Scientific Education at Graduate Course: An Approach to Applied Linguistics

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ABSTRACT

It describes an approach to scientific education, developed and experienced in the training of teachers and researchers, in a graduate course in applied linguistic studies, in the Northern Region of Brazil. In this sense, this article presents the characterization of a tool called Science Education Circuit (SEC), used in course planning from the perspective of the mentioned approach. Documentary research also illustrates the challenges established in a task of scientific dissemination that is part of planning. It is based on an antidisciplined articulation of theoretical assumptions about research practices in teaching and teacher training. The study showed that the procedural facet of scientific education was favored by the collaborative planning of the course, and it revealed four linguistic activities introduced in the rewriting of opinion articles produced and published in newspapers: lexical choice; defined nomenclatures; reference and citation; and focused content. This task guaranteed an experience of scientific dissemination by graduate students.

KEYWORDS

Scientific dissemination. Literacy. Course planning.

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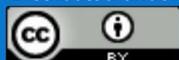Universidade Federal do Tocantins

Educação Científica na Pós-graduação: Uma Abordagem da Linguística Aplicada

RESUMO

Descreve-se uma abordagem da educação científica desenvolvida e experienciada na formação de docentes e pesquisadores, numa pós-graduação em estudos linguísticos aplicados, na Região Norte do Brasil. Nesse sentido, este artigo apresenta a caracterização de uma ferramenta denominada Circuito da Educação Científica (CEC), utilizada no planejamento de curso na perspectiva da referida abordagem. A pesquisa documental ainda ilustra os desafios instaurados numa tarefa de divulgação científica integrante do planejamento. Fundamenta-se numa articulação indisciplinar de pressupostos teóricos sobre práticas de pesquisa no ensino e na formação docente. O estudo mostrou que a faceta processual da educação científica foi favorecida pelo planejamento colaborativo do curso, e revelou quatro atividades linguísticas instauradas na reescrita de artigos de opinião produzidos e publicados em jornais: escolha lexical; nomenclaturas definidas; referência e citação; e conteúdo tematizado. Essa tarefa garantiu uma experiência de divulgação científica pelos pós-graduandos.

PALAVRAS-CHAVE

Divulgação científica. Letramento. Planejamento de aula.

Educación Científica en el Posgrado: un Enfoque de la Lingüística Aplicada

RESUMEN

Se describe un enfoque de la educación científica desarrollado y experimentado en la formación de profesores e investigadores en un curso de posgrado en estudios lingüísticos aplicados en la Región Norte de Brasil. En este sentido, este artículo presenta la caracterización de una herramienta denominada Circuito de la Educación Científica (CEC), utilizada en la planificación de cursos desde la perspectiva de ese enfoque. La investigación documental también ilustra los desafíos que se plantean en una tarea de divulgación científica que forma parte de la planificación. Se basa en una articulación indisciplinada de supuestos teóricos sobre las prácticas de investigación en la docencia y la formación docente. El estudio mostró que la faceta procedimental de la educación científica se vio favorecida por la planificación colaborativa del curso, y reveló cuatro actividades lingüísticas introducidas en la reescritura de artículos de opinión producidos y publicados en periódicos: elección léxica; nomenclaturas definidas; referencia y cita; y contenido temático. Esta tarea garantizó una experiencia de divulgación científica por parte de los estudiantes de posgrado.

PALABRAS CLAVE

Divulgación científica. Literacidad. Planificación de clases.

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Introduction

In Brazil, literacy studies developed significantly in the past decades, which is evident in the different frames adopted by investigations on the culture of writing. Therefore, different labels are employed to name different investigative stances, for example, teacher literacy, academic literacy and scientific literacy. The first is employed in investigations concentrated on the writing practices that influence teachers' work (KLEIMAN, 2001; SILVA, 2012). The second is employed in investigations that involve writing at university in the role of mediating collective activities (FIAD, 2016; PEREIRA, 2018). The third label is characterized by abilities to deal with situations of daily interaction, influenced by knowledge and discourses involving science (SILVA, 2016, 2017, 2019, 2020a).

These three frames complement each other in the investigative and pedagogic approach to scientific education employed in pre-service teacher education or in the continued development of language teachers (SILVA, 2020b; SILVA; FERREIRA, 2021). This approach enables professors to engage in research activity, recognizing themselves as producers of knowledge that guide their own professional practice. Moreover, it is desirable that they employ pedagogical strategies aligned to their experiences in teaching school classes.

These frames reveal the social commitment of investigations in the literacy studies, consequently, the social responsibility of research in Applied Linguistics (AL), the field of investigation to which the present work belongs (SILVA, 2021). The scientific education approached originated in the sciences of nature but still incipient in the linguistic studies, for which it can lead to promising development for teacher education and language teaching (SHAMOS, 1995; HOLBROOK; RANNIKMAE, 2009; LIU, 2009; SILVA, 2020a). Hence, the article discusses applied linguists can be educated to become motivators of scientific education, assuming the exercise of communicating specialized knowledge (SILVA, 2021).

This article concentrates on the process of scientific education experienced by graduation students in the field of applied linguistic studies. To that end, it describes the implementation of a circuit of assignments that organize the program of course in a *strictu sensu* graduation degree, and emphasizes the challenges faced by master and doctoral students in the process of (re)writing opinion articles for ordinary readers, which were published in local print newspapers. The opinion articles discussed the social contributions of AL and constituted one of the assignments in the circuit.

The present work aims to fill in the gap in AL research and in pedagogic experiences informed by the scientific education approach in language teaching. The article stands out by sharing a productive collaborative teaching practice for graduation courses, which can inspire similar works in different areas or fields of knowledge, especially in the broad spectrum of Humanities.

This article is organized into four main sections in addition this introduction, the final remarks and the references. The first synthesizes the theoretical background of an approach to scientific education in teacher education from the indisciplinary perspective of AL. The second characterizes the educational context of the graduation course, and, concomitantly, describes a pedagogical tool to mediate the planning of the course. The third synthesizes assumptions from the systemic-functional linguistics (SFL) employed in the analyses of texts and describes the documents used in this investigation. The fourth section brings the analyses of linguistic activities implicated in the rewriting of opinion articles that were categorized in this research.

