basic concepts of chemistry when the teacher makes use of the textbook, and for that purpose a method framed in the mixed research paradigm was devised.

3. METHODOLOGY

The mixed approach is a process that collects, analyzes and links quantitative data and qualitative information in the same study (Mertens, 2009; Tashakkori and Creswell, 2007; Martínez Llantada, 2005; Creswell, 2002; Williams, Unrau, Grinnell and Epstein, 2005 and Tashakkori and Teddlie, 2003) and may involve the conversion of qualitative data into quantitative data and vice versa (Mertens, 2009). The results of this type of study are in many cases numerous and varied, so they must be systematically ordered to interpret the information received. For this reason, triangulations, diagrams and computer programs are used to analyze this type of data. Some theorists agree that there is no single model to analyze the data obtained and that each researcher will be able to outline their own interpretation process. Based on the above and from the observations of Krippendorff (1980), Miles and Huberman (1984) and Taylor and Bogdan (1986), it was decided to establish content analysis as the predominant technique to approach the observations that emerged from the interactions.

Content analysis is a procedure that allowed the analysis and quantification of communication materials. In general, it makes it possible to analyze in detail and in depth the content of a communication, regardless of the number of people and materials involved in the process, and it can use any data compendium tool such as diaries, journals, letters, questionnaires, surveys, projective tests, books, advertisements, interviews, radio, television, among others (Holsti, 1968).

On his part, Krippendorff (1980) defines content analysis as "the technique intended to formulate, from certain data, reproducible and valid inferences that can be applied to a context" (p. 28). In the case of this research, the content analysis allowed the understanding of the school texts in the specific context in which they are generated and used in interaction with the informants, in addition, the handling of the state of art and the theoretical foundations on which the study was cemented.

According to Krippendorff (1980) this technique places the researcher with respect to reality in triple perspective:

- The data and information as communicated to the researcher.
- The context in which the data and information are generated.
- The way in which the analyst's knowledge forces to divide reality to facilitate its understanding.

Content analysis is then configured as an objective, systematic, qualitative and quantitative technique that works with representative materials, marked by exhaustiveness and with generalization possibilities. For this study, this technique was applied to interactions among school texts, concepts, pedagogical contexts, the teachers, in short, to all the members of the research body.

3.1. School texts

This part of the corpus is made up of three school texts used for the administration of the Chemistry subject, in the third year of General Middle Education (GME). The objective that led to the constitution of this group of school texts was to collect a sample of the explanations contained in them for the teaching of Chemistry and to carry out an analysis of their use, conceptual management, their characteristics and implications that they may have in the development of the knowledge.

Based on the above, the frequency of use, availability, profile of the authors, which were only theory books and, finally, the edition, were taken into account for the selection of the school texts. Based on these selection criteria, the selected school texts were Chemistry 3rd year - Related Series from Santillana Publishing House. (2013). Science to live in community. Natural Sciences 3. Volumes 1 and 2 - Bicentennial Collection. (2012), and, Chemistry 3rd year of Romor Publishing House (2010).

3.2. The concepts

For this part of the corpus, it was considered as a criterion to select the type of concept -systemic, macro concepts or superordinate concepts- that is those involving other groups of concepts derived and dependent on it - Basic and subordinates concepts. These concepts give rise to others in the subsequent topics specified in the official program of the subject. Then, the relevance of the concept verifying that the proposed concepts are in the Syllabus for the prescribed level; therefore they are fundamental cores in the content of the School Texts and, lastly, the school significance expressed in the fact that its use reappears in higher levels of study than the one addressed here and in other subjects.

Meeting the aforementioned criteria, the concepts that make up this part of the corpus are: Measurement, Matter and Energy. They belong to the Venezuelan level of education of third (3rd) year of GME; the intent to choose this study level is that it is the first time the student comes across Chemistry as a subject. Except that in the

Nature Studies program corresponding to the first year of the Venezuelan GME, the concepts of Measurement, Matter and Energy are also addressed, but from explanations that are more related to aspects of Physics as science.

The approach to the three concepts is made from the language and from Chemistry; later from teaching, consequently, when addressing it, linguistic meaning and definition in Chemistry are combined. For the selection of these concepts, it was taken into account that they are macro concepts that is they involve other conceptual groups derived from and dependent on it, called micro concepts. Secondly, they are proposed in the Subject Program at the level of education selected, therefore they are fundamental cores in the content of School Texts. Lastly, its use reappears in the subject program of higher study levels than the one addressed here.

