

Contributions and Difficulties of Reading and Writing Practices for Teaching and Learning Physics in High School: Reflections in Light of School Culture

Joselaine Setlik  Brazil
Ivanilda Higa  Brazil

Literature reviews defend the importance of reading and writing practices in Physics classes, which can assume different roles and purposes in the school. This research analyzes perspectives of different subjects, teacher and students, about the contributions and difficulties of considering those practices when teaching and learning Physics in classes of this discipline in high school. Assuming reading and writing as sociocultural and schooling practices and adopting the concept of School Culture, the research was carried out in a public school, in three classes of third year of High School. The instruments used were classes' observations, intervention, and interviews with 14 students and with the teacher, analyzing the perspectives of these different subjects on such issue, in light of the concept of School Culture and Culture of the School. From the analysis, among several elements, it was observed that for these subjects, reading allows a better understanding and amplification of their perceptions on the concepts, while writing helps memorizing and expressing knowledge. The intervention evidenced that it is possible to adopt such practices in Physics classes, in order to expand the contributions to teaching-learning, by exploring other aspects related to the concepts studied. The difficulties evidenced are mainly associated to the students' relation with these practices, to the teacher training as well as to a school culture that influences their use, especially in a discipline that has its culture already established.

Keywords: Reading; Writing; Physics Teaching; School Culture.

Introduction

Different disciplines, in different school contexts, may use reading and writing for different reasons and purposes. According to Guedes and Souza (2011), all school disciplines have the responsibility of developing and improving the practices of reading and writing – not limiting it to the discipline of Portuguese language. The National Guidelines for Basic Education of High School, for example, state that the political-pedagogical projects of schools should consider, among several elements, “the appreciation of reading and writing in all areas of knowledge”¹ (MEC, 2013, p. 178).

In the discipline of Physics, in high school, at least since the 90's, studies have proposed classroom reading activities, defending the importance of this practice for the learning of concepts and the interaction with different areas of knowledge (Almeida,

1 All quotations in this paper were translated by its authors.

& Ricon, 1993; Almeida, Silva, & Babichak, 1999; Almeida, Silva, & Machado, 2001). As mentioned by Almeida and Ricon (1993), reading can contribute to the formation of habits and attitudes regarding the information conveyed about science, as well as facilitate the incorporation of scientific knowledge.

Studies on reading in the Physics teaching support the idea that this practice can be potential for learning, from the reading of textbooks and accompanying materials (Assis, & Teixeira, 2005), the reading of scientific dissemination texts (Pagliarini, & Almeida, 2014; Silva, 2013) to the reading of literature texts (Ferreira, & Raboni, 2013).

Students can relate to written text in different ways. Geraldi² (2003, mentioned in Flôr, & Cassiani, 2011, p. 74) points to the existence of four “types” of relations between text and reader: information-seeking reading, when the reader reads the text to find answers to existing questions; text-study reading, in which the reader takes from the text all that it can offer; pretext reading, when the reader uses the text for the production of other works, and fruition reading, when the simple presence of the text is enjoyed. In school activities, it is more frequent to observe the use of information-seeking reading, which seems to be a more limited form of relationship between reader and text, as it may silence other interpretations that could be performed by students.

Writing in Physics classes, in turn, is usually associated with reading activities. Although in a smaller number, some studies point to the potentiality of different uses of writing in such discipline (Charret, & Krapas, 2008; Paula, & Talim, 2015).

Carvalho and Barbeiro (2013) indicate that writing can be problematized in the school by different aspects: as a school content to be acquired and developed, therefore the school being responsible for developing the writing skills; as a vehicle of pedagogical communication, considering both its dimension of knowledge transmission and the students’ explanation, through evaluation. The authors also mention a new aspect, which is to consider its role in the process of acquisition, elaboration and expression of knowledge, conceiving it as a learning tool. This perspective broadens our view about writing, as it allows us to see it as potential in the (re)building of knowledge by students in the various disciplines.

Although studies show the potential of reading and writing for teaching and learning Physics, these practices can still cause strangeness in teachers and students who share a perception of school in which certain practices - exercises and problems, for example - are more pertinent to the discipline, to the detriment of reading and writing. Studies indicate that text reading practices are not always used/encouraged (Andrade, & Martins, 2006; Assis, & Carvalho, 2008), which goes from teacher education to the conditions under which classes take place. Analyzing and understanding the presence (or invisibility) of reading and writing in Physics classes require investigating the concrete conditions under which Physics classes take place - in a school with a teacher and students immersed in a particular culture (Forquin, 1993) of teaching and learning Physics.

² Geraldi, J. W. (2003). *Portos de passagem*. São Paulo: Martins Fontes.

This research seeks to broaden the results reported in the literature review, reflecting on the relations of this topic adopting theoretical assumptions about learning and language based on Vygotsky and Bakhtin and in light of the discussions of Forquin (1993) about school culture and culture of the school.

The research was conducted in the discipline of Physics, in three classes of the third year of high school, from a characterization of the school context (mapping the presence of reading and writing in the discipline's established culture) and the development of a didactic activity, seeking to insert different ways of using reading and writing in that culture, creating a context that would allow us to investigate how the students and the teacher would relate (their individual responses) to this other approach to reading and writing in Physics classes.

The concepts of school culture and culture of the school

Verbal language is essential in the social context and in the cultural transmission. The school is part of a social context and beyond the role of cultural transmission, it has its own culture. Forquin (1993) states that between education and culture there is an intimate and organic relationship, distinguishing the concepts of school culture and culture of the school, which should not be confused.

The concept of school culture is linked to the cultural transmission of “cognitive and symbolic contents that, selected, organized, ‘normalized’, ‘routinized’ [...] usually constitute the object of a deliberate transmission in the context of schools” (Forquin, 1993, p. 167). For this author, school culture is a selective and derived culture, which is materialized “by the intersection of institutional actions (official curriculum), teachers (actual curriculum) and students (learned curriculum)” (Mendes-Filho, Gonçalves, Vidal, & Paulilo, 2004, p. 146). School culture would thus be a second culture that comes from a culture of creation or invention, therefore a derived and transposed culture (Mendes-Filho, Gonçalves, Vidal, & Paulilo, 2004). Julia³ (2001, mentioned in Mendes-Filho, Gonçalves, Vidal, & Paulilo, 2004, p. 143) adds, to the excessive weight of the norms given to the concept, the attention to the daily practices, inviting the researchers of the area to also question themselves as to the inner operations of the school.

Reading and writing practices can be considered objects of the culture, developed in the social environment (Cruvinel, 2010), and taken by the school in its purposes and auxiliary means.

Physics, as well as other disciplines in Basic Education, has specific characteristics related to the school culture of a global institution, that is, there are pedagogical practices and contents that throughout history have been constituted as “belonging” to the discipline. Chervel (1990) argues that the internal organization of disciplines is to some extent product of history. Throughout the history of the constitution of different

3 Julia, D. (2001). A cultura escolar como objeto histórico (G. Souza, Trad). *Revista Brasileira de História da Educação*, 1, 9–44. (Obra original publicada em 1995). Recuperado de <http://www.rbheold.sbhe.org.br/index.php/rbhe/article/viewFile/273/281>

school disciplines, it may have generated an understanding that certain disciplines have the role of developing certain competences, influencing teachers' pedagogical practices. The teaching and development of reading and writing texts, for example, can be mostly entrusted to the native language teachers, disregarding its importance in the cultural transmission and structuring of thought in other subjects.