An approach to scientific education

The first studies on scientific education related to teacher education and language teaching are recent (SILVA, 2016, 2020a, 2020b). On the grounds of this approach developed in AL, these studies defend the following theses or complementary purposes: (a) make visible linguistic studies as legitimate science; (b) conceive teachers as knowledge producers; (c) assume research as pedagogical strategy in teacher education; (d) assume research as pedagogical strategy in language classes.

Somehow the last three theses have already been discussed in less recent scientific productions, generated in the Science of Education, which conceives research as a type of scientific and educational principle in teacher education and for basic education schools, influencing bigger issues regarding the pedagogical work in different school subjects (DEMO, 2010, 2011; FREIRE, 2017; FREIRE; FAUNDEZ, 2017; SCHÖN, 1991). These productions defend the continuous reflection on the teacher's part regarding their professional practice and propose pedagogies oriented by questions and by the creativity of participants in educational situations, in the opposite direction of reproductive or content-based teaching.

The theses gain strength, accuracy and increase the interest in the visibility of language research when they are seen from the perspective of scientific education in the scope of linguistic studies. Therefore, the approach assumed here was constructed under the influence of studies from a prolific tradition in the natural sciences, involving more directly distinct pedagogical propositions for Biology, Physics and Chemistry classes. These investigations started around the first half of the 20th century, after World War II, justified by distinct interests, from the need to change course programs for more functional and productive teaching models, to demands regarding the strengthening of great nations through the robust scientific and technological development (HOLBROOK; RANNIKMAE, 2009; LIU, 2009; SHAMOS, 1995). According to Liu (2009), the interests of research on the topic are various and summarized as: (1) enabling better political decisions and economic outcomes; (s) helping to reduce superstitions; (3) improving individual behavior; (4) helping to create a more ethical world (LIU, 2009, p. 303).

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The author defends that the policies for the scientific education for the general population must observe a type of continuous between formal and informal education, within which the development of scientific knowledge is prompted. It is noteworthy that, normally, the time children spend at school is shorter than the time they spend in other social spaces, therefore, the latter cannot be ignored. In other words, children, young people and adults can also learn about science in a more spontaneous way, in different settings, such as libraries, museums, parks and beaches, also including the handling of games, thematic toys, in addition to the access to different media, such as newspapers, magazines, television and the internet (LIU, 2009; SANTANA; SILVA; FREITAS, 2021). Hence, Liu (2009, p. 306) claims that science literacy[1]:

> should be an evolving state instead of a status to acquire. People constantly learn science in and outside school, within and outside work, and both formally and informally. Learning science is indeed a life-long process, rather than the goal to achieve once for all.

According to Liu (2009), every worker is responsible for participating in scientific activities and promoting greater scientific education in their areas of expertise. Such a proposition needs to be effectively assumed by professionals in the humanities, since the natural sciences enjoy more social visibility as shown by opinion surveys on the subject. Considering that *status*, the natural sciences are characterized here as legitimate or prestigious.

A recent investigation of the National Institute of Science and Technology in Public Communication for Science and Technology [*Instituto Nacional de Ciência e Tecnologia em Comunicação Pública da Ciência e Tecnologia*, INCT-CPCT] regarding what young Brazilians between and 15 and 24 years of age think about science, for example, observed that they associate that word to "studying something. The life sciences, in the case, were most remembered" (INCT-CPCT, 2021, p. 48)[2]. They are related to school subjects or courses, like Biology and Chemistry, despite citing less frequently "experiments, laboratory and scientific method" (INCT-CPCT, 2021, p. 49)[3]. The same research revealed that youth that visit museums and other cultural spaces are more interested in science (INCT-CPCT, 2021, p. 70)[4]. This last data reinforces what Liu (2009) proposed.

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[1] Due to the various nomenclature in Brazilian research (*alfabetização científica, letramento científico, educação científica*) and foreign research published in English (scientific literacy, science literacy, scientific education), the original nomenclature used by the author will be preserved in this first citation of his work.

[2] In the original: "ao estudo de algo. As ciências da vida, no caso, foram as mais lembradas".

[3] In the original: "experimentos, laboratório e método científico".

[4] On this issue, another noteworthy data from the research conducted by INCT-CPCT (2021, p. 100) is that "The historic series of surveys showed, in its last edition, a decrease in the number of visitations to institutions related to science, contradicting the increasing trend observed before. This could be associated with the great reduction of resources for science communication activities that happened recently and that led to a decrease in the number of programs, actions, expositions and even to the termination of spaces dedicated to science." Moreover, it is underscored that "the reason for not visiting those places is not related to disinterest, generally, but could be explained by other factors, such as the lack of science museums in the area (26%) and the lack of time (17%). Other justifications were "not knowing where these centers or museums are", "they are too distant" and "being unable to afford it" (INCT-CPT, 2021, p. 102).

In a different study, 23 pre-service teachers from different teaching degrees and higher education institutions in the North and Northeast Regions in Brazil were interviewed on what they conceived as doing science and on the scientific contributions of their own field of knowledge.[5] The undergraduation students in the teaching degrees for natural sciences showed more resourcefulness and confidence to answer, being able to comment on humanities as well. On the other hand, undergraduation students in humanities degrees faced difficulty to elaborate answers and the two participants from a language degree were not able to comment on research conducted in their own field (SILVA *et al*, 2018a; 2018b).

Given the evidence, here, a change in attitude by humanities is proposed, particularly, for the applied linguists who develop socially committed and critical research (SILVA, 2021). To that purpose, the last three theses listed in the first paragraph of this section must to be discussed. In that sense, teaching degree classes must be conceived as spaces of knowledge production, such as the experience shared by Silva and Campos (2022) for the pre-service education for literacy teachers, based on the dialogue between school and university representatives in virtual sessions. Hence, the claim for a change in attitude on the part of professors, who still insist in reproducing content and are not effectively seen as researchers by students.

