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THE IMPORTANCE OF LINGUISTICS FOR THE EDUCATION OF GRADUATES IN CHEMISTRY AT A PUBLIC UNIVERSITY IN BRAZIL'S COUNTRYSIDE

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Abstract: In this work, linguistics is presented as an important tool for teaching Chemistry. Linguistics is divided into oral and written communication and reflects on the process that facilitates the understanding and formation of new ideas. Highlighting the importance of textual interpretation and understanding of contents in the Chemistry course, it was necessary to carry out a study showing how language is included in an undergraduate course in the area of Exact Sciences. Language mastery is not easy, but when it is achieved academic performance is greatly improved and favors both undergraduates and graduates in Chemistry. This research was carried out through a questionnaire with 30 students of the Degree in Chemistry of a public university located in the interior of Brazil. The questions covered how students perceived the importance of linguistics in the course, how it can influence their ability to write and speak, and whether it would be possible to have any interference in academic development without the correct use of verbal language. According to the results obtained, it can be concluded that most students consider linguistics a relevant topic to be worked on in order to improve teaching. As for the understanding of the contents, in a way, the Chemistry course in question leaves something to be desired in the language process, leading to believe that it is necessary to carry out a more detailed analysis of the pedagogical proposal of this course, in order to offer options that help in the purpose. to improve the language performance of their students.
KEYWORDS: exact Sciences. Higher education. Verbal language.

INTRODUCTION

From birth we learn forms of communication, whether gestural or oral. With regard to orality, language begins to be perfected from kindergarten and lasts throughout a student's life, regardless of the area of knowledge in which he will be inserted, since the knowledge inherent to the Portuguese language is directly related to linked to any degree course, including Chemistry. Thus, although the curricula of exact sciences courses emphasize quantitative skills, such as problem solving and calculations, the acquisition and development of skills related to linguistics, such as reading and interpreting texts, are essential for the occurrence of of good training.

To illustrate this scenario, it can be highlighted that the main form of communication and expression of ideas is dialogue and writing, in addition, we need to develop argumentation skills when exposing knowledge. It is not enough to master a certain subject (the molecular orbital theory, for example), it is necessary to organize ideas, to know how to present them in a coherent way, to relate them to other contexts, it is essential to know how to speak correctly and express yourself well to explain the theory, write an article on the topic, and/or participate in a seminar and be evaluated by a professor.

Bearing in mind that every chemist, in addition to having scientific knowledge, needs to be able to express himself in a coherent way and produce texts, the importance of linguistic activity within a course of Exact Sciences is perceived, since the performance of the licentiate is directly linked to mastering the mother tongue, which is the "bridge" to better professional qualifications.

It is understood, therefore, that the grammatical use and expression of spoken language is something notorious, since if the correct use of language is successful, there will be a greater understanding on the part of the listeners, there will be an exposition of ideas with more clarity, including of scientific content. Mastery of the language makes the future graduate gain professional prominence.

This reality, in turn, is not different in terms of writing, as the act of writing well reflects on the clarity of ideas. Proper punctuation and sentence organization make the writings cohesive, making it easier for readers to understand.

Based on this context, this work portrays the importance and effectiveness of linguistics in the training of future teachers inserted in a training course in the area of Exact Sciences, in order to investigate, specifically, how the practice of writing and speaking reflects on the academic reality of the Degree in Chemistry of a public university in the interior of Ceará. For this purpose, based on the beliefs of the students of the Degree in Chemistry at this university, it is intended to analyze their oral and written performance and to approach, from the methods that teachers use in Chemistry classes, the importance of knowledge of the scientific language and the Portuguese language.

The interest in this topic arose from the experiences of one of the authors of this paper, given that, while he was teaching, he experienced difficulties in scientific writing (preparation of academic papers, articles, papers for congresses, etc.) and in the use of better arguments when explain chemistry content. With that, this researcher felt the need to determine how this linguistic context has influenced other chemistry students, and how this can be improved *déficit*.

It is reiterated, therefore, that this research was justified by the intention of providing relevant data on the relationship between Linguistics and Chemical Science, based on the search for answers to the following problem question: how does verbal language influence in the training of future professors in the area of Exact Sciences, specifically those with a degree in Chemistry?