Forquin (1993) also includes the contribution that the concept of culture provides to the understanding of school practices and situations, giving to this culture the concept of culture of the school. Carvalho (2006) explains that the culture of the school can be seen as a relativization of the school culture (which starts from external determinations) due to the set of organizational factors and social processes specific to this space and, therefore, demonstrate that the school is not a passive receptacle, but, on the contrary, actively acts in the reinterpretation and operationalization of external instructions.

Understanding school practices and situations requires reflecting not only on the school culture, thinking of the school as belonging to a global institution with formalized norms and structures, which are constituted throughout history, but also on the culture of the school, configured by the identity and particular relationships of its actors.

Reading and writing: sociocultural and schooling practices

Vygotsky understands man as a social subject who develops through the interaction with the social world (which enables the internalization of new psychic functions). Thus, knowledge comes from external experiences through the process of cultural appropriation, being learning, which occurs through relationships with the subjects and the environment, mediated by cultural instruments, such as language.

Considering the role of learning, whether in the school or not, as a stimulus for development, Vygotsky (2014) proposes the concept of zone of proximal development (ZPD). For him, "the developmental process does not coincide with that of learning, the developmental process follows that of learning, which creates the so-called potential development zone" (p. 116). It is in the distance between what is already known (actual level) and what can be known with the help of the other that the subject's development is possible.

For Vygotsky (2008), concept is the meaning of a word, and its development more than a mere mental habit, is actually a real and complex act of thought that presupposes the maturation of many intellectual functions such as abstraction, deliberate attention, logical memory, among others. He differentiates the so-called scientific concepts, which are developed through formal school education, from spontaneous concepts, which are related to everyday living. Understanding the development of concepts requires understanding the interdependence between scientific (non-spontaneous) and spontaneous concepts.

Although these concepts develop in opposite directions, they are closely interrelated. Gaspar (2014) explains that "the learning of scientific concepts depends on the mastery of the related spontaneous knowledge: when there is this mastery, learning

occurs, when not, learning does not occur” (p. 133). Thus, spontaneous concepts must have reached a certain level in order to absorb a related scientific concept (Vygotsky, 2008).

In the context of Science, some words are used with specific meanings. Understanding a scientific text, for example, requires knowledge of specific concepts. In the perspective pointed by Vygotsky (2008), the development of these concepts is not only related to the repetition or explanation of the meaning of words, but to learning through the contact with situations in which these concepts are used, that is, in the approximation of scientific concepts with more concrete situations.

According to Hedegaard (1996), teaching should seek the involvement of students in new types of activity that make it possible to create zones of proximal development, thus, by relating scientific concepts to spontaneous concepts it will be possible to develop new skills and possibilities for action. Reading and writing in Physics classes can enhance activities of this discipline by allowing students to, for example, operate in different ways within the zone of proximal development, enabling the students to become more aware of their spontaneous concepts through verbal description, while at the same time bringing the scientific concepts closer to their daily experience, assigning meanings at the most concrete level.

It is important, in Physics classes, to emphasize not only the formal writing of Physics concepts, but also the writing production. In school, it is often tended to deprive students of their personal narrative spaces about knowledge, making them operate on concepts studied only in the most traditional ways (such as defining, describing, characterizing, etc.), i.e., writing is taken as an operation of knowledge in which the emphasis is shifted from everyday events to the benefit of a categorical approach (Goés, 2001). It is potential for learning to seek situations that emphasize the student’s expression in relation to their subjectivity and daily life, seeking to approach spontaneous and non-spontaneous concepts also through the verbal expression of their thinking.

Similar to Vygotsky’s thought, Bakhtin (1992) conceives the word as a sign and understands it within the realm of human significance. However, while Vygotsky (2008) seeks to establish relations between thought and language, Bakhtin analyzes language by considering its use in social relations and events as a human activity.

Bakhtin discusses issues related to language, not concerned with the system of language forms, but having the utterance as object. Language is characterized by the Bakhtin’s Circle with an interactive/relational approach, conceiving language in its concrete and living integrity and not as a specific linguistic object (Castro, 2010). For Bakhtin (1992) “people do not exchange sentences, nor do they exchange words (in a strictly linguistic sense), or word combinations, but exchange utterances constituted with the help of language units” (p. 297). Therefore, the utterance differs from the sentence and is considered as the real unit of verbal communication. The use of language in the different spheres of human activities always occurs through concrete and unique utterances (oral and written).

Each sphere of communication has its specific and relatively stable utterances, called speech genres, in which thematic content, style, and compositional construction merge indissolubly (Bakhtin, 1992). The concept of genre is not limited to structures or texts, but implies dialogism and ways of understanding and facing life (Brait, & Pistori, 2012). In verbal communication activities, we always use speech genres, that is, utterances that have a certain standard form.

According to Bakhtin's thought, it is only possible to master a particular genre of discourse through the experience with it. For Bakhtin (1992), a person who has not lived in a certain sphere of human activity, will not master his or her repertoire of speech genres, since learning a particular genre occurs through experience and contact with these types of utterances.

From the perspective of the dialogical nature of language, an utterance is never isolated from others, in reality it is always a response to previous utterances. According to Bakhtin (1992) "the utterance is full of echoes and memories of other utterances, to which it is linked within a common sphere of verbal communication" (p. 316). Thus, if we analyze a text written as an utterance, it is constructed from different voices, and its comprehension will occur through the attitude of active response and will depend on the reader's socio-historical context and his or her previous experiences with other utterances. Therefore, different readers may assign different meanings to the same text, as well as elaborate different utterances as response.

The discourse (either oral or written) is constituted by the alterity of voices. Sometimes these voices are so covered with the subject's understanding that it is not possible to identify this vocal encounter delimiting them, for example. In addition to understanding the constitution of written texts, Bakhtin's theory provides support for thinking the voice of the subjects as a personal point of view or perspective, because the subjects are responsive⁴ and at the same time dialog with different voices and are also determined by an extraverbal context.

According to Bubnova (2011), for Bakhtin, personalized voices "represent differentiated ethical and ideological positions in union and continuous exchange with other voices" (p. 270). The voice appears to be subjective, and can be understood in this way, as the unrepeatably response of a subject situated in a unique socio-historical position. However, the subjects are surrounded by several voices that incorporate their voice in a dialogical resonance. In this study, through interviews, the perspectives (voices) of different subjects (teacher and students) on the contributions and difficulties of activities involving reading and writing in Physics classes were analyzed. It is the response of these different subjects to the activities developed in the school context. A deeper understanding of these diverse perspectives is possible when one considers that vocal alternation is part of the process of structuring our interactions (Castro, 2014).

4 For Bakhtin, the subjects are constituted in their relations with the other. The singularity/individuality of the subjects is in the plurality of their experiences, which place them in a single place of response.

Objective

The aim of this research is to analyze the perspectives of different subjects - Physics teacher and high school students - in the school context about the contributions and difficulties of reading and writing practices in Physics classes, in light of the concepts of school culture and culture of the school (Forquin, 1993). It is understood that in this way, it will be possible to expand the results already published in the literature about this issue.

From Bakhtin, one understands the voice of the different subjects about the activities in this school context as their individual responses; therefore, particular perspectives of the individuals that were strengthened, complemented or confronted.

In order to achieve the overall objective, the analyzes were performed in three steps, here entitled A, B and C:

A) To characterize which reading and writing practices are present in these Physics classes, seeking to understand the contributions and difficulties of these practices in the teaching and learning process, according to the teachers' and students' voices;

B) To characterize how teacher and students relate to another way of using⁵ reading and writing texts in Physics classes, seeking to understand the contributions and difficulties of the use of reading and writing in this way, according to the voices of the teacher and students;

C) To analyze how school culture and culture of the school influence the relationship of teacher and students with reading and writing practices in Physics classes.