3.3. The pedagogical context

For this part of the corpus, the educational institutions were considered. Being specific, there were eighteen observation request letters that were sent to various schools in the area called Gran Caracas - out of the total requests made, four schools had no teachers in the area of Chemistry, therefore the subject was not being taught. Nine had teachers from other areas with knowledge of Chemistry. Three schools, since they did not find teachers, they placed an advanced student and, finally, only two schools responded that they could contribute to the study. The pedagogical contexts in which the observations were carried out are described below.

3.3.1. Pedagogical Context "A"

This educational institution is under public administration. It serves students from first to fifth year of General Middle Education. The School is located in Sucre Municipality, in the city of Caracas, Venezuela. The middle school is located in a lower-middle class environment belonging to stratum IV (According to the stratification method developed by Marcel Graffar in Morales Gil, 2003; pp. 56-77). On the other hand, it works in two shifts, morning and evening, and in total, it serves an enrollment of 818 students. It consists of modest and somewhat small buildings. The staff of this institution is made up of a principal and two deputy principals, one for each shift, a sectional coordinator, an evaluation coordinator, a study control coordinator, two guidance teachers, and it has a total of 31 teachers, eleven of which are from the Natural Science area.

3.3.2. Pedagogical Context "B"

This pedagogical context is a school under private administration. It serves students ranging from the first levels of Initial Education to the last level of GME. The educational establishment is located in Sucre Municipality, in the city of Caracas, Venezuela. The socio-economic level could be called "middle class", belonging to strata III and IV, according to the criteria established in Morales Gil (2003) for the

study of the Venezuelan population. With a morning shift, and with complementary evening activities. It serves an average enrollment of 567 students. It is a three-story building, of large dimensions (more than 2000 mt²). It has 19 classrooms, a library, 5 administrative offices, 2 laboratories, 2 food outlets and bathrooms for both, students and teachers. The classrooms are ventilated and spacious with an approximate capacity for about 35 students per course. The staff of the institution is made up of a principal in charge, 2 assistant principals, 2 coordinators, an evaluation coordinator, a study control coordinator, a counselor and 28 professors for different dedications.

3.4. The teachers

It was considered necessary to address them both, for the use they make of the school text during class, and for the underlying explanation that comes from the conceptualizations in the school text. In this sense, the number of Chemistry teachers to select was three, because the research with the type selected here present difficulties when compiling the information and when carrying out the analysis of it.

Therefore, choosing the informants is performed based on the criteria established by Goetz and LeCompte (1988) in the selection of participants/informants. The authors state that the selection requires the prior establishment of "a set of attributes" (p. 89). In this case met the criteria of administration of the Chemistry course in the third year of GME, college degree of Natural Science professor, Chemistry professor or bachelor degree in Chemistry with teaching component, having different degrees of experience, and finally, professors of different genders and ages.

To obtain this information, the biographical interview was applied at a first meeting, in order to obtain the necessary and pertinent information that facilitated the understanding of the referential framework from which their specific pedagogical practices start.

3.4.1. The biographical interview

The biographical interview questions were demographic, about background, professional, and teacher training. The interview was organized in two parts: the first part where the general data of the teachers is investigated, and the second part where the academic and professional data of the teachers / informants is investigated.

3.4.1.1. According to their general data

Regarding gender, one man and two women were selected. The age was between 34 and 51 years old. In relation to marital status, the man is married and the two women are single.

The three of them had a university degree. As for the years of experience, this fluctuates between 11 and 23 years. On the other hand, it was observed that the two teachers are doing postgraduate studies while the man does not have, nor is he pursuing a diploma, specialization, master or doctorate.

Regarding the labor situation, it is pertinent to point out that two of them have the status of hired employee in the institution in which they work, while the third one is awaiting the opposition contest that the Ministry makes to regularize his presence in the institution. Regarding the hourly load that each teacher administers, one of them has a load of 28 hours per week, while the other two have less than 16 hours per week. The three teachers/informants stated that they had other jobs in other pedagogical contexts.

3.4.1.2. According to their academic and professional profile

Although the informants have training in the area, they work professionally in education and are pleased with their profession, it is important to highlight that some of them came to teaching in a forced way; they are all active teachers. They stated that their ways or styles of teaching are diverse and range from memorization to the construction of knowledge. The use of resources is diverse; there is management of non-technological and technological resources. Regarding the school text, all the informants use it both as a support in the explanation and in the assignment of activities or exercises. They consider important the practical work or laboratory, aspect that escapes from this investigation.