Based on this initial questioning, the objective of the research was elaborated, which consisted of investigating the speech and writing process of the Licentiate in Chemistry students of a public university, reflected in the routine actions of each student, that is, the data obtained in the research must show how the student expresses himself through oral and written language during graduation; to evaluate the linguistic performance of the students of Chemistry of this university, so that the level of the students is qualified in linguistic terms and to investigate if the course of this public university in the interior of Ceará needs changes that can help the speech and writing process, analyzing if this is a relevant topic to be discussed in favor of a proposal to update the academic curriculum.

Before discussing the importance and influence of linguistics for the chemistry course, the central theme of this work, it is interesting to know some definitions of this term, as well as the purpose. It starts, therefore, from the understanding that Linguistics must be treated as a scientific area that studies verbal and grammatical language, as well as the evolution of languages. Duarte (2012) complements this definition, adding other important aspects:

> The term "Linguistics" can be defined as the science that studies the facts of language. In order to understand why it is characterized as a science, let us take the case of normative grammar as an example, since it does not describe the language as it really is evident, but how it must be materialized by the speakers, constituted by a set of signs (the words) and by a set of rules, in order to carry out the combination of these (DUARTE, 2012).

Language is a science and a tool for the purpose of facilitating thinking, making sense of events in the natural world, and solving communication problems. That is, language constitutes a way of thinking, interpreting and intervening on reality. According to the National High School Curriculum Parameters

(PCNEM),

> Language is considered [...] as the human capacity to articulate collective meanings and share them, in arbitrary systems of representation, which vary according to the needs and experiences of life in society. The main reason for any act of language is the production of meaning. Language is a social heritage, a "first reality", which, once assimilated, involves individuals and causes mental, emotional and perceptive structures to be regulated by its symbolism. (BRAZIL, 2000, p. 19).

Verbal language is distributed in oral and written form, both refer to forms of communication. Oral communication aims to inform (promote idea and knowledge) and convince (change or reinforce existing ideas), that is, to promote understanding of processes, ideas or concepts and increase the level of acquired knowledge. On the other hand, written communication is an indispensable tool for any professional, because in addition to verbalizing knowledge, it is necessary to transform ideas into text, using appropriate words to convey what you intend to convey, obeying grammatical rules and exposing these ideas clearly.

IMPORTANCE OF LINGUISTICS FOR CHEMISTRY

With the intention of collaborating for the interpretation of scientific problems and theories, for the use, mastery and greater understanding of exact disciplines, linguistics aims to assist students in textual interpretations and statements of questions.

In the course of the degree courses, in the exact areas, the linguistic performance of the student is demanded in several ways, whether in the presentation of seminars, formulation of reports in laboratory classes, construction of reviews in pedagogical disciplines, research from the reading of scientific articles, production and presentation of works for congresses and/or problem solving. However, it is a consensus in research on the subject that most academics in these areas experience difficulties in developing most of the activities mentioned above. This perspective is confirmed by Rodrigues and Costa (2011), when they emphasize that "due to difficulty in interpretation, exact science students are unable to extract from the problems the data necessary to set up the calculations and end up not solving the questions".

Contrary to this reality, the National Curriculum Guidelines for the Bachelor and Licentiate courses in Chemistry held in Brazil, emphasize that students need to learn not only the concepts, laws and principles of Chemistry, but also to know how to correctly pass on these concepts both in scientific language, oral and written, which can be exposed in texts, reports, posters and internet, etc. (BRAZIL, 2001). Notes that are consistent with the understanding that the development of skills related to linguistics is intrinsic and necessary for the training and professional path of these subjects.

It is observed, however, that the challenge of writing texts with the purpose of learning and teaching chemistry can cause a distance between the individual and this form of communication. Text production is a form of learning and teaching for which most science students are not prepared. The student cannot perceive the effectiveness of writing for his success as a scientist, and others, even if they do, they can not do it, because they do not identify with the methods of influence. One of these methods can be the habit of reading.