Methodology

This research is of a qualitative nature, situated in the context of discovery, that is, as characterized by VanderMaren (according to Lessard-Hébert, Goyette and Boutin, 1990), an exploratory inductive process and a formulation of interpretative and prescriptive theories.

The definition of the empirical field had as criterion the approach to a classroom where the teacher had a degree in Physics, acted in the public school system in a permanent teaching position (tenured) - by the stability in the workplace - and with an innovative profile, open to changes.

According to Lessard-Hébert, Goyette and Boutin (1990), one of the means of instrumental validation of qualitative research is the confrontation of data constructed from a triangulation technique, used in this investigation. Therefore, it is sought, from

⁵ The characterization of the presence of reading and writing in the investigated school context (Step A), based on non-participant observation, indicated that reading is used when searching for information, but a more effective work on this practice does not happen. Writing, in turn, is present in notes, evaluations and experimental reports, getting closer to the perspective of a pedagogical communication vehicle (Carvalho & Barbeiro, 2013). In this work, the expression "another way of using" refers to the use of reading and writing in a different way from that previously observed in that context, that is, in the construction, and not just expression or memorization, of knowledge in the Physics discipline.

the same space and events, to build interpretations from different perspectives: from the observer, the teacher and the participating students.

Initially, observations were made during a quarter in three classes of third year of high school, in order to understand how written utterances were present in Physics classes, in a movement of approximation to the culture of the school in relation to reading and writing in those classes, bringing subsidies to build the interpretations related to Stage A. After the first weeks and in agreement with the teacher, a didactic activity was proposed to be developed in the classroom, within the available time, adopting the reading and writing of texts in an unusual way up to then in the classes observed, allowing the building of data to respond to Steps B and C. Such activity was entitled “Development of Electromagnetism”. Finally, at the end of the quarter, semi-structured and individual interviews were conducted with 14 students and the teacher.

In this investigation, interviews with students and the teacher have an essential technical role, since the participant observation technique, used prior to the interviews, provided the data to be confronted to raise new questions and interpretations (Lessard-Hébert, Goyette, & Boutin, 1990). For the qualitative research that starts from the participant observation technique, the interview with the subjects is fundamental and enriches the investigation. According to Lessard-Hébert, Goyette and Boutin (1990), the interview technique enables the researcher, after the participant observation, to “confront their perception of the ‘meaning’ attributed by subjects to the events, to the perception that the subjects themselves express” (p. 160). In the present article, the analyzes are performed on the data constituted through the observation and, above all, the interviews, which reveal the subjects’ perspectives about the object of this investigation.

To enter the empirical field, contacts were made and the research presented to the Physics teacher and to the school’s pedagogical coordinator, obtaining authorization to develop the research in the Physics classes. The research objectives were explained to the students and their participation was free and voluntary. An Informed Consent Form (ICF) was sent to parents and guardians of all students of the three classes so that they could become aware of the research and authorize student participation. Of the 96 students, 44 brought the term with the permission of their parents. Despite of already having the ICF signed by the parents, it was presented a new ICF to the 14 students who were willing to participate in the interviews, for their understanding of the process and personal manifestation of voluntary participation. The participating teacher also signed an ICF to participate in this investigation.

To analyze the interviews, understanding language as essentially dialogical according to Bakhtin (1992), an analytical device proposed by Veneu, Ferraz and Rezende (2015) was used, following the steps: 1) Identification of the utterance (answers to the questions asked by the researcher); 2) Preliminary reading of the utterance (identifying linguistic elements and establishing relations with the Stages and the research objective); 3) Description of the extraverbal context (the common spatial horizon of the interlocutors; the context of the utterance; who the participating subjects are, etc.) and 4) Analysis of

the utterance (articulating the extraverbal context with linguistic elements to respond to the general objective of the investigation). The choice for this analytical device is related to the dialogue (search for coherence) with Bakhtin's theories, in which the analyzes and interpretations are based. The interpretations of the speeches are organized according to the similarities observed in the utterances of these students and the teacher in the interviews.

Elements of the extraverbal context: school's, teacher's and students' profile

The school where the research was conducted is located in the capital of a southern state, in a middle-class neighborhood about six kilometers from the city center - considered not far from the center, given the size of the capital - and offers elementary, high school and vocational education, being recognized in the community for its good physical structure and extracurricular actions/projects.

At the time of this research, the collaborating teacher had had a degree in Physics for 14 years and had been working in the public school system for 12 years. He was first employed as a teacher through the Simplified Selection Process (PSS) and had been working in a permanent position in that school for 11 years. He had completed a specialization course in Applied Technologies for Education, as well as other extension courses. He had participated in the Continuing Education courses offered by the state Department of Education, despite indicating in his speech some criticism of the methodologies used in these courses.

Since he started working at this school, he has been open to supervise interns and research papers from college students, as well as being a supervisor of PIBID (Institutional Program for Teaching Initiation Scholarships). It is a teacher open to new ideas and to dialogue with the university, seeking update and innovation in his classes.

At different times of training (initial and continuing), the teacher had had the opportunity to reflect and discuss the use of reading and writing texts in the school and in Physics classes. He recalled that during undergraduation, he participated in discussions in a discipline of Teaching Methodology of Physics, in which reflections about reading and writing were made, when he focused more on textual production because he had presented a seminar on the topic. He also mentioned discussions not specifically focused on the Physics discipline during continuing education courses at the school. He attended a Symposium in 2006 where participants brought discussions on issues concerning the reading of literary texts related to Science. He also mentioned a recent participation (in the same year when the interview was held) in a PIBID Workshop in which the need for all school subjects to work with reading and writing texts in their classes was discussed.

Regarding the students participating in the interviews, it is noteworthy that they were not previously chosen for having a certain profile. Thus, it favored a diversity, notably in relation to their habits and preferences for reading and writing texts in daily life. Each had their own goals and characteristics, coming from different cultures and

backgrounds. To preserve anonymity they will be indicated throughout this text by the codes A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13 and A14.

Each class had around 30 students, about 90 in total. Fourteen of them were interviewed, having as criteria that the student had participated in any of the classes in which the activities of reading texts from the textbook and writing the letter to a scientist were developed, also that he/she would be willing to participate voluntarily in the interview and that their parents or guardians had signed the consent form. There were five students from class A (A2; A3; A4; A7 and A13); three from class B (A1; A9 and A11); and six from class C (A5; A6; A8; A10; A12 and A14), all between 16 and 18 years old. They all mentioned that they intended to continue studying after high school, in technical courses or undergraduate programs.

Most of them stated that they liked to read (A2; A3; A4; A7; A8; A9; A10; A13 and A14), and some of them mentioned reading as an activity they performed in their free time (A3; A4; A7 ; A8 and A14), which can be interpreted as a greater affinity of these students with reading texts.

Elements that characterize each student will be rescued throughout the analysis of their utterances, bringing their extraverbal context for reflection.

Analyses and results

The analyzes and interpretations will be presented around the three guiding Steps (A, B and C), aiming to reach the general objective of this investigation. In Stage A, the subjects' voices in relation to the reading and writing practices identified in the context of the investigation (culture of the school) are analyzed. In Step B, their voices in relation to the reading practices inserted by the researcher in that context (another way of using reading and writing) are analyzed. In Step C, new elements about the perspectives of the participating subjects are examined and discussed, allowing us to analyze how school culture may influence the way subjects relate to such practices.