4. ANALYSIS AND DISCUSSION

For the systematization of the experience, the following collection sheet was used, which allows integrating the observations made in each class session (see table 1).

Table 1. *Information gathering form for interactions.*

Information collection form for classroom interactions		
1. Classroom:		
2. Pedagogical moment:		
3. Didactic unit:		
4. Concept:		
5. Interactive process:	5.1. Dialogical units:	5.1.1. Interlocutors:
	5.2. Monological units:	
6. Speech:	6.1. Start:	
	6.2. Development:	
	6.3. Closing:	
7. Sequence:	7.1. Of information:	
	7.2. The organisation:	
	7.3. Of activity:	
	7.4. Of exposition:	
	7.5. Dictation:	
	7.6. Of questions and answers:	
8. Production:	8.1. Oral and written production	
	8.2. Production of examples	

	8.3. Transfer
	8.4. Explained in pairs
	8.5. Inquiry
9. Use of school text	9.1. Individual events
	9.2. Shared events
	9.3. Referents
	9.4. Activities

Nota: adaptation of Del Valle (2011).

Source: self made.

4.1. Teacher/informant "A"

The classroom corresponds to the pedagogical context "B" which was divided into two sections, one with 24 students and the other with 25 students; this corresponds to the section of 24 students. The recording of all the sessions that included the didactic unit was made. The observations were made in the first quarter of the school year (period from September to December), intentionally selected according to the content administered and in accordance with a planning that belongs to the educational establishment and responds to the official program of the subject (see table 2). Due to the variety of encounters, it is also possible to observe various dynamics, moods, dispositions to learn and levels of fatigue.

Table 2. *Information collection form for interactions in pedagogical context "B" Professor "A".*

Information collection form for classroom interactions	
1. Classroom:	"B" Professor "A"
2. Pedagogical moment	First moment
3. Teaching unit:	Materials I: non-characteristic properties (School text: Chemistry 3rd year - Editorial Romor. Unit 1.)
4. Concept:	Measurement
5. Interactive process:	5.1. Dialogue Units: Present 5.1.1. Interlocutors: Dialogue initiated by the teacher and controlled by him using compulsory participation.
6. Speech:	5.2. Monologue Units: Present 6.1. Start: "!Good morning, let's see..."; "silence"; "Take out the book and the notebook". Students are invited to read the topic to be covered in class, silently and for 10 minutes. The teacher also does the silent reading. 6.2. Development: <i>Summarization</i> is made. With the school text in hand, he says "group, do you know what it is to measure? Measurement?" "Everything around us, matter, can be quantified, measured, then" "What is measurement?" "What do we measure daily?", "Do you follow me?" Accompany the explanation with signs to objects in the classroom and <i>contextualizations</i> . 6.3. Closure: enter the end with the <i>definition</i> "Then measurement is the process of giving a number and a unit to the subject in order to know how much there is of it..." Then, the teacher leaves some exercises

copied on the board with the title "Assignment- review" for students to do at home. In subsequent classes the resolution of these exercises is not addressed, simply continues with the next part of the topic or another topic.

7. Sequence:

7.1. Information: during the development of the class using everyday situations: supermarket, supply, bathroom scale...

7.2. Organizational: it offers participation turns, however there are overlaps between the interlocutors, which is understood as disrespect in the turns of speech.

7.3. Activity: individual activity for solving exercises copied on the board and that come from the teacher. The textbook used does not contain an activity section at the end of the thematic unit.

7.4. Exhibition: Made by the teacher and by students

7.5. Dictation: -0-

7.6. Questions and answers: the teacher asks questions to activate the discussion, the students intervene openly, questions arise from the students, other students answer and the teacher closes the discussion.

8. Production:

8.1. Oral and written production: The production given is written and refers to the mechanical resolution of exercises. It is not possible to recognize the proper handling of the concept. In one session, there was an approach for students to make a brief presentation of the topic, but the idea was diluted and it was not carried out.

8.2. Production of examples: -or-

8.3. Transfer: During compulsory participation a student explained how it was possible to make a dilution of household chlorine (sodium hypochlorite) using volume measurements at home and the relationship established between the concentration of the product and the cleaning power.

8.4. Explanation in pairs: Students intuitively get into pairs to solve exercises. The mastery of two students to the resolution of exercises was noted.