A new reading of the terms used by Chassot (2003) for natural sciences teachers at basic school, "teacher educator" and "teacher informant", allow for the claim that universities need professor educators rather than professor informants. The latter are content with practices of knowledge transmission, who, in the words of that author, are candidates to unemployment or to be used "by the system to continue doing something use(less) in the neoliberal tendency to transform teaching (not Education) into a commodity and produce happy customers, as proposed by the adepts of Total Quality" (CHASSOT, 2003, p. 54-55)[6]. The former, in turn, fit the description proposed in this article as knowledge producers who "have their position secured in the new times" (CHASSOT, 2003, p. 55)[7].

According to Demo (2011, p. 36), "research must be seen as a social process that crosses the entire academic life and penetrates the spines of both professors and students"[8]. Inspired by Demo (2011), it is assumed here the understanding that teachers, from kindergarten to high school, and professors, from undergraduate to the doctorate degree – each in their own way, given the differences in workload – are researchers who produce knowledge; communicators of their own knowledge and motivators of educating students as researchers. This is represented in Figure 1.

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[5] The study was conducted by graduation students taking the course theme of this article as one of the tasks outlined in the Science Education Circuit (SEC), as described in the next section (SILVA *et al*, 2018a; SILVA, *et al*, 2018b).

[6] From the Portuguese: "pelo sistema para continuar fazendo algo (in)útil nesta tendência neoliberal de transformar o ensino (não a Educação) em uma mercadoria para fazer clientes satisfeitos, como apregoam os adeptos da Qualidade Total".

[7] From the Portuguese: "colocação assegurada nos novos tempos".

[8] In the original: "pesquisa deve ser vista como processo social que perpassa toda vida acadêmica e penetra na medula do professor e do aluno".

Figure 1. Conception of teacher/professor
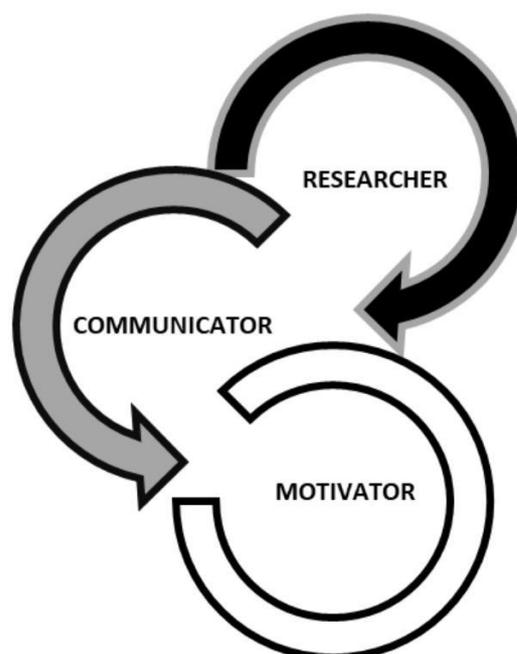
Source: based on Demo (2011)

Enabling research experiences for pre-service teachers at university, particularly ones that unfold into class-integrated activities, can lead to a more sustainable professional education, since the research activities will constitute an array of pedagogic strategies for basic education, once those educators start teaching at schools. These activities represent opportunities of quality dialogue about science between components of the school community.

The research conducted by the INCT-CPCT (2021) reveals an interesting data on the role of teachers as interlocutors for youth seeking scientific information. Half of the youth in the survey revealed that, in the month before the study, they had talked to someone about science and technology, and their main interlocutors were teachers and friends. The ones who did not talk about these subjects claimed that they lacked interlocutors for that type of conversation. According to the INCT-CPCT (2021, p. 80),

> This data shows that schools are an important space of dialogue for the subject, which is not surprising; on the other hand, it shows that youth talk about science autonomously, without the intervention of teachers or guardians.[9]

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[9] In the original: "esse dado mostra que a escola é um espaço importante de diálogo sobre o tema, o que não é surpreendente; por outro, mostra que os jovens empreendem conversas sobre ciência de forma autônoma, sem a intervenção de um(a) professor(a) ou responsável".

Researching is compulsory at the graduation level, which is the focus of this article, but it is seldom articulated to teaching practices for courses taken by master's and doctoral students. One example of such an articulation were the shared experiences, which also highlight the challenges of pre-service education for knowledge communicators. In other words, here, these challenges were made evident in the process of writing opinion articles experienced by graduation students. Finally, the set of assignments they developed may have contributed to the education of researchers and, particularly, of motivators, especially for professors in teaching degree.

In the next section, the context of the research is characterized and the assignments developed in the course are briefly described, with particular emphasis on the functionality of a pedagogical tool conceived to organize the course program.

Characterizing the context of the investigation

The present study reports a teaching experience through a documentary research. The experience is synthesized in the Science Education Circuit (SEC) represented in Figure 2, which displays the main assignments developed in the course Advanced Topics IV: Scientific Literacy[10], offered by the Graduation Program in Letras at Universidade Federal do Tocantins (UFT) and the Graduation Program in Letras: Language and Literature Teaching at Universidade Federal do Norte do Tocantins (UFNT). At the time, the course was offered for the first time, for this reason it was called as in-development[11].