Step A: Reading and writing present in the school culture of Physics: contributions and difficulties according to the subjects' voices

Text reading activities in the classroom were not frequently used in the observed classes. The teacher often encouraged students to do prior (non-mandatory) individual searches and readings to discuss concepts later in the classroom. Thus, although reading to learn Physics was not explicitly and intentionally explored, it was a possibility for students as they could and were encouraged to seek information through reading in the after-school context. However, it was up to each of them the initiative and responsibility to search for texts appropriate to their interests, and could opt for other forms of access to information.

Writing activities, in turn, were more prominent in the practices of this context, since the teacher encouraged students to have a notebook to take notes about the contents studied, not allowing copies of solved exercises. During the written evaluations, they

could consult this notebook with their notes, taken during or after class.

The content studied in the two-month period in which this research was conducted was electromagnetism and the teacher chose to work with experiments developed and presented by students as group seminars. The students sought the materials and executed the entire construction of the experiment. The teacher provided scripts for each experiment with indications of explanatory text (non-mandatory reading practice) and YouTube videos, as well as topics from a script/report that should be written by the group (non-mandatory writing practice).

Following, the results and analyses are explained considering these different activities developed in the quarter: (i) individual pre-classes searches and readings, (ii) individual notes in the notebook and (iii) Experimental Activity Presentation: reading the base text and writing the script.

(i) Individual pre-classes searches and readings (non-mandatory)

In the interview, the teacher pointed out as a failure the fact of not encouraging so many moments of reading in his classes, in the sense of not teaching how to interpret the texts of Physics.

Teacher: So there are very few moments when I read with them, I see my mistake at this point, I have to teach a little more how to interpret Physics texts.

For him, the fact that many students have difficulties with the interpretation of texts makes reading a complementary process in learning, since, in the classroom, mediations are necessary for the student to understand the text and the concepts of Physics. The sentence “my mistake at this point” suggests that the teacher, perhaps influenced by what he supposed was the expectation of his interlocutor (the interviewer), recognized that reading practices are necessary, giving his utterance a self-critical intonation about his performance in classroom. Thus, although he recognizes the importance of this kind of practice, it is not usual in his classes.

It is understood that the difficulty of students with the vocabulary/interpretation of the text, which will be examined later, can bring them closer to explanations of these concepts through audiovisual resources. The students interviewed were also questioned about searching other sources of information outside the classroom. There are students (A13, for example) who like reading and yet prefer to watch video lessons on the Internet when have difficulty understanding concepts of the discipline:

Interviewer: Even when you have difficulty understanding?

A13: Oh yes, then I search on the internet, or maybe a video lesson. Usually video lesson. In this case I no longer look for anything written. Unless it's a work, that I have to do some work, then yes.

Only A1 declared not searching for information in the extraclass context. The other students stated that they read about the concepts studied when interested in the topic (A2 and A5); when they have difficulty understanding (A3, A6, A10, A11, A13 and

A14) or when they need to study for a test (A4, A12, A7, A8 and A9).

None of the students mentioned reading and searching for information on their textbooks at home⁶. When they feel the need, they generally use the internet. Most of the students interviewed perform these searches for information not because of their interest in the subject, but especially when they feel difficulties or need to understand better some subject for a school evaluation.

Thus, these data show that individual readings and searches can help students access more information (when interested in the subject) and better understand the contents studied in class (when they have difficulties or there will be evaluation). The difficulties mentioned refer to the interpretation of texts by students who, in some cases, prefer to obtain audio and video information to written texts.

(ii) Writing in individual notes made in the notebook

Regarding writing in individual notes made in the notebook, in the teacher's voice, the students who prepared the notebook generally did not need to consult it, because the act of writing is a way to study and understand the content:

Teacher: So I ask them, in the notebook, to also write down what that formula is, what each letter of the formula means, which unit it uses. So when the student really does all this, there are students who come at the end of the test and say: Teacher, I put it all in the notebook and I didn't even use the notebook. So they begin to realize that the fact that they write in the notebook, they are already studying and not memorizing for the test. They are remembering what that is.

In this excerpt, the teacher incorporated the students' indirect speech that was submitted to his voice, seeking to strengthen his argument. In his opinion, by allowing the use of the notebook during the evaluation, it would be possible to evaluate the students' reasoning and not if they memorized information, as this would be unnecessary since the student could consult the information if it had been previously written in the notebook. This dimension of the importance of the written record to study the subject later and prepare for tests is also evidenced by Paula and Talim (2015).

Considering writing as a complex act of thought organization (Vygotsky, 2008), notebook writing can be understood as an important moment of reflection on what is important to take note and the content itself, and structuring of thought in relation to concepts studied because the student needs to understand what they are writing and to create supports for their reading later.

When asked in the interview about feeling the need to write and outline concepts in the notebook even without the teacher's request, most students (A1; A3; A4; A5; A7; A13; A8; A9; A14) stated that they took notes. According to the utterances of some of them, writing down contributed in different ways: it helps to pay attention in class and

⁶ Although not an objective of this text, it is important mentioning that this is a result worth reflecting upon; mainly considering that there is a large funding from the federal government in programs such as the National Textbook Program (PNLD - Programa Nacional do Livro Didático in Portuguese).

to memorize the information (see utterance of A8, for example), which corroborates, to some extent, the appropriation made by the teacher of the students' speech, in the previous passage.

A8: Yes. Because ... I, the test, even to pay attention, I have to have some focus and when I'm taking notes it requires attention. And taking notes also helps a lot later, because even if the teacher explains and I understand at the time, later I will never remember the way he said it or the way he explained it. So I always try to take notes. [...] So it's great because sometimes you write it down and you don't even remember that later and on the test you can use this notebook. So ... you see the notes and it is much clearer, much easier for you to remember the topics seen in class.

A13: It's for Physics and all subjects, I think. You speak there and I, you, writing down what the teacher says helps you remember later the class given, you may not need to make more effort there, to be researching something.

A14: Because it helps me. Because then I do not forget, I have to memorize things by writing down because if I do not I will forget that, so I have to write down, otherwise...

In the writing of the notebook, the notes were made because they could assist the student in the test, as exemplified in the lines of students A8, A13 and A14. This is because, in their perspective, writing down helped them memorize the content.

In these voices, there is a potentiality, but also a certain limitation, for not conceiving writing as an intellectual activity (Vygotsky, 2008). More than memorizing content, thought exists mainly through words (Vygotsky, 2008), writing may require becoming aware of the act of thinking itself, so that writing can be conceived as a process of reflection, organization and structuring of thought, rather than a simple mechanical act of writing letters or words, to memorize contents.

Student A12, in one of his utterances during the interview, pointed out a difficulty in relation to the "free" writing in the notebook, from the teacher's explanations. This student's utterance also brings elements for reflection on school culture:

A12: So I think the teacher should like... I don't know ... write more on the board like, content like more explained by means of concept, I think that would be better, than we researching or he talking and we writing. Because I can't pay attention to him talking when I have to write at the same time.

A12's speech also shows the individuality of each student. If for some students writing in the notebook helps to pay attention in class, for A12 both actions simultaneously hinder his concentration (also confronting the positive perspective presented by the teacher). His expressions "write more on the board" and "more explained by means of concept" can be interpreted as criticism of the methodology adopted by the teacher who did not contemplate this kind of practice. Usually the discussions proposed by the teacher in the classroom took place without systematization on the blackboard. On the one hand, these systematizations/conceptual definitions demanded by A12 may be important in the movement of approximation of spontaneous and scientific concepts (Vygotsky, 2008), but on the other hand, they may portray practices strongly

present in the school culture (which without proper care may be limited to mechanical reproduction).