8.5. Inquiry: -0-

9. Use of school text

9.1. Individual events: the school text is used as a reading material during the class sequence.

9.2. Shared events: In some moments, a student reads an excerpt and the class follows the reading together with the teacher.

9.3. Referents: The school text is used as a continuous reference in the class by the teacher, the class and the explanation is supported by it and accompanied by its examples.

9.4. Activities: does not contain.

Source: self made.

Observation in this context with this informant was characterized by the appearance of dialogic and monologue units with a colloquial and scientific language, close, with the use of the second person singular during the interaction. It refers to the class as "group". It continually alludes to facts of daily life such as: the weighing of food in establishments, measures of domestic gas, weighing of people in pharmacies, among others; however, their monologic statements are permeated with, expressions of political disagreements, personal economic situation, the purchasing power of the Venezuelan before 1998 and the intentional use of terms such as "Those who can pull some strings", "your commander" and "we have a

homeland". These terms cause various emotions in the class and allow certain dispersions within the explanation; the teacher picks up the thread of the class and approaches the contents with precision. He defines the concept by saying:

- (UC1): ... *measurement is then [UR1] 'a process, it takes steps', in which the one that [UR2] 'measures using a suitable instrument', [UR3-UR4] 'gives a quantity in number 'and a proper unit of the dimension that measures a material'; [UR5] the measurement as such is given by the measuring instrument.*

The school text used by this teacher/informant does not expressly define Measurement, it only presents some relationships of this concept with what is done or achieved with it on a daily basis. From the Specialized Reference Books (SRB), it was obtained that the attributes that make this concept are:

- '*quantitative*': defined by numerical use in the concept.
- '*process*': defined as a set of consecutive phases.
- '*exppracexpe*': defined as Practical experiences or experiments.
- '*units*': defined by the use of a standardized amount of a certain magnitude, adopted by convention or law.
- '*uninumber*': defined as a binomial number and unit.

In addition, comparing these attributes with the definition given by the teacher / class informant, such a definition has the following attributes:

- '*process*': "...*a process, it takes steps...*"
- '*quantitative*': "...*grants a quantity in number...*"
- '*uninumber*': "...*it gives a quantity in number and a proper unit of the dimension that measures a material...*"

Additionally, the teacher / reporter from experience provided a new attribute to the definition such as the measuring instrument ('*instmedida*')

- '*instmedida*': ...*It measures using a suitable instrument...*" "... *The measure as such is given by the measuring instrument*".

As for the interactive process, it was observed the presence of dialogic units and some spontaneous, which emerged from the class with participations that complemented the explanation of the teacher / informant. As for the discourse markers, it was shown that the teacher / informant attracted the attention of the class and although the students spoke, he did not stop his explanation. Then, in the sequences and during the development of the class, the teacher / informant asked a generation of questions that stimulated the production of associations with the everyday context.

During the beginning of the class the teacher/informant asked the students to take out the textbook, the class uses it and the teacher / informant invited them to read or review, at all times he kept it in his hand or on the table and on the subject under study. This school text, due to its particular construction, was not used for the allocation of exercise solving activities -mathematical calculations- regarding this concept. The evaluation that was carried out to verify the learning of the definition

and management of the concept was limited to a memory repetition in the first part of an objective written test, where the recognition of some measurement instruments was also requested; both items had an average of 1.34 points out of 2 points. The exercises performed in the classroom were part of a formative assessment and due to timing issues; the students were not told if their results were correct or incorrect.

After reviewing the recordings and annotations made during the meetings with this teacher/informant, it was possible to affirm that the attitudes shown by the students during the development of the classes were willing to pay attention and participate. The classroom discourse dynamics occurred in a horizontal nature, directed by the teacher/informant towards the rustic association of the concept with its usefulness and application in the student's immediate context.

4.2. Teacher/informant "B"

This classroom corresponds to the pedagogical context "A" made up of 59 students. The recording of all the sessions that included the didactic unit was made. The observations were made in the first moment of the school year (period from September to December) intentionally selected according to the content administered and according to an instructional planning that corresponds to both the educational establishment and the official program of the subject (see table 3). Due to the variety of encounters, it is also possible to observe various dynamics, moods, dispositions to learn and levels of fatigue.