Figure 2. Science Education Circuit
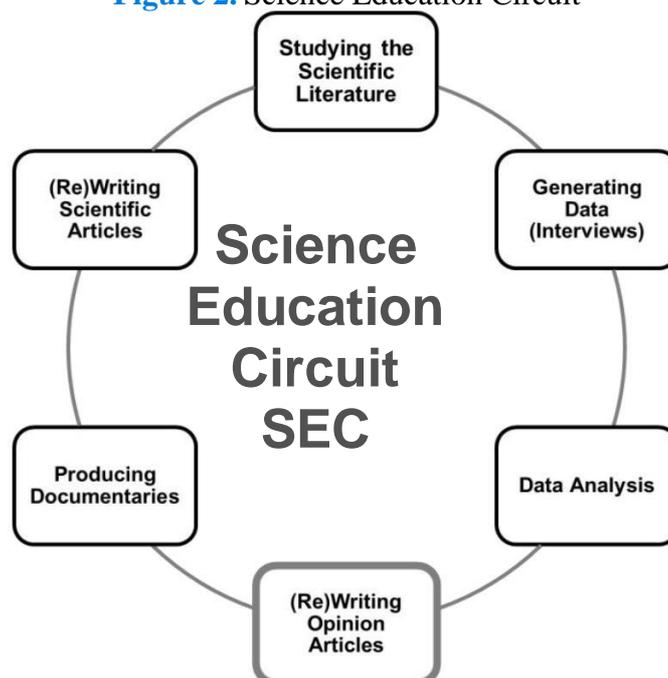
Source: the author

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[10] In Portuguese: Tópicos Especiais IV: Letramento Científico
[11] In the following semesters, the course was titled Scientific Education.

The SEC is conceived as a pedagogical tool to organize the course program and to create educational situations that allow students the experience of scientific or investigative practices. The collaborative construction of the work is the main feature of this tool, therefore, the assignments are not exclusively idealized or planned by the professor in charge of the course. A different version of this tool is used in undergraduation courses, which lists intermediate assignments executed by students under the professor supervision to generate a final product (SILVA, 2020b). In Figure 2, the assignments were proposed to generate two intermediate products – the opinion articles and the documentary – which contributed directly to the collective elaboration of the final product – scientific articles. The probability of different outcomes also shows the possible applications of SEC.

The circuit is organized into six main assignments developed on the grounds of collective decisions, as seen in Figure 2. Again, the assignments were not planned in advance by the professor. The position of the assignments in the circuit represented in Figure 2 does not represent the actual sequence used for that academic term, since some assignments were divided into smaller activities. The study of the scientific literature was conducted throughout the course, supporting and, at times, motivating the educational situation.

The writing of two scientific articles with different research objects despite the same *corpus*, was the final product of the circuit. After the completion of the course, the articles were submitted, approved and published in scientific journals (SILVA *et al*, 2018a, 2018b). Because most journals limit the number of authors to a single article, the 14 students were divided into two writing groups. Nonetheless, even this number of authors still reduced the possibilities for those publications.

The graduation students conducted 23 interviews with undergraduation students from different teaching degrees enrolled in four higher education institutions in the North and Northeast Regions in Brazil, as described previously. The interview relied on questions proposed to function as a script, such as: (1) "Certainly, you have heard of scientific research. What do you understand by making science?"; (2) "Mention some social situations in which knowledge produced by science in general can contribute to solve or to mitigate social issues"; (3) "Would you know, in your area of study, of any example of science making?". The research *corpus* was generated through the transcription of the recordings of the interviews, which were also analyzed collectively during face-to-face meetings.

Given the relevance of the answers and considering the first recordings in video, it was agreed that a documentary would be produced to the purposes of science communication, since the access to the research by the non-specialist audience would hardly be ensured through scientific articles, which are the typical means of peer communication[12]. This

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[12] The documentary was advertised on the university website and made available on the institution's official YouTube channel. The respective links are: https://ww2.uft.edu.br/index.php/ultimas-noticias/20594-

assignment triggered several learnings, since the graduation students needed to elaborate a script for the audiovisual production, to select and to edit scenes, as well as to subtitle the production. The interpretation in Brazilian Sign Language (*Libras*) was provided to guarantee accessibility to the deaf community. Certainly, the awareness toward the use of *Libras* interpretation was promoted by the contact with a deaf graduation student throughout the semester. The graduation students themselves subtitled the documentary in English after translating the text.

The assignment highlighted in Figure 2 corresponds to the production of opinion articles also characterized as a strategy for science communication. Newspapers publish hired columnists but they also normally accept spontaneous contributions from their readers. To that end, they observe the relevance of the themes, the textual quality in terms of language, the consistency of the approach to the topic, and the controversy of the opinions. This particular assignment was developed upon the acceptance by *Jornal do Tocantins* to publish the series *Letras com Ciência* composed of 15 texts. The first article was written by the course professor himself to introduce the series of texts, which he also coordinated. The course professor was responsible for ensuring the quality of the written productions and for e-mailing the texts with the author's photographs, as instructed by the journalist in charge of the opinion section.

In the following section, the linguistic assumptions used in the documental series are presented along with an overview of the opinion articles.

Characterization of the investigated documents

The documents under analysis here are the different versions of the opinion articles produced during the graduation course in question. At the time, the versions were archived as documents for research purposes. Later, the professor recollected the pedagogic experience based on the circuit and investigated the documents to understand and strengthen the collaborative approach to teach at graduation teaching. A preliminary version of this scientific article was shared with the authors of the opinion articles in which relevant linguistic activities were identified in the process of rewriting. The treatment of the documents and the results were confirmed by the authors in a method that is typical of investigation involving collaborators or AL research participants (KLEIMAN, 2002; SILVA, 2010).

The opinion articles were approached qualitatively, since their analyses relied on the theoretical assumptions introduced earlier (HOLBROOK; RANNIKMAE, 2009; LIU, 2009; SILVA, 2020a, 2020b; to name a few) as well as on the socio-semiotic notion of language for text analysis (HALLIDAY, 1985; HALLIDAY; YALLOP, 2008), as described ahead.

documentario-explora-definicoes-para-o-que-e-ciencia and
https://www.youtube.com/watch?v=Vb2DhVUZVcom Access on 29 Sep. 2021.

The documents that form the research *corpus* are listed in Chart 1. The texts were identified according to the published version of the articles. In the first column, the titles and the authors were named, while the second column informs the periodical and the publishing date. The texts were published by three different newspapers with daily, weekly and monthly editions for eleven months, extending beyond the duration of the course.