Thus, in the students' view, the contributions of the practice of writing in a notebook were to keep the attention in the explanations, to memorize information and to study/understand the content. The difficulties appeared due to limited views on the role of writing (based on the memorization of contents) and school culture, since some students felt the need for the teacher to write on the blackboard the contents to be copied in the notebook.

(iii) Experimental Activity Presentation: reading the base text and writing the script

Regarding the reading of the base text recommended by the teacher for the development of the experimental activity, in the interview the students were asked if they had done such reading. Most students stated that they did not access the links indicated by the teacher, but made searches on the Internet, using Google search tool to find information on websites in texts, images or videos. Only three of the students interviewed (A3, A7 and A8) stated that they had read the recommended text, but also sought information from other sources because they had difficulties interpreting the text:

A7: I searched. Because I couldn't do it, so I had to research.

A8: I read. I didn't understand very well, but I read.

Interviewer: Why did you not understand very well?

A8: Because I found it a bit confusing. Like, Physics reading for me is not a reading that I will understand, because I find it a bit confusing, but it helped in the explanation because when I had to explain to the teacher, from what I had read, I was able to convey some things. But for me, the video made it much clearer. [...] I searched other websites, other ways to explain also, easier, simpler, a summary. And then I got it, it was more the part of presenting.

Student A8 expressed, more clearly, difficulties in reading texts related to Physics, which led him to seek information from other sources and other support, in this case the video. Considering the extraverbal context, A8 has affinity with reading, even in his spare time, and yet he said: "it is not a reading that I will understand" or "I find it a bit confusing". In "it is not a reading that I will understand", it can be interpreted that this is not a problem of this specific text, but of texts of the area, that is, if other texts of Physics are proposed, he will have difficulties as well. Authors such as Almeida, Silva and Babichak (1999) and Silva (2013) show that students have difficulties in producing meanings for reading in Physics classes, which are also related to not understanding concepts. At the same time, this student says that reading the text indicated by the teacher and a summary helped him in the presentation, indicating that the written text

may have helped him since it is an easy-to-check material in his oral presentation of the experiment to the classmates.

According to the reports of other students, reading texts, not necessarily those indicated by the teacher, was the main source of information to help understanding the experiments. In the interview, the teacher confirmed that some students went beyond what was requested (as evidenced in the students' speech), seeking several readings to perform the activity.

Teacher: Although I gave them reference and everything, I saw people who went beyond, who looked for other references. And there were students who sought other references because did not understand what I had given [...] The students really cared about learning, understanding what was happening there.

In this case, the indirect incorporation of students' speech in the teacher's voice may lead to the interpretation that the search for other references by some students ("there were students who") was due to the students' interest in the activity developed. The previous utterances of the students show that, in some cases, as the teacher also points out in his speech, the search was due to the difficulty of understanding the concepts through a specific source (the written text recommended by the teacher), but, in fact, most students endeavored to find different means of information. These data also highlight certain changes in the way students relate to school activities, due to the easy access to information through the internet.

In summary, the contribution of reading the base text indicated by the teacher for the development of the experimental activity was to assist in the presentation of the experiments to the class. However, it is noteworthy that only three of the students interviewed had read the recommended text, with interpretation difficulties. Therefore, once again, students' difficulties in interpreting texts and their preference for obtaining information through internet searches, audio and video were emphasized.

Regarding the writing of the experimental script for the presentation of the seminars on electromagnetism experiments, although it was not mandatory, many students chose to do it. Of the students interviewed most (A3, A4, A5, A8, A9, A11, A13 and A14) wrote the script for the presentation. Students who did not write the script explained that they did not feel the need to organize ideas because the experiment was simple.

These students' report indicates that, for them, writing the script was important for several reasons: it helps to understand and organize the ideas (A2, A9, and A14), as a "step by step" of what should be done (A4, A8, A11 and A13), or for the teacher to evaluate the activity (A5). Thus, the students attributed different meanings to the writing of the experimental script.

In the students' utterances about the experimental script, there are elements for discussion about the influence of culture of the school on their perspectives.

A4: It was, because like, with those more straightforward questions, you end up understanding much more the topic.

A5: Yes, because the teacher needs to evaluate what we've understood. Because it's not just coming up with the experiment there and talking about what you saw in the video, you need to look for something more about it...

Student A5, for example, in an extraverbal context analysis, indicated that he did not have the habit of reading and taking notes in Physics classes, but considered the script important because the teacher needed to evaluate the activity somehow. It seems that this student conceived the experimental script as a practice belonging and necessary to the fulfillment of school norms, but not as a process that would help their learning, that is a view of writing similar to a pedagogical communication vehicle (Carvalho, & Barbeiro, 2013). In school practices of Physics, the experimental script in conjunction with this type of activity can be considered a traditional practice, making students understand it as something relevant in this discipline. This student also mentions the use of the video to perform the activity ("talking about what you saw in the video"), and not the recommended written text. Regarding A4's speech, the expression "with those more straightforward questions" also refers to the existence of a culture (Forquin, 1993) of school activities, which will be examined later in the discussion of Step C.

The other students, who considered the writing of the script important, somehow relate this practice to their learning as a guide for the presentation or for allowing the organization and understanding about the work. It is possible to interpret that the script made it possible to guide the student's perception and the writing process made it possible to systematize and organize the various information (Vygotsky, 2008) they had found.

Thus, script writing contributed to understanding and organizing the ideas, a guide for oral presentation, to express knowledge and for the teacher to evaluate the activity. The difficulties mentioned were not feeling the need for writing and the limited view on the purpose of writing (the need for guiding/model questions to be followed), a limitation that seems to be related to the School Culture regarding the practices in the discipline of Physics.-

Step B: Reading and writing texts in another way: Contributions, difficulties and relationships of subjects with them

Seeking another way to use reading and writing in the classroom, interfering in that culture initially observed, an activity entitled "Electromagnetism Development" was proposed to the teacher. It was developed by researcher and teacher jointly and put in practice by the teacher in the classes after students' presentations of the experiments.

A first outline of the activity was proposed by the researcher, who offered it to the teacher to make changes, if desired. The activity was conceived to compose in an organic and articulated way the list of activities developed so far in that topic (electromagnetism). Regarding the reading of texts, the objective was to encourage students to establish relationships beyond the search for information (Giraldi, 2003 mentioned in Flôr, & Cassiani, 2011, p.74). Writing, besides copying or answering questions, was proposed as

a means for students' personal expression about the concepts studied.

In pedagogical terms, the aim was that these activities would help in the (re) construction of knowledge by students, as another means of operation with such knowledge within the zone of proximal development (Vygotsky, 2014). In terms of research, it was sought to create a context that would allow the analysis of how students would relate to this other way of using reading and writing in Physics classes

The activity was developed in two classes. In the first one, it happened the reading of two texts that dealt with historical aspects of electromagnetism. Some questions were proposed to the students, whose answers were not explicit in the texts, but occurred from reflections on them. The texts were taken from the Physics textbook adopted at the school, as it was a resource to which all students had access, its use had not been observed in the classroom, however. The texts referred to the history of electromagnetism, addressing experiments developed by scientists such as William Gilbert, Hans Christian Oersted, Michael Faraday, André-Marie Ampère, among others. Some of these experiments had been previously discussed in class at the seminars presented by the students. Thus, the texts could allow the deepening of discussions already held, providing a more general view on the construction of knowledge of Electromagnetism over time, from the contribution of several scientists at different times.