Table 3. *Information collection form for interactions in pedagogical context "A" Professor "B".*

Information collection form for classroom interactions	
1. Classroom:	"A2 Professor "B"
2. Pedagogical moment:	First moment
3. Teaching unit:	Materials I: non-characteristic properties (Science for living in community. Natural Sciences 3. Volume 1. Unit 8 - Bicentennial Collection)
4. Concept:	Matter.
5. Interactive Process:	5.1. Dialogical units: 5.1.1. Interlocutors: Dialogue initiated by the teacher and controlled by him using compulsory participation. 5.2. Monogal units: X in predominance.
6. Speech:	6.1. Start: "good, good..."; "pay attention"; "take out the book". This time was prolonged and required increases in the tone of voice to achieve silence, but not attention. The students' gaze was scattered. 6.2. Development: "Let's see who can define matter" "What is matter?", "What is not matter then...?" "Since the explanation begins here, although it asks questions, it directs its responses to specific students and, in the face of the silence or refusal of the answer, it does not make any orientations that lead to an approximation to the answer that is sometimes far from the true scientific explanation; immediately he responds. During this development, reflective activities are also carried out but with the same dynamics as with open inquiry questions.

7. Sequence:

6.3. Closing: "summary then..." "copy...". The closing was plunged into the dictation of the definition made by the teacher, with book in hand, but which he took from his memory.

7.1. Information: during the beginning of the class in relation to previous knowledge, specifically with the previous didactic unit where measurement, measurement scales and measurement instruments were addressed. It is inferred that during that class they made measurements to various large materials.

7.2. Organizational: The word order is neither random nor spontaneous, they are designations of participation *by finger*.

7.3. Activity: Although activities are proposed, they are not carried out by the students but by the teacher himself.

7.4. Exhibition: The exhibition is dominated by the master class - made by the teacher.

7.5. Dictation: to copy the definition stated by the teacher in the student's notebook at the end of the class.

7.6. Questions and answers: the teacher asks questions to activate the discussion, assigns interlocutors to answer, answers what he himself has asked, questions arise from the students, other students answer and the teacher closes the sequence.

8. Production:

8.1. Oral and written production: -o-

8.2. Production of examples: -or-

8.3. Transfer: -or-

8.4. Explanation in pairs: -or-

8.5. Inquiry: -o-

9. Use of school text

9.1. Individual events: the school text is used as reading material during class.

9.2. Shared events: -o-

9.3. Referents: -o-

9.4. Activities: only reflective type activities that do not end or show any kind of learning.

Source: self-made.

The teacher had difficulty initiating the students' participation, a joke was necessary to give rise to the participations. The teacher uses a language close to the students and engages them in discussion by using the familiar "You" form. A structure can be seen in his explanation. Once the concept is defined, he relates it by means of the use of examples brought from the context.

The professor / informant defined the concept by saying:

- (UC2): *Matter is everything that surrounds us, [UR6] 'everything that has a place in space' and [UR7] 'has a mass'. For example, tables are matter, the floor is matter, that fruit is matter, the thermos is matter, everything, everything around us is matter. What else is matter? What is not matter then...? Tell me* -pointing to a student-

The school text used by this teacher / informant defines Matter by saying:

- (UC3): "Think for a moment about the material things you have at home, you will find: household appliances, furniture, beds, lamps, tables. These objects *are perceptible with the naked eye, they have a certain mass and occupy a place in space, in a general sense we call them Matter*" (MPPE, 2012; p. 148).

Both the SRB and the school text used by this teacher / informant agree that the constitution of this concept is given by the following categories:

- '*possession*': "...they have a certain mass..."
- '*placement*': "...they take up a place in space..."
- '*perception*': "...they are perceptible with the naked eye..."

Comparing these attributes with the definition expressed by the teacher / informant in the class, we have to leave out the aspects associated with sensory perception. Its definition used in the classroom has the following attributes:

- '*possession*': "...and it has a mass ..."
- '*placement*': "...everything that takes up a place in space..."

During the interaction, it was evidenced the presence of dialogic units forcedly selecting who should answer. As for the discourse markers, it was recognized that at the beginning of the class attention is attracted by raising the voice tone to draw attention to the group. Then, during the development, a generation of questions was made, but alluding to memory aspects rather than analysis or approach to the context. No response from students, professor/informant conceptualized and in an exciting way, he began to name situations related to the concept. This emotion made the students look at him and focus on his discourse, in addition, he moved his arms and pointed to many objects present in the classroom, and in an impulsive way, and he named many saying:

- (UC4): This concept must be very clear, you must learn it, many other concepts derive from it, such as the one that follows, which is measurement, because matter must be measured.