Chart 1. Opinion articles produced by graduation students[13]

TITLE / AUTHOR	NEWSPAPER / DATE
1. Scientific research at schools Wagner Rodrigues Silva	Jornal do Tocantins, 23 set. 2017.
2. For a school that teaches to question Mirella de Oliveira Freitas	*Jornal do Tocantins*, 01 Oct. 2017.
3. The school of whys Aylizara Pinheiro dos Reis	*Jornal do Tocantins*, 13 Oct. 2017.
4. Science in the world of untruths Renato Goveia Martins	*Jornal do Tocantins*, 29 Oct. 2017.
5. Research for literacy Dijan Leal de Sousa	*Jornal do Tocantins,* 11 Nov. 2017.
6. Girl, go watch cartoons Bruno Reis Santana	*Jornal do Tocantins*, 23 Dec. 2017.
7. More sciences for the deaf Fernando Cardoso dos Santos	*Jornal do Tocantins*, 30 Dec. 2017.
8. Science for whom? Michele Silva Costa Sousa	*Jornal do Tocantins*, 02 Feb. 2018.
9. Children and differences in language Carlos Wiennery da Rocha Moraes	*Jornal do Tocantins*, 04 Feb. 2018.
10. Instrument of alienation?[14] Victor Chiang B. B. Mendes	*Jornal do Tocantins*, 24 Feb. 2018.
11. Science in teacher educator Bárbara de Freitas Farah Matos	*Jornal do Tocantins*, 05 May 2018.
12. Sciences: what for? For whom? Eloiza Marinho dos Santos	*Primeira Página*, 14 - 20 May 2018.
13. Language sciences and school Mayron Rodrigues Cordeiro	*Primeira Página*, 14 - 20 May 2018.
14. Science through writing Leide Lene Santos Silva	*Primeira Página*, 20 - 26 May 2018.
15. Science fair Raimunda Araújo Silveira	*Jornal Tocantins* News, July 2018.

Source: the author

During the time the texts circulated, publishing was interrupted four times in January, March, April and June. These intervals were not related to the submission of the texts to the newspaper that had agreed to publish the material. In fact, as observed in Chart 1, only after two consecutive months – March and April – the texts were submitted to different periodicals to ensure the full publication of the series *Letras com Ciências*. The reason for the hiatus is

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[13] A panel of the opinion articles is presented in the Annex of this article.
[14] For unknown reasons, this text was published under a different title from the original one. In fact, the title published by the newspaper, "Historical judgment", does not relate to the content of the text.

unknown. Were there too many opinion articles discussing similar issues? The authors were careful not to repeat a certain topic, however, a common subject characterized the series.

The analysis of the different versions of the texts was based on the socio-semiotic theory proposed by Halliday (1985) in the scope of systemic-functional linguistics. Hence, the notion of text assumed in the documentary research:

> [...] a text, then, is both an object in its own right [...] - an instance of social meaning in a particular context of situation. It is a product of its environment, a product of a continuous process of choices in meaning that we can represent as multiple paths or passes through the networks that constitute the linguistic system [...] (HALLIDAY, 1985, p. 11).

The documents convey clues on social facts and reveal forms of social interaction, two properties that ensure these texts can be conceived as objects of scientific research. Therefore, *corpus* analysis concentrated on the verbal materiality of the negotiations implicated in the (re)writing of the opinion articles, considering the professor's interventions in the different versions of the graduation students' writings. Occasionally, these interventions were made by the master's and doctoral students themselves, a further indicative of collaboration. The negotiations in writing were the effort to adjust linguistic choices to the proper register for scientific communication through the chosen genre.

During the assignment, the graduation students moved from the academic context, characterized by peer communication, to the context of a daily newspaper, which was used as reference and is characterized by scientific communication for ordinary citizens as well[15]. Hence, the professor's interventions frequently clarified or even reminded graduation students that the articles needed to be accessible for readers without expertise in language studies. This is shown in the following intervention: "This paragraph seems to engage with peers, not with the ordinary citizen!". Regarding the possible linguistic adjustments to communicate scientific and technological information to the common audience, composed of non-specialists in the subject, Bueno (2010, p. 3) argues that:

> [it] requires decoding or recoding of the specialist discourse, employing resources (metaphors, illustrations, or info-graphs, etc.) that could penalize the accuracy of information. Hence, there is the continuous conflict, in science communication, between the need to preserve the integrity of technical terms and concepts to prevent misguided or incomplete readings and the forceful demand of establishing communication effectively, which is only possible by respecting the social-cultural or linguistic background of the audience.[16]

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[15] Ordinary citizens are conceived here as individuals to whom the scientific domain or the academic sphere are unfamiliar. Even under that condition they contribute to the public funding of scientific activities through compulsory taxes, of which a small amount is directed by the government to public funds that sponsor Brazilian research.

[16] In the original: requer decodificação ou recodificação do discurso especializado, com a utilização de recursos (metáforas, ilustrações ou infográficos, etc.) que podem penalizar a precisão das informações. Há, portanto, na divulgação científica, embate permanente entre a necessidade de manter a integridade dos termos técnicos e conceitos para evitar leituras equivocadas ou incompletas e a imperiosa exigência de se estabelecer efetivamente a comunicação, o que só ocorre com o respeito ao background sociocultural ou linguístico da audiência.

According to the socio-semiotic approach, it is possible to make some predictions regarding the situational context through text analysis, similarly to how context enables the prediction of several linguistic choices in the verbal materiality. According to Halliday (1985, p. 36), [...] "we can and do (and must) make inferences from the situation to the text, about the kinds of meaning that are likely to be exchanged; and also inference from the text to the situation" [...].

Register, then, is the set of linguistic choices made in the verbal materiality motivated by contextual conditions. The immediate conditions are: (a) the theme, (b) the participants in the interaction and (c) the means of circulation of the text. Considering the assignment instructions and the situational context of the newspaper, which, somehow, was anticipated for the assignment, the conditions were: (a) the discussion about linguistic research as activities of a legitimate science; (b) the interlocution between graduation students (masters and doctorate degree), some of which are also school teachers, and the various readers who ignore the theme of the discussion[17]; (c) the digital and print publication of opinion articles, with the latter being preferred by the group at the time, showing that master's and doctoral students wanted to see themselves represented on the pages of a newspaper.