> [...] the reason why students are arriving at universities without adequate preparation would be due to the poor training of these students in high school, but it was concluded that this fact is due to the lack of reading and interpretation of these students, that it could come, yes, from the bad formation in High School, but that could also be worked on and

> corrected at the university; this task must be fulfilled both by teachers and by the students themselves. (MALTA, 2004, apud SANTOS, et al., 2015, p. 12).

An illustration of this worrying scenario is reported by Rodrigues and Costa (2011) in the results of a survey with students in the first semester of the Exact Sciences area at a state university. In this research, 51.5% said they believe that reading is not so important for their training, demonstrating that "[...] Portuguese language is just a detail" (Idem, p. 1).

INFLUENCE OF LINGUISTICS IN THE MAGISTERIUM

Based on the idea that linguistics has a classificatory character, a brief report is made about its importance in hiring future teachers in competitions, focusing on the interview process, which emphasizes, in addition to knowledge, the candidate's didactics.

By highlighting that being in contact with books reduces the difficulty in producing and interpreting texts, Rodrigues and Costa (2011) point out, in their work, the following speech of a teacher, in order to exemplify how linguistics is charged in hiring, whether from any area: "*I did very poorly, because I was very confused, like, I read, I didn't understand what they wanted me to develop in that newsroom*".

> She attributes her failure in the contest for mathematics teacher to her undergraduate course, where the focus was on calculations. We believe that it must be a goal of all educators, which also includes mathematics teachers, to cultivate the practice of reading in students, with a view to creating a critical citizen who understands and argues about the world around him. (RODRIGUES; COSTA, 2011, p. 1).

Students must meet the teaching requirements of the institution, whether elementary and secondary education, or higher education. A good professional must be qualified and prepared not only to teach, but to direct, supervise, plan, coordinate and guide. Therefore, communication is insistently demanded in education. This aptitude can be achieved through linguistic study, which must be included in any undergraduate course, including Chemistry.

The improvement of the undergraduate in Chemistry increasingly includes oral communication as an element of certain importance. Due to the continuous growth of the scientific area and the competition in the market, this communication becomes a rich instrument to support the Chemistry teacher.

METHODOLOGY

This article discusses a case study, carried out in a public university located in the city of Sobral-CE, Brazil, with 30 undergraduates in Chemistry. According to Yin (2001) "a case study is an empirical investigation, a method that covers everything – planning, data collection techniques and data analysis". The research took into account only the students who belonged to this course, regardless of the semester they attended, since the idea was to analyze, based on a self-assessment of the students, whether they considered the forms of language to be dominant or not, or they still understand (or not) the need to address this issue within the scope of the course in which they are inserted.

Thus, through an exploratory perspective, this research seeks to "satisfy the desire to acquire knowledge, without there being a foreseen practical application" (RODRIGUES, 2007, p. 42), because among its purposes are included the expansion of knowledge about the subject and dissemination of the situation of writing and the form of expression of the licentiate students of this public university, in addition to the search for the identification of the influence of the teaching methods of the subjects in the linguistic development of the

students.

In this case, a qualitative study was carried out, considering that the research is related to reality and the imposition of consequences resulting from a certain meaning, and centered on the dynamics of social relations. For according to Minayo (2001 apud CHIAPETTI, 2010, p. 144), "qualitative research works with the universe of meanings, motives, aspirations, beliefs, values and attitudes, which corresponds to a deeper space of relationships, processes and phenomena that cannot be reduced to the operationalization of variables".

The research tries to expose and explain the topic addressed based on several articles in the literature (FLÔR, 2009; QUEIROZ, 2001; BRAZIL, 2001; MATTOS; WENZEL, 2014; RODRIGUES; COSTA, 2011; MORAIS et al., 2014; RODRIGUES, 2007), which explain some aspects of language in science education, which were used to collect prior information about the context addressed.

Based on the theoretical assumptions that supported this investigation and on the authors' reflections on the investigated context, a questionnaire was prepared with twelve subjective questions and two objective ones focused on performance, strategy, importance and influence of the language and writing of the undergraduates in Chemistry. At a later time, these testimonies were analyzed, through a 'detailed look' of the opinion of each student to the questions that were addressed to them, verifying what they had in common for a comparative evaluation.