His language, although scientific, is aimed at a student in training, and it is necessary, nevertheless, to try to connect the concept of Matter with atom and it became necessary to make a group of explanations that perhaps were not indicated in the didactic unit. When this happened the following imprecision occurred:

- (UC 5): "The atom is the smallest particle that exists".

If what the teacher/informant mentioned is analyzed, it is obtained that:

- The atom is defined in the field of Physics and Chemistry as the smallest quantity of a chemical element that has its own existence and that was considered indivisible. It consists of a nucleus, with protons and neutrons, and orbital electrons, in a characteristic number for each chemical element (RAE, 2001; Mahan and Myers, 1990; Whitten, Galley and Davis, 1992).
- The atom is made up of a dense nucleus with a positive charge that is surrounded by relatively distant negatively charged electrons. The nucleus is made up of subatomic particles called neutrons, which are electrically neutral, and protons, which are positively charged (McMurry, 2001; Mahan and Myers, 1990; Whitten, Galley and Davis, 1992 and Ebbing, 1997).

Therefore, the atom is the smallest amount of a chemical element, which is made up of other particles, but there are smaller particles than the atom itself that make it up.

Another imprecision was observed when, during the explanation, the professor alluded to visible objects saying:

- (UC 6): tables are matter, the floor is matter, that fruit is matter, thermos are matter...

But he does not do so to gaseous physical states which are also matter.

Although during the beginning of the class the teacher / informant asked the students to take out the school text, he kept it on the table without using it; he only referred to the school text for the definition of the concept and invited them to read and review it. Reflective activities were proposed, read and answered by the teacher. The students read the text to the extent that the teacher's explanation was given and the participations were isolated with a general passive attitude prevailing. The evaluation that was carried out to verify the learning of the definition and management of the concept focused on the memory repetition of the definition in an objective written test where two density calculation exercises were also proposed as the relationship established between mass and the volume of a material; the items had an average of 2.11 points out of 4 points. The imprecision of the atom was shown in responses to the definition of the concept and it was not specified whether the gaseous state is matter or not.

After reviewing the recordings and annotations made during the meetings with this teacher / informant, it was possible to affirm that the attitudes shown by the students during the development of the classes were willing to pay attention, but not to participate. The specific participations did not generate arguments, but rather confirmations of the extension of the definition. The classroom discourse dynamics occurred in a horizontal character, dominated by the teacher/informant, based on the second person singular and rhetoric directed by intimidation until the definition was memorized.

4.3. Teacher / informant "C"

This classroom corresponds to the pedagogical context "B" which was divided into two sections, one of them with 24 students before and the other with 25 students and this classroom corresponds to the section with 25 students. The recording of all the sessions that included the didactic unit was made. The observations were made at the second moment of the school year (period from January to April), intentionally selected according to the content administered and its instructional planning (see table 4). Due to the variety of encounters, it was also possible to observe various dynamics, moods, dispositions to learn and levels of fatigue.

Table 4. *Information collection form for interactions in the pedagogical context "B" Professor "C".*

Information collection form for classroom interactions	
1. Classroom:	"B" Professor "C"
2. Pedagogical moment:	Second moment
3. Teaching unit:	Unit III: The Structure of Matter. Unit 2: Atomic theory. Chemistry 3rd year - Related Series - Editorial Santillana
4. Concept:	Measurement: Matter: Energy:

- 5. Interactive Process:** 5.1. Dialogical units: X 5.1.1. Interlocutors: Dialogue initiated by the teacher and controlled by him using compulsory participation.
- 5.2. Monological units:
- 6. Speech:** 6.1. Start: "How hot is it?"; "Why will it be so hot?"; "How will that heat get here?"
6.2. Development: "that heat that is making is a form of energy, the light that enters through the window or if we hit the table and a sound is produced... there is energy". "Based on these observations, can we define energy?"
6.3. Closing: "To finish then, quickly, ten of you who share an example of energy that you observe in your daily environment".
- 7. Sequence:** 7.3. Information: during the beginning of the class by way of interpellations with everyday situations.
7.2. Organizational: spontaneous student participation to establish meanings.
7.3. Activity: for the closing of the class in which the growth of relationships between the concept and the daily fact is intended.
7.4. Exhibition: Made by the teacher
7.5. Dictation: Not observed.
7.6. From questions and answers: the teacher asks questions to activate the discussion, the interlocutors appear in order to answer, there are questions from the students, other students answer and the teacher closes the sequence.
- 8. Production:** 8.1. Oral and written production: Both oral and written production are given during the class, as well as the reading and exchange of the products. This dynamic makes possible the continuous evaluation of the conceptual construction processes, examples, contextualizations and inquiry.
8.2. Production of exemplifications: The majority of the class is able to propose examples that arise from lived situations and situations that are occurring during class. The exemplifications were consistent with the attributes of the concept.
8.3. Transfer: When the different types of Energy are addressed, the students recognized in each one both work and heat, two attributes concepts handled in topics prior to this Energy. This shows the ability to transfer in a positive and lateral way.
8.4. Explanation to pairs: During the resolution of the activities the students were arranged in pairs by the teacher's instruction and it was observed that both students participated in the activity giving each other support and clarifying doubts.
8.5. Inquiry: It took place spontaneously with the intention of looking for other types of Energy in addition to those that were present in the school text.
- 9. Use of school text** 9.1. Individual events: -o-
9.2. Shared events: it is carried out for the approach to the concept, as a complement to the explanatory sequence of the teacher.
9.3. Reference: During class, the textbook supports the explanation and the activities.
9.4. Activities: Inquiry activities are discussed, hyperlink activation is explored through technological tools such as tablets and mobile phones, and finally, final verification activities are carried out and shared.