The non-immediate conditions are related to broad cultural aspects, that define the generic composition and define the organization of the information in the text, for example, the argumentative and expository dimensions of the opinion article. On this matter, Halliday's words must be resumed:

> [...] There are classes of texts, and this is what gives us the general notion of a register. The feeling we have, as speakers of language, that this text is like one is simply a recognition that they belong in some respect to the same register. (Halliday, 1985, p. 42)

Concerning the contextual condition of the theme, twelve authors emphasized humanities and, specifically, AL and Language Sciences in general as legitimate fields of production for scientific knowledge[18]. This shows the influence of one of the theses regarding scientific education, as described in the previous theoretical discussion, also approached during the course. Humanities are opposed to privileged areas, since only the latter are easily recognized as sciences by the ordinary citizen.

Twelve authors, not exactly the ones from the previous paragraph, named the following areas: *Astronomy, Biology, Engineering, Physics, Medicine, Chemistry, Soil Science, Health Sciences, Animal Sciences, Exact Sciences and Technology*. By naming these sciences, some authors outlined their contributions to society, such as the production of

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[17] Newspapers have wider audiences since the print version, albeit the internet access, was at once low cost and addressed at well-known places in the largest cities in Tocantins. *Jornal do Tocantins* has discontinued print
[18] Other fields of knowledge related to the great area of humanities were mentioned in the opinion articles: Arts, Teaching, History and Literature.

machinery, the development of new techniques to use soil, the production of new medicine, the creation of new treatments and surgery procedures.

At first, the opinion articles were reunited in two groups: texts with and without explicit contributions of research in AL. Seven articles were placed in the first category and eight in the second, without premeditation for the numbers. Despite the balanced numbers, given the first instruction for the writing assignment, authors faced some difficulty in outlining the contributions of applied research in a way that the diversified readership of the newspaper could understand the text. Hence, focus on written interlocutors.

On this issue, the research conducted by INCT-CPCT (2021, p. 158) showed that youth have "the conviction that resources for sciences must be channeled for areas that respond to urgent social demands in Brazil"[19]. They recognize the importance of education when discussing the possibilities of transferring, increasing or reducing the scarce official resources for science and technology, however, in the report, no evidence was identified of youth relating educational demands to science contributions in the field. The report indicates the channeling of public resources that contribute to "sectors like mobility, transport, curing diseases and sustainable development"[20] (INCT-CPCT, 2021, p. 158).

Texts in the group *with outlined contributions* present AL or, more generically, language sciences as responsible for producing knowledge whether applied to educational contexts or not. Applications to the educational context were cites as the contributions to the teaching of reading and writing and pre-service teacher education, as well as their impact on (a) the elaboration of linguistic policies that guarantee social rights to (b) produce adequate didactic materials that (c) ensure children's literacy and (d) the understanding of strategies that produce language practices in pre-service teacher education.

The second case outlines AL promising contributions to (a) the fight against fake news, including the proposition of critical teaching practices; (b) the description of indigenous languages in terms of alternative education for minority groups; and (c) the study of the culture of writing to understand human behavior or the social dynamic.

Texts in the group *without outlined contributions* present the importance of investigative practices for teaching and for the pre-service education of language teachers. Examples of such practices are the teachers who research or are critical of their own professional performance and school science fairs that approach linguistic phenomena. At the time of the graduation course, many students were school teachers or worked in pre-service teacher education, therefore, it is likely that these were the subjects they felt most confident about. Once again, the participants show themselves through their writings.

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[19] In the original: "convicção de que os recursos para a ciência devem ser canalizados para áreas que respondam a demandas imediatas da sociedade brasileira".
[20] In the original: "setores como mobilidade, transportes, cura de doenças e desenvolvimento sustentável".

This last group also embraces texts that highlight the need for investment in contexts other than the educational, such as the production of linguistic knowledge to facilitate communication between the deaf and the hearing communities. The group also implicate texts that prioritize science communication in Brazil, in clear criticism of the disproportional demands made by funding agencies for the university internationalization. This issue is discussed at the end of the analysis.

In the following section, the linguistic activities that arise in the process of rewriting the opinion articles are displayed. They were divided according to the following categories: lexical choice, metalanguage, reference and citation, and content.

Categorized Linguistic Activities

The opinion articles were submitted to rewriting, generating between two to five versions of the text in order to ensure the adequacy of the register used in the newspaper. Limiting the number of characters for the title (30 with space) and for the text (3,600 with space) to fit the standard used by the newspaper was one of the challenges faced by the graduation students, as the first versions exceeded that number of characters.

The professor's interventions were motivated by distinct inadequacies, involving general linguistic adjustments that could happen in texts of any genre. It is emphasized that, occasionally, interventions were made by the graduation students themselves, who reciprocated the reading of the opinion articles in the process of rewriting.

Rewriting was mostly requested due to correct typical grammar mistakes, to grant objectiveness to longer sentences as well as to suggest a change in subject and avoid deviation from the aim proposed to the task. Five graduation students needed to change the subject of their articles in preliminary versions of the text. Examples of interventions motivated by typical linguistic mistakes were: "Confusing syntax!"; "Revise. More simple writing. Break sentences here"; "There's a limited number of characters for this much repetition!".

Considering the discussion thus far as well as the linguistic activities implicated in the rewriting of texts selected as documents for this investigation, it is noteworthy that:

> [...] language is a social behaviour and meaning a social phenomenon. By this we mean that language is more than an individual possession or ability, that language 'exists' because of its life in social interaction, that meaning is shaped and negotiated in social interaction and that meaning must be studied with due recognition of its social setting (HALLIDAY; YALLOP, 2008, p. 50).

Lexical choice was the category chosen to name situations in which words that could be either replaced or suppressed to facilitate the readers' understanding. The professor's interventions focused on choices of words typical of the academic domain, including metalanguage from the language studies.

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The case of three words recurrently used in formal interactions ("conceptions"; "imaginary"; "perception") is shown in Figure 1. These words were highlighted by the professor in the introductory paragraph of the first version of an opinion article, revealing, then, that they were perceived as replaceable to ensure the access of a wider readership.