The second class was based on writing a letter to William Gilbert, encouraging the textual production of students in a freer way, i.e., without the need to copy concepts, but to write bringing out their subjectivity, according to their understanding.

Following, the results of the application of this activity are presented, highlighting the analysis of the subjects' voices and relationships with (i) reading texts from the textbook and (ii) writing the letter to William Gilbert.

(i) Reading texts from the textbook

Regarding this activity, it was observed that given the possibility of altering the initial outline of the activity proposed by the researcher, the teacher made suggestions considering his perceptions about his workspace, which came from his repertoire of experiences. He suggested, for example, that instead of the three texts originally proposed by the researcher, they should read only two texts - the two that dealt with historical aspects - besides the reformulation of some questions. According to him, many students have difficulty concentrating, losing interest in reading long texts, for example. Thus, reading in Physics classes would not always be motivation for learning. In fact, four students (A1, A5, A6 and A11) stated in the interviews that they did not like reading due to lack of patience and attention, aspects pointed out and considered in the teacher's suggestions.

However, the discouragement of the student may be related not only to the length of the text. As pointed out by Almeida and Mozena (2000), the way reading is worked can increase student's aversion to this practice and even to science. Silva (1997) also points out that it is necessary to think about how to make students want to understand

the texts and read about Physics, that is, how to make reading in Physics no longer a “compulsory reading” in school, but reading for pleasure (Geraldi, 2003 mentioned in Flôr, & Cassiani, 2011, p.74).

In the interview, the teacher stated that he liked the texts used in the activity because they provided a complement to what was being discussed in the classroom. According to him, with such texts the students were able to understand the historical part about the experiments previously discussed.

Teacher: [...] Mainly the historical part, which I find very interesting. And that the students can, or could, at least those who came to give me feedback, understand very well what was really going on in the phenomena there.

Although any proposed activities involving classroom text reading were not observed in that context, the teacher mentioned that he found the historical aspect of knowledge interesting (“I find very interesting”), which may have influenced his positive view of the reading activity. According to the teacher, for students, in the context of application of the activity, it seemed to make sense to read the text at that time.

From Bakhtin’s theory of the dialogical nature of language, reading a written text can be understood as an active and responsive dialogue with an utterance. The text is not enclosed in itself and its meaning is constructed by the interactive process between reader and utterance. Jobim and Souza (2008) explain that understanding an utterance requires “the interlocutor to find the place of that utterance in the context of its previous meanings” (p. 108). Hence, the importance of considering the context and previous utterances with which the reader had contact, to reflect on the different meanings attributed to the utterances. The proposal of reading two texts was made in a context of activities on the subject of electromagnetism, and the way the student interacted with the various utterances of previous classes (activities, experiments, videos, schemes, discussions, among others) may also have influenced the meanings they built for reading about the topic (Bakhtin, 1992).

In the interview, the students were asked about reading these texts during the proposed classroom activity. Two of them (A2 and A13) missed this class. Of the remaining twelve, six (A4, A6, A7, A9, A10 and A12) said they enjoyed this activity. The reasons they gave were that it adds new information (A4 and A7), the text is clear (A6) and the interest in the history of science (A9, A10 and A12). It is possible to see, for example, in the speech of student A9:

A9: I liked it because I like History a lot too. So he linked things that happened in the past, how they happened and such. This area of Physics is very cool to me.

Six other students (A1, A3, A5, A8, A11 and A14) did not like the texts and the reasons mentioned were lack of interest (A14), the text is not clear (A1 and A3), does not like to read (A11) and a certain lack of interest in the history of science (A5 and A8).

A5: I don’t really like to learn about scientist stories, but ... (pause) I just remember I did an activity which, I remember it had, I think five questions or more.

Such utterances show some contrast in the classroom due to the diversity of interests and meanings that the students attributed to the activity.

By analyzing the elements of the extraverbal context, considering students' profile and utterances in the interviews, it is clear that the identification of the student with the reading or thematic of the text influence the development of this type of activity in the classroom. While for some the fact that the text deals with the history of science is attractive to reading, for others it is a reason for disinterest.

Student A12, for example, said he did not like reading but had an interest in History. His father is a teacher of this discipline, and this may have made him enjoy reading the proposed texts. A similar case occurred with student A6, who said he had no affinity for reading but found the activity interesting. Other students (A4, A7, A9 and A10) liked reading and liked the texts. Thus, considering that the schooling process also inserts the student in a new culture, working with reading can motivate and arouse new interests for students.

Student A11, in turn, did not have the habit of reading and stated that he did not like the texts precisely because of his lack of interest in reading. In other cases (A3, A8 and A14), the student liked reading, but did not like the proposed texts.

Student A7, although saying he liked the activity, he considered that if the questions proposed after reading the textbook texts were more focused on the text, perhaps the students would pay attention to the information and learn it:

Interviewer: You did not see much relation...

A7: Yeah ... that's it, there could be more questions even if they were more silly, but for us to take the text and read and write to learn and read well. I think this is what I would change.

Perhaps because this type of activity - questions with answers focused on explicit information from the text - is common in school, people may have the perception that this is how one learns a certain topic, by repeating information considered important.

As pointed out earlier, for the functioning of this type of practice, it is important to have a context sufficient of meaning that allows students to dialogue with the text (Bakhtin, 1992). This context can be created by the teacher. In the development of the activity, the reading was performed individually, without interference, questioning, etc. by the teacher. However, as Assis and Teixeira (2005) points out, in addition to the use of potentially significant texts for learning, teacher mediation, adopting a dialogical posture with students, can arouse interest and motivation regarding reading.

The development of this activity, being a different situation in those classes, can bring some insecurity to the students and the teacher, because it alters the space of the class. Authors such as Assis and Carvalho (2008) point out that, often, in the face of this insecurity, the teacher does not enable necessary articulations and starts to adopt a non-dialogical posture. Chaves, Mezzomo and Terrazan (2001) also point out that the teacher's lack of familiarity with readings related to the type of text used hinders his

acting as a mediator.

The teacher emphasizes in one of his utterances that to work with reading and writing in teaching requires a solid training in the conceptual part of Physics, because students can be motivated by these practices to question concepts.

Teacher: An activity like the one we applied to the students, the great difficulty is that the teacher has to have A LOT of mastery of everything. Of the historical part, the conceptual part and this we also notice that there is a failure in the teachers. Both the teacher who has just graduated and the teacher who is retiring. We hardly see a teacher who can really come 110% prepared to the classroom. You must have talked to the students; their complaint is that there are teachers who do not let the student ask questions in the classroom. They have doubts, but when they will ask something the teacher is rude to them. Tell them to be quiet. And their difficulty is also in being able to answer the students' questions.

According to the teacher, despite the speech, many teachers have difficulties to develop different activities in their classes. Although he had participated in some moments of training on reading and writing, he reflected that he still had difficulties to conceive activities of this kind. Another aspect that draws attention to this utterance is the teacher's education for the different aspects of the specific subject. The teacher's speech leads to the interpretation that the proposed activity, exploring other aspects of Electromagnetism, may raise doubts and questions from the students, doubts that teachers may not be prepared to answer. It seems that the more traditional approach to knowledge can avoid these different sense assignments by students. In this specific case, the teacher mentions difficulties attributed to other teachers (in the third person), without including himself in his speech.