For the presentation of the results, we chose to use percentage data, which do not minimize the qualitative focus of the study, on the contrary, seek to emphasize the analyzes carried out, through the interpretation developed by the authors. In addition, the results obtained were explored and compared with other studies available in the literature, in order to expand knowledge on this topic, through immersion in this specific reality.

RESULTS AND DISCUSSION

In order to obtain information from undergraduates in Chemistry at a public university, located in Sobral, about the influence of linguistics and its variables on undergraduate training, a questionnaire was applied exploring their opinions. This information is summarized in the following sections.

IMPORTANCE OF LINGUISTICS AS A TOOL FOR THE STUDY OF CHEMISTRY

The first question dealt with the students' opinion about the importance of linguistics as a tool for the study of Chemistry. Of the 30 students who answered the questionnaire, 90% considered linguistics a very important tool for the study of Chemistry, while the other 10% considered it to be of reasonable importance. This result can be considered valid, as there is a recognition by the students that linguistics is not negligible for their training at the undergraduate level.

INFLUENCE OF THE LINGUISTIC DOMAIN IN CHEMISTRY LEARNING

The students were asked, in the second question, whether they agreed or disagreed that the domain of linguistics influenced the learning of Chemistry. All respondents agreed, and among the opinions of those who agreed, 77% reported very similar opinions that can be summarized from the idea that the linguistic domain favors the interpretation and understanding of texts; course content and problem questions, facilitating and making learning satisfactory. Below are some testimonies:

- "Chemistry has its own language and without the domain of linguistics it ends

up making its understanding even more difficult".

- "Facilitates the interpretation of texts and issues to be resolved"
- "It is pertinent that in all areas, not just chemistry, the way of passing on the content is clear, so accurate linguistics contributes to learning".
- "Those who have mastery of words find it easier to understand content that has very technical language".
- "Language is fundamental for the development of teachers in the classroom".
- "The understanding of words facilitates the understanding of texts, increasing this understanding even more when the individual is able to understand the parts that make up the word, thus being able to understand a word never heard by him, but which can be understood by the composition of the sentence and the sentence. knowledge of the meaning of part of the word.

DISCIPLINE(S) OF THE DEGREE IN CHEMISTRY THAT FAVORS (M) THE LANGUAGE LEARNING

The students were encouraged to give their opinion on the existence of some subject(s) in the course that favored language learning. Those who claimed to exist were asked to describe which one(s). Of the students questioned, 23% answered that there were no subject(s) in the course, 10% did not want to answer and 67% said there was. The subjects most cited by this majority were: pedagogical subjects (50%), descriptive inorganic chemistry (30%) and other subjects from the Chemistry course.

Among the pedagogical subjects mentioned by the students are: Teaching Practices, Internships, Methodology of Scientific Work, Ethics, Libras and Textual Studies. These were acceptable results, as it is expected that in some way these disciplines work with linguistics. However, the students who mentioned the internships highlighted that they influence language learning, but not in the way they must, as they are superficial in this purpose.

Those who referred to Descriptive Inorganic Chemistry highlighted that because this discipline requires a more careful reading, it ends up helping, in a certain way, in linguistics and consequently in writing.

DOMAIN OF LINGUISTICS FOR THE EXERCISE OF THE MAGISTERIUM

All the students questioned considered the mastery of linguistics to be important for teaching, and according to the various types of answers, a mixture of the closest ideas was made to highlight that the majority (57%) consider that in order to exercise teaching well, or that is, to provide a class that is easily understood by the students, the domain of linguistics is essential. Below, some testimonials were listed:

- "It is necessary for the teacher to master the use of words, even so that he can replace a word that is difficult for students to understand by one with the same meaning, but which they have more verbal contact with and with that they will understand better".
- "A good teacher must know how to express himself well so that his students understand what he is passing on, so teaching and learning will be satisfactory".
- "The domain of linguistics favors the understanding of concepts, as well as the ability to express the acquired knowledge"
- "Regardless of the area of activity, the scope of verbalized content becomes a relevant route in passing on the concepts

of each discipline".

Another 43% said that the teacher who dominates the mother tongue develops or reinforces the way of expressing their knowledge, passing on the contents spontaneously, with ease and good didactics.