Source: self-made.

The existence of dialogic units with a scientific language according to the level addressed was observed, with the use of adequate meanings and clear didactic transpositions corresponding to the concept to be taught; the dialogue is done in first, second and third person singular with use of the names of each student, however, when they want to address the teacher, they call her "teacher". Continuously reference is made to events or facts of everyday life to establish relationships between the concept and a palpable fact that demonstrates the existence, characteristics and various types of energy. The class remains framed in the scientific fact, no allusions are made to another topic that does not have to do directly with the focal point that is developed in class. The teacher/informant defined the concept of Energy as:

- (UC 7) *...is a complex concept because often we fail to see it, but it is easy for us to feel it. Energy is [UR8] 'a force that exists in the environment, that can generate changes, that can change' and [UR9] 'that in this process generates work', but not work like the one we regularly do as a task, no, not like that one, a mechanical work, of change in matter.*

The school text used by this teacher / informant does not explicitly define the concept of Energy. As mentioned above, although the school text makes use of the concept of Energy, it seems that it presupposes in a pragmatic way its handling by the student and this is shown in the approach to situations referring to the concept of the atom in atomic models and in the nature of matter where it addresses the types of Energy, the behavior of particles, electronic jumps, among others. According to the SRB, the attributes that make up this concept are:

- 'capacity': defined as property of the energy to do
- 'capacity1': defined as work
- 'capacity2': defined as heat

Comparing these attributes with the definition expressed by the teacher/informant during the class, we have that said definition presents:

- 'capacity': *"...it is a force that exists in the environment, that can generate changes, that can change..."*
- 'capacity1': *"...that in this process generates work..."*

From this definition spontaneous dialogue units arise, which emerge from the class. These units are examples from the students. As for discourse markers, it can be seen that the teacher/informant attracts the attention of the class, no mobile phones in use, or other electronic devices; the audience is in response to the teacher.

The teacher/informant suggested using the textbook just before defining the concept and did it to show images that would complement the explanation. He did not refer to it for the definition nor was there an invitation to read it. It was only graphic support. The activities were carried out in the classroom in which the teacher indicated the work in pairs. The students selected their partners without inconvenience in a friendly climate. The activities were carried out in the order presented in the textbook and the questions that arose were fully discussed, and in

most cases the students, themselves answered the concerns of their classmates and, if necessary, the teacher took part in it. The evaluation that was carried out to verify the learning of the definition and management of the concept was through the recognition of some types of energy present in images, their possible transformations and the writing of a paragraph in which the student had to make a production on energy in his immediate context; In this evaluation the course had an average of 1.60 points out of 2 points.

Finally, after reviewing the recordings and annotations made during the encounters with this teacher / informant, it was stated that the dynamics established in the class were quite particular as it promoted the participation of the students spontaneously, attentively, proactively and willing to express their ideas and agreements on the shared theme; All this was part of the formative assessment of the students. The discourse aspects were horizontal and respectful, oriented by the teacher/informant towards the association of the concept with phenomena produced in the context of the student.