Example 1. Lexical Choice	Contextualization[21]
When you come across science or scientific research, what comes to your mind in general? I propose this exercise to trigger critical thinking about the conception of science and research that we have in our imaginary, hoping to contribute to the expansion of that perception[22].	1st version 1st paragraph
When you hear people talking about science, what does it remind you of? We propose this exercise to trigger critical thinking about the understanding of scientific research. We aim to contribute to the expansion of how people understand science.	Published version 1st paragraph

The published version of the excerpt shows the replacement of two lexical items ("conception"/"understanding"; "perception"/"understand") and the suppression of one ("imaginary"/ Ø). These changes were simultaneous to the syntactic adjustments seen in the comparative reading of the texts in Example 1. These negotiations were performed in writing between the graduation student and the professor throughout the production of three versions prior to publication.

The indispensable use of metalanguage that needs to be explained in detail is seen in Example 2. Lexical choices subject to replacement or suppression are also highlighted.

Example 2. nomenclature	Contextualization
Applied Linguistics, a flexible science that investigates phenomena related to language, for example, has recently developed innovative research on the scientific literacy of learners. These investigations aim, among other things ~~mostly~~, to educate teachers that offer students the contact with scientific investigation. Therefore, in addition to promoting research, the scientific literacy of learners can weaken the effects of fake news that are more and more frequent[23].	1st version 3rd paragraph
First the explanation, then the metalanguage. It makes Reading easier for the ordinary citizen!	Professor's intervention on the use of metalanguage
Unclear!	Professor's intervention on the end of the paragraph

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[21] The examples separate under the label *contextualization* information to distinguish the excerpts from the professor's interventions. Each version of the text as well as the position of the excerpt in the text were identified.

[22] Double underline in the published version by the professor regarding lexical adjustments. Underline is used for analysis purposes in the excerpt highlights.

[23] The examples use *italic* to indicate the professor's additions, while underline in the unpublished versions correspond to the highlighted passages in the original to insert comments.

A science turned to the plural investigation of social phenomena <u>involving the uses of languages in the everyday interaction, known as Applied Linguistics,</u> has developed more recently innovative investigations focused on understanding scientific conceptions as well as investigating the uses of writing in the sciences. <u>People who share scientific practices or knowledge have scientific literacy.</u> Applied linguists aim among other things to <u>educate teachers that offer students the contact with knowledge production. By approximating students to science making, the scientific literacy can weaken the effects of fake news, which, in their constitution, reveal little support (or none at all) in evidence or actual investigations.</u>	Published version 3rd paragraph

Double underlined words indicate the professor's highlights on the text. The words "flexible science" were replaced with "plural investigations", used in one of the intermediate versions of the text. The former expression, in turn, was suppressed for the reformulation of the notion of AL. Probably, the orientation to invert the order of the conceptualization of AL was inadequate ("First the explanation, then the metalanguage. It makes Reading easier for the ordinary citizen!"). The original sequence was preserved in the texts by other graduation students. The intervention could have addressed the less clarifying concept of AL ("flexible science that investigates phenomena related to language").

The label "scientific literacy" was preserved because of the conceptual explanation ("People who share scientific practices or knowledge have scientific literacy."), which became clearer after the examples of the type of research conducted by applied linguists regarding this investigative frame ("innovative investigations focused on understanding scientific conceptions as well as investigating the uses of writing in the sciences").

Moreover, the word "learner" is cited twice in Example 2, but only the first was highlighted since the second is part of the final excerpt, which was underlined and commented on by the professor ("Unclear!"). In the published version, that lexical choice was ignored and the references to learners were replaced with "students".

Reference and citation were another linguistic activity frequently identified in the texts. They assumed the form of explicit mention to authors studied in the course, and could display typographic marks, such as quotation marks and italic, as seen in Example 3. The excerpt was suppressed in the subsequent version, after a change in the theme of the discussion. Four versions of this text were produced before the published text.

Example 3. References to authors	Contextualization
<u>Essay</u> on Science <u>According to Pedro Demo, well-known Brazilian sociologist, "*there is not a single professor who is not a constructor of science*</u>". But, after all, what is science? What is the importance of science for education?	1st version 1st paragraph
This name is too academic for a popular newspaper!	Professor's intervention on the title
Say it without referring to authors. This is too academic.	Professor's intervention on the first paragraph

Another excerpt allowed the confirmation that the citation does not identify the year and the page of the work cited. A current hypothesis is that such citations were motivated by the media genre, to distinguish the practice from the academic standard. Just one citation in the documents informed the year and page of the work. The professor's intervention recommended keeping the information but not the citation ("Say it without referring to authors."), which was characterized as an academic practice ("This is too academic.").

Citations were not the only semiotic element identified as an indicative of the academic register. Other linguistic choices were also underscored ("Extremely academic!"; "DON'T TALK ABOUT THE MASTER'S!"). In regard to the issue, the lexical choice present in the title of the article ("Essay") and commented by the professor ("This name is too academic for a popular newspaper!") is highlighted. The title seems to establish an intertextual relationship with the novel by José Saramago *Blindness*[24], or even indicate the classification of the text as an essay.

The subject of the discussion is indicated by the questions in the introductory paragraph ("But, after all, what is science? What is the importance of science for education?"). The subject was adjusted after a couple of recommendations by the professor ("What if you wrote an article about that? The actual title should be: SCIENCE FAIRS AT SCHOOL"; I INSIST ON THE DISCUSSION ABOUT SCIENCE FAIRS, YOU CAN TALK ABOUT IT BASED ON THE [course] READINGS"). In other words, the school science fair was identified in the text itself as relevant, thus preventing the repetition of issues discussed in the other texts[25].

The category content identifies (1) the adjustments made on the themes without abandoning the preliminary text, and (2) the writings on issues that were different from the ones approached in preliminary versions because they either repeat the content of the other texts or discuss issues that diverge from the proposition. In the latter, it is noteworthy that a text was written focusing on the aspects pertaining to the natural sciences, reproducing the exact opposite of the proposed during the course.