Thus, for the teacher and the students, the contributions of the insertion of this textbook reading practice were complementing content discussions, broadening the view and understanding of the concepts (History and Philosophy of Science) and arousing new interests in reading or in the thematic of the text. The difficulties identified were the interpretation of texts and concentration, lack of interest in reading or in the topic of the text, lack of space for dialogue/mediation in the classroom, school culture and teacher training (insecurity due to content diversity).

(ii) Writing a letter to William Gilbert

Regarding this activity, it is initially emphasized that the main objective was not to teach the genre of letter and no writing models were offered. Through this production - which could take different forms according to the creativity of each student - it was sought to motivate the expression and systematization/reconstruction of the students' ideas about the discussions and readings carried out during the quarter.

The specific analysis of the letters produced by the students, based on Bakhtin (1992) and Vygotsky (2008), was published by Setlik and Higa (2017). Although such analysis is not the focus of the present article, some results are briefly highlighted: some

students' difficulties in writing about Physics were highlighted and scientific concepts did not appear or appeared vaguely in their writings. In the letters produced, it was also observed that four students (A4, A8, A9 and A10) seemed to use writing for personal expression taking different voices for themselves (Bakhtin, 1992), without full copies of information from other sources. They reported in the interview that the activity provided them with new reflections on the content.

Asked whether they liked the activity or not, those who liked it said:

A4: [...] A different class because we don't always do these things and ... it was cool, I really liked it.

A8: Oh, I liked it. Really enjoyed. As I said, writing is something I like. [...].

A9: I found it a very new experience for a Physics class. I found it something innovative. Because I thought ... at least from what I studied in other courses and all ... nothing like that, I thought it was a good idea.

A10: I thought it was cool, because ... we idealize a moment like that, even if not possible, we can talk to someone who was important in the past, [...] it was very interesting from my point of view.

The subjectivity of each student, with their previous experiences, influences the relationship they establish with the letter writing activity. While student A8, because he likes to write, identified with the activity, others like Philosophy (students A4 and A9) or History (student A10), and for them the possibility to communicate with a scientist from the past, or questioning/reflecting on the future, made the activity attractive and meaningful.

Some students (A6 and A14, for example) experienced difficulty in writing, saw no meaning in the activity, and no contributions to their learning. The absence of a real interlocutor other than the teacher may have, in these cases, influenced this perspective, as it can be seen from A6's voice:

A6: [...] If the guy was a writer, was alive, and we were going to write to actually deliver the letter, then I think I would be excited, would have a greater interest, but in this case I do not.

The main difficulty highlighted by the teacher in using reading and writing texts in the classroom was the lack of time, both for the preparation of the activity - selection and elaboration of the material that will be used - and for the application in the classroom.

Teacher: Negative points, which I can sometimes use as excuse too, is the lack of time. It is the time in the classroom and the preparation time of the activity. Because it's not just like that: "Oh, I liked it". Read the first sentence of a story and tell it to students. No. You have to read. You have to interpret. And sometimes I use that too, saying "Oh, I have no time to do anything different for the students". But then you get home and stay there, watching television, or here at school you spend most of your time talking, instead of really making use of it. [...] So a negative point is this, which is not even a negative point,

it is because we as teachers end up giving the excuse of lack of time.

First, the teacher stated that lack of time is a difficulty, but then he said, in a self-critical tone, that it could be an excuse. It must be considered that the teacher was expressing himself in the context of an interview and that this may have influenced the way he expressed his thinking.

Thus, the inclusion of writing of this genre in this context contributed for the students to imagine new possibilities, problematize/reflect on the future, express their understanding and as a new way of operating with knowledge (within the ZDP). The difficulties mentioned were lack of interest and difficulty with writing related to Physics concepts, absence of a real interlocutor (besides the teacher), school culture and conditions to prepare and apply the activity (time).

Step C: School Culture and Culture of the School in the relationship of teacher and students with reading and writing practices in Physics classes

From Bakhtin and Vygotsky, it is understood that the experience in a space of education makes the subjects have a certain perception about the world, and therefore also about the school and its practices. In the speeches of the subjects in the interviews, there is a dialogical resonance of their personal experiences, inside and outside the school environment. Thus, school culture also influences the perception of these individuals about the practices inserted in this space. This has already been highlighted in students' utterances about the activities presented before, and here the argument about this aspect with other elements identified in the analyses is reinforced.

From the research data, it was possible to evidence that there is a conception that working reading and writing is the exclusive task of the Portuguese Language teacher. This was, for example, the teacher's conception of reading texts until participating in a training moment on this issue:

Teacher: I assumed it for a while. I assumed that, not text production, but reading to me was the responsibility of the Portuguese teacher. Then I had a reading workshop this year that completely changed my thinking. [...] The reading of the Physics questions, the Physics texts, has to be done by the Physics teacher [...].

The teacher had a conception coming from his experiences as a student of Physics in high school and college. He stressed that “not text production, but reading” was, in his view, the responsibility of the Portuguese teacher. The contact with another discourse, at a training moment in a workshop and through his participation in this research, led him to a change of perception about reading in the discipline: “the reading of the Physics questions, the Physics texts, has to be done by the Physics teacher”.

He also mentioned that many students had the resistance to accept changes in traditional classes, as they were already conditioned to a certain type of class - and reading and writing texts may not be part of this “model of class” instituted as pertinent in the Physics discipline.

Teacher: [...] speaking about methodology, there are many students who are very traditional, and need the teacher to write on the board. They think reading is in Portuguese classes.

This conception was brought by some students in the interviews, such as A14:

Interviewer: If you were a Physics teacher, would you use reading and writing texts to teach?

A14: I don't think so, because there is already another teacher doing it, I think it's important reading and all, because I like reading, but I don't think so, I think in my class I would leave it to another teacher.

In the utterance above, the student emphasized that he thought it was important and liked to read, but would not use this practice if he was a Physics teacher, "would leave it to another teacher", "because there is already another teacher doing it". From this utterance, it is interpreted that, for A14, reading and writing texts is not a practice that belongs to Physics classes, that is, as the teacher indicated, "there are many students [...] who think that reading is in Portuguese classes". Analyzing the extraverbal context of A14, it is noteworthy that he is interested in continuing to study in the Exact Science Area, so he prefers "calculations" in Physics classes.

Thus, it is clear that, from their experiences in the school culture, the students themselves have a conception of what is or should be a Physics class, and what are considered pertinent school activities in each subject.

From students' interviews there seems to have been greater acceptance of the activity of reading texts and questions to be answered, rather than writing the letter to a scientist of the past. According to Bakhtin (1992), mastery of a discursive genre requires experiencing the utterances in a given sphere of communication. Students use certain types of utterances in Physics classes - which are part of the practices from the school culture (Forquin, 1993) - and the inclusion of new ones, such as reading texts or writing a letter, expressing their own relationships of sense, can create difficulties due to their lack of experience with this genre (Bakhtin, 1992). Alternatively, the view that this type of activity fits into the practices of other disciplines rather than Physics may be an obstacle to assign meanings to it.