5. CONCLUSIONS

As it was shown in the individual analyses, the observation was characterized by the predominance of dialogue units over monologues with the use of a scientific language, close, focused, at times imprecise and inclusive. The sequences in the classroom show three different moments, a beginning in which the recapitulation induced or provoked by the teachers is applied and that is presented by the strategic application of activation questions and focalizing elements that try to connect previous knowledge with those that will be addressed in class. After the appearance of a linguistic marker and from it, the central explanation of the session starts, with a predominance in the masterly explanation, which applied some teaching strategies and, finally, the closure marked by the completion of activities.

The use of contextualization is denoted (Izquierdo Aymerich, 2004) with similar intentions to those found in school texts, but with a much higher frequency of appearance ($f=11$); in fact, it is the most recognized didactic strategy in interactions that leads us to think that the teacher knows its potential at the moment of explanation in Chemistry, a criterion that may come from their academic training, and which is also shown in Ros (2011), Meroni, Copello, and Paredes (2015) and finally in Moraga Toledo, Espinet Blanch and Merino Rubilar, (2019).

The teachers who made up the observations graduated from recognized universities and each one with a particular emphasis on a teaching model, that is, some professors who learned through the application of the behavioral model, another one with the cognitive model and some with the constructivist model. ; with at least fifteen years as graduates, some with postgraduate studies or teaching updating, and all with a particular vision towards the teaching of Chemistry.

The recognition of learning models in the observed classes was very particular, and it was difficult to identify a pure model that could frame the class, and thus be

able to identify how it would be carried out -as in Cordero (2019)-, what to expect, what not to expect, and thus be able to recognize the class and model by means of which it was given, but since the attributes of each learning model were clear, it was possible to characterize the teacher for his way to teach.

The first one to be characterized was the *Professor-preacher*. This characterization is somewhat curious. This is a kind of teacher who requires an ambo to speak and does not leave the school text out of his hand, open on the page that supports his explanation. His contextualization occurs from his personal experience and challenges the class to delve into his memories without neglecting the political tinge that affects his environment. The interaction that he carries out is particular, at first, he is the protagonist, but after the conditions are activated, he turns into a spectator and the class is the one that participates. He recites the definitions as a learned sentence, so memorization plays an important role in his teaching process.

The second one to be characterized was the *Professor-professor expert*. A type of academic that pours a rigid structure class to his students, with a detailed explanation and a textbook that remains on the desk as decoration. His classes are masterful, with a predominance in the monologue in which the students do not have a great participation since he only encourages his own participation. He is the traditional, conservative and leading type of teacher. His concern is focused on three aspects, offering information to students, his memory and that of the students. He sets a goal and is in charge of transmitting the proposed contents, he is not interested in motivation and he even forgets in a certain way the human dimension of the student.

The third one to be characterized is the *Professor-detail oriented professor*. This typology corresponds to what seems to be the ideal. He is clear before getting to class about what he will do, everything is designed for students to learn, immovable in the purpose of his explanation. He is not satisfied with the traditional that, although it is good, it could be better, for that reason he brings some novel activity, something that breaks rooted conceptions. His explanation is unobjectionable; the textbook is the support book and squeezes every part, from the presentation to the final activities. The way he treats students is horizontal and respectful, he promotes the education of students and entertains them. His focal point is to promote confidence in students to carry out inquiry and spontaneous participation.

Finally, regarding conceptual management, it is possible to conclude that greater importance and dedication is given to the learning of definitions that could be seen as isolated than to teaching concepts, which is confirmed in the evaluation strategies (Certad, 2016). Most teachers / informants give relevance to memorization, to the "Rote learning" of definitions rather than understanding the chemical phenomenon. Teachers dictate them, and students are asked to repeat so that they can learn them.

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AUTHORS:

Pedro A. Certad Villarroel

Bachelor of Education, specialist in Technology, Learning and Knowledge, Doctor of Education (UCV). Associate Professor at the Metropolitan University, Research Professor, Director for the development of competences and Director (E) of initial studies at the Metropolitan University. Affiliated University: Metropolitan University (UNIMET).

pcertad@unimet.edu.ve

ORCID: <https://orcid.org/0000-0002-5936-834X>

Research Gate: https://www.researchgate.net/profile/Pedro_Certad

Tulio Ramírez

Lawyer, Sociologist, MSc. in Human Resources Training, Doctor of Philosophy and Educational Sciences (UNED). Full Professor at the Central University of Venezuela, Libertador Experimental Pedagogical University and Andrés Bello Catholic University. Director of the Doctorate in Education (UCAB). Affiliated University: Andrés Bello Catholic University (UCAB).

tuliorc1@gmail.com

Orcid ID: <https://orcid.org/0000-0002-9012-8707>