WORD (S) THAT DEFINES (M) TEACHING CHEMISTRY WITHOUT UNDERSTANDING LINGUISTICS

Students were asked to highlight (m) some (s) word (s) that define (m) teaching chemistry without understanding linguistics. From this questioning, the difficulty of interpretation of some students was notorious, as 17% answered with words that did not satisfy to which it was questioned. Such as: *"symbols", "calculation", "chemistry", "study of matter" and "atom"*.

Another 33% did not answer this question. It can be assumed that both those who responded inappropriately and those who failed to respond did not read the question carefully or did not understand it, thus leading to a misinterpretation of the question. However, the majority (50%) understood and quoted acceptable words. Among these, we can highlight: *"tabula-rasa", "little effective", "superficial knowledge", "difficult or complex", "insufficient"*. Further reinforcing the importance of linguistics for some.

SUBJECT OF TEXTUAL STUDIES AND LINGUISTIC PRODUCTION

Students were asked about the existence of an optional subject contained in the Chemistry course matrix: Textual Studies and Linguistic Production, and those who were aware of its existence were asked to describe its purpose. Some scholars have described very similar purposes to the following responses:1) *"works the production of texts"* and 2) *"deepening the history of science education"*. And among these, some declared that they had already attended or are studying.

However, the majority (60%) of the students say they are not aware of its existence because it is an optional subject, but it is available in the curriculum. Unfortunately, most students ignore the elective subjects, and are only interested in them when they reach the end of the course, as they need to take some of them, but discard the subject in question.

As for undergraduates who said they knew the subject (10%), but were unable to explain its purpose, their statements converge with those who only heard about it or saw it in the curriculum, out of curiosity. Others consider that this subject is not part of the curriculum, as it is optional. They claimed to be a discipline belonging to another course.

The students gave their opinion on the mandatory (or not) of the discipline of Textual Studies and Linguistic Production. The majority (76%) were in favor of the obligation, and some declared its importance for several reasons:

- "because it is very important".
- "Many students experience difficulties".
- "It would improve the development of teachers".
- "To improve the didactics of future teachers".
- "It makes it a lot easier at the time of some textual productions such as: articles and TCC".

Among the students who answered NO (17%), there were those who knew about the subject and those who did not. Some of these said they did not know the purpose of the discipline, but they deduced it from the subject and were able to say that it is not mandatory. Among the reasons are the following, reported by two students:1) *"linguistic productions is already coupled in several disciplines" and* 2) *"this topic can be addressed in the TCC discipline"*. These placements are incoherent, because in the course conclusion work (TCC)

the student must already have the basic notions to complete his work, and there is no time for classes in correct writing of the language. A small portion (about 7%) stated that, for not having knowledge of the discipline, they would not give an opinion.

FINAL CONSIDERATIONS

At first, one can affirm the importance of linguistics for the study and understanding of Chemistry, since the entire sample population of the research agreed with this premise. It is noteworthy that most students related this importance to simplification in the interpretation of texts and questions related to the contents of the Chemistry subjects. This result can be considered satisfactory, although this importance was not maintained by all students in the other questions, leading to some contradictions on the part of a portion of those investigated.

The course's proposal to offer the discipline of Textual Studies and Linguistic Production to assist in the language learning process is extremely valid, however, as it is an optional discipline, it is beyond the reach of most students, making it imperceptible. Taking this course may not be the only way to improve academic performance in the sense of improving oral and written skills, but it is a good option for these purposes.

The results obtained in this work indicate that most students consider linguistic study important, but that this resource is not being well exercised within the course, even though some students have considered seminar presentations and elaboration of reports and projects as auxiliary methods for improvement of oral and written language, these were still insufficient.

The research results also show that many students feel insecure when writing, exposing their ideas clearly, having difficulties to organize ideas on paper, making understanding difficult. Although the sample population does not favor a faithful assessment of the ease of writing and orality of each student, it is still possible to state through self-assessments that most of them have greater difficulties in clearly exposing ideas in written form than in oral form.

In view of the results obtained, it is also plausible to state that the pedagogical proposal of the Degree in Chemistry needs changes to assist in the teaching and learning process of linguistics, since most of the curriculum of the course aims, in addition to carrying out experiments, to solve problems questions and formulation and interpretation of texts.

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