Example 4 displays a case of adjustment in content that led to a change in the main issue of the text. The modification was indicated in the titles for both versions of the article: "International graduation?"; "Science for whom?".

Example 4. Content adjustment	**Contextualization**
Therefore, the need for organizational and structural changes in Graduation Programs that seek international quality involves the effort of different actors that focus on the strategic planning to prompt the production of scientific material in other languages, to elaborate cooperation projects, to offer disciplines in foreign languages, to provide	1st version Last paragraph

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[24] T.N. The title in Portuguese is translated literally as *Essay on Blindness*.
[25] This opinion article was the last text published in the series *Letras com Ciências*.

continued professional development through mobility abroad and to receive foreign students and researchers qualified in the studies offered by the course.	
Xxxxxxx, Your text agrees with the government's mission without questioning it! To approach this matter in the literacy studies, it is necessary to see the issue from different angles: the angle of the excluded. How about writing a critical text questioning internationalization, considering the lack of policies to sensitize society regarding the work developed by scientists, which, I underscore, is funded by the very people who ignore science? In short, as it is, you're missing the point of the series!	Professor's intervention
In the process of internationalization, if the institutions that achieve better scores and investments are the ones whose production is communicated in English, how can science be communicated and made accessible to the local population, who is not a part of academia and speaks Brazilian Portuguese? The criticism is that the knowledge they produce is limited to scientific productions or to the "shelves", available just for the institutions of research, technology and innovation. Science is not always applied to the social reality or shared with non-specialists.	Published version 3rd paragraph

The first version discusses challenges in the internationalization of Brazilian Graduation Programs, such as publishing scientific production in English and developing cooperation and mobility projects for faculty between national and foreign institutions. The official discourse about that politics was established and reproduced in the first version of the text. This fact was highlighted by the professor's intervention, who recalled the commitment of literacy studies to people placed at the margins of society.

The intervention suggests the confrontation of the official demand for internationalization and the lack of robust policies for scientific communication, to ensure the citizen's clarification regarding research, especially the ones conducted with public resources ("How about writing a critical text questioning the internationalization considering the lack of policies to sensitize society regarding the work developed by scientists […]"). The question also points to contradictions regarding the taxes, which are invested in research and paid by the same Brazilians who ignore the national scientific production ("funded by the very people who ignore science").

The relevance of internationalization was not neglected in the published version, but emphasized the need for equal efforts so science becomes accessible to Brazilians ("how can science be communicated and made accessible to the local population, who is not a part of academia and speaks Brazilian Portuguese"). Therefore, similar to the other examples presented in the article, this last data reveals signs of how the scientific education approach has contributed to trigger criticism in graduation students regarding official policies and social demands.

Final Remarks

The experiences of collaborative teaching at level revealed the need and the productivity for the "science and public" perspective, defended by Liu (2009). Hence, the

Science Education Circuit (SEC) has become a powerful tool for collaborative planning, involving the continuous negotiation between the participants in the educational process – graduation and undergraduation students. The assignments in the Circuit fostered educational situations that allowed the participants to experience relevant research and scientific communication practices.

Despite the fac that master's thesis and doctoral dissertations are products of systematic research, the latter is not always present in courses taken at graduation level. The experience reported here involved community outreach, as the opinion articles were made available for a reading audience of uncalculated reach. Therefore, the present article can be used as reference for future articulations of academic activities.

The graduation students committed to the assignments and demonstrated excitement and gratification in the face of the outcomes produced in the course. The principles of scientific education listed in previous research (SILVA, 2020a) were mobilized (*curiosity, communication, collaboration, creativity, persistence, relevance* and *investigation*) and, certainly, the competences described here were improved due to team work (*curiosity, communication, collaboration, creativity, criticism, compassion, control* and *citizenship*).

Scientific education must be part of the pre-service education in the various fields of knowledge and not limited to a Graduate Program with that particular aim, as recommended by Liu (2009). In Brazil, the scarcity of public resources, the likely inexistence of private resources to fund AL research, as well as the limited representations about science shared by society urge the adoption of the pedagogical and the investigative approaches of scientific education in language studies graduate programs.

Finally, considering the social commitment of AL research, it is indispensable that the approach of scientific education is widely adopted by applied linguists. In addition to investing in research on the subject, these researchers cannot ignore scientific communication. Explaining research to the ordinary citizens must become common practice, only then will they become well-informed allies.

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Annex

Panel with published opinion articles

Ciência no mundo da inverdade

Renato Govela Martins
Mestrando em Letras na Universidade Federal do Tocantins (UFT)

Pesquisar para alfabetizar

Dijan Leal de Sousa
Professora da UFT/MA Mestranda em Letras

Menina, vá assistir desenho!

Bruno Reis Santana
Servidor da Universidade Federal do Tocantins (UFT) e Mestrando em Letras

Mais ciências para os surdos

Fernando Cardoso dos Santos
Professor da Universidade Federal de Tocantins e mestrando em Letras (UFT)

Ciência para quem?

Michele Silva Costa Sousa
Mestranda em Letras (UFT)

Criança e diferença na língua

Carlos Wiennery da Rocha Moraes
Servidor e Mestrando em Letras (UFT)

Julgamento histórico

Victor Chiang
B. B. Mendes
Mestrando em Letras (UFT)

Ciência na formação do professor

Bárbara de Freitas Farah Matos
Doutoranda em Letras (UFT)

ELOIZA MARINHO DOS SANTOS

Ciências: para quê, para quem?

MAYRON RODRIGUES CORDEIRO

Ciências da linguagem e escola

"As ciências da linguagem podem ser compreendidas, de maneira simples."

LEIDE LENE SANTOS SILVA

Ciência pela escrita

"Pode-se afirmar que, após as pinturas nas cavernas, ela foi uma das principais formas de registro da história da humanidade."

FEIRA DE CIÊNCIAS

Raimunda Araújo da Silveira
Doutoranda em Letras (UFT) e professora do SEDUC/TO