In a general analysis of writing, it is clear that students had a positive view about the writing of the experimental script (usual genre in experimental practices, it can be considered belonging to the school culture in this discipline), giving greater meaning to such practice for the learning process. The experimental script is a more frequent discursive genre in this subject's classes, also giving the student a greater property to operate with knowledge through it. Regarding the writing of the letter, although some students liked it and got involved with the activity, the results indicate that there was a greater resistance to this activity. Physics classes have a repertoire of discourse genres used in the teaching-learning process, and perhaps the writing of a letter is not part of this repertoire, mainly due to the characteristic of systematization of contents in the

culture of this discipline, through mathematical language. Brait and Pistori (2012) point out that genres are always linked to a tradition, and are in constant transformation. The school has a certain tradition in the different school subjects, that is, a culture that often leads teachers and students to privilege certain types of utterances in the context of each subject, composing a usual repertoire, which can be modified. However, the insertion of a different genre in this space may cause, on the first contact, some strangeness and difficulty in using it.

Summary: Reading and Writing - Contributions and Difficulties

In the previous items, by reducing and analyzing the empirical data, it was possible to highlight contributions and difficulties in the use of the different utterances written in the investigated context.

In Figure 1, such contributions and difficulties are summarized and systematized:

Types of Utterance	Practices of Reading and writing	Contributions	Difficulties
Usual and already present in the context investigated	Reading (optional) in individual pre-class searches	Search for more information about the topic Better understanding of contents studied in class	Students' interpretation of texts Preference for obtaining information through audio and video
	Writing in the notebook	Keep attention on explanations Memorize information Study/understand content	Limited view of the writing role School Culture (some students want the teacher to write the concepts on the blackboard to be copied in the notebook)
	Base text reading to develop the experimental activity	Understand experiments	Students' interpretation of texts Preferences for obtaining information through audio and video
	Experimental script writing	Understand and organize ideas Express knowledge Guide the presentation or oral explanation of experiments For the teacher, evaluate students' performance in the activity	View that writing is not necessary Limited view on the writing role (need for guidance with specific/model questions to be followed)

Figure 1. Reading and writing: Contributions and difficulties

Types of Utterance	Practices of Reading and writing	Contributions	Difficulties
Not usual in the context investigated	Reading of texts about history of Electromagnetism taken from the textbook	<p>Supplementary information and discussions</p> <p>Expanding the understanding about concepts (History and Philosophy of Science/ thematic of the text)</p> <p>Arouse new interests for students, related to reading or thematic of the text</p>	<p>Students' interpretation of texts</p> <p>Students' lack of concentration</p> <p>Lack of interest in reading or thematic of the text</p> <p>Lack of classroom dialogue/ mediation</p> <p>Teacher training (insecurity due to content diversity)</p> <p>School Culture (students miss more specific questions, focused on the text – information seeking; reading should be worked in another discipline)</p> <p>Conditions for the teacher to prepare and apply the activity</p>
	Writing of a letter to William Gilbert	<p>Imagine new possibilities</p> <p>Problematize/reflect about the future</p> <p>Express your understanding</p> <p>New way to operate knowledge</p>	<p>Difficulty and lack of interest in writing related to Physics concepts</p> <p>Inexperience with the genre</p> <p>No real interlocutor other than the teacher</p> <p>School Culture (ease with experimental script and difficulty in the “freer” writing of the letter; some do not see meaning in the activity proposed)</p> <p>Conditions for the teacher to prepare and apply the activity (lack of time)</p>

Figure 1. Reading and writing: Contributions and difficulties

It is noticed that the researcher's intervention in the context, proposing an unusual way of written utterances in the classes, allowed to perform analyzes in light of the concept of school culture and culture of the school (Forquin, 1993), expanding knowledge about the contributions, possibilities and difficulties in writing and reading

texts in Physics classes, already published in the literature of the area.

Seeking to identify the nature of the difficulties identified by the students and the teacher, Figure 2 was constructed. The columns present difficulties related to students and difficulties related to other aspects, since studies have shown that there is a tendency to attribute to students failure of this type of activity (Amaral, 2010; Andrade, & Martins, 2006). In this investigation, it was also possible to identify other general aspects that hinder the adoption of these practices.

Practices	Nature of difficulties	
	Related to Students	Related to other aspects
Reading	Interpretation of texts	School Culture and culture of the school (lack of familiarity with different practices and other genres of discourse in Physics) Teacher Training (insecurity due to the content diversity, which can influence the lack of discussion/dialogue in the classroom)
	Lack of interest in the thematic of the text	
	Preference for other means of access to the same content (video and audio)	
	Lack of interest in reading	
Writing	Structuring of texts	Poor teaching conditions to prepare the activity (lack of time)
	Lack of interest and motivation in writing	

Figure 2. Reading and writing: The nature of difficulties

The scarce time to plan (precarious working conditions) and develop reading and writing activities is mentioned by the teacher in the interview as the main difficulty and influence the development of all activities discussed in Figure 1.

On the one hand, it highlights important elements to be considered if any change in teaching practices is desired: the precarious working conditions of Basic Education teachers (which hinder planning of unusual activities). On the other hand, considering that, in view of these difficulties, teachers generally choose to continue developing activities that are already traditionally incorporated and considered important in the school culture in this discipline. This also shows how important the established school culture is in the selection of ways of teaching (and hence, suggesting to students the valued ways of learning in the subject).

Figure 2 shows that the difficulties related/attributed to students may be due to the non-use and encouragement of these practices in the context of the discipline. Thus, elements that are often suggested as difficulties could be taken as an indication of the need to adopt this kind of activity in Physics learning more systematically, since Vygotsky (2008) and Bakhtin (1992) emphasize the importance of the experience to learning concepts and mastery of different forms of utterances.

Conclusions and Implications

This research aimed to analyze the perspectives of different subjects - teacher and students from a school context -, about the contributions and difficulties of reading and

writing practices in Physics classes, with reflections in light of the concepts of school culture and culture of the school (Forquin, 1993).

Analyses of the empirical research data show that the students' involvement and the meanings attributed to the activities are related to their cultural characteristics (Forquin, 1993), that is, their profile and interest in reading or writing, or in the thematic of the activity. The contributions from the activities developed during the research, for example, are not positive for all students; there are nuances, individualities, expressed in the voices of the subjects interviewed (Bakhtin, 1992). From the synthesized results in Figures 1 and 2, one can reflect on some relationships that are highlighted.

In the usual ways of using reading and writing in the investigated context, reading (either in individual searches or for the development of the experimental activity) contributed favoring a better understanding of the knowledge, while resulting in difficulties of interpretation of texts by the students.

In the voices of the participating subjects, it seems that, in general, the texts, because they are written, have limitations as to their potentiality for student's learning, that is, the texts help in the learning of Physics when associated with another type of contact of the student with knowledge (audio, video or dialogue with the teacher). When there is a context of greater significance, it seems that it becomes possible for the student to establish meanings for the written text.

In turn, the writing in the notebook is seen as positive by the students regarding the memorization of knowledge. Regarding the experimental script (not mandatory) there also seems to be a positive view associated with School Culture (as a step-by-step activity - schoolwork - and as an instrument for the teacher to evaluate).

The alternative reading and writing practices proposed in the context of this investigation - the reading of textbook texts involving historical elements and the writing of the letter -, brought new aspects about the knowledge of Electromagnetism that were being studied in that quarter. The activity was significant within a larger learning context of that knowledge; among the exercises, problems, scripts and experimental reports it was possible to develop new ways of working reading and writing that allowed other possibilities to reflect and build knowledge in Physics. However, for both reading and writing activities, the difficulties were mentioned in greater numbers (Figure 1).

Figure 2, specific about the difficulties, shows that some are related (or attributed) to students, due to difficulties in vocabulary, interpretation and structuring of texts. This has already been pointed out by several studies (Almeida, Silva, & Babichak, 1999; Amaral, 2010; Andrade, & Martins, 2006). Understanding that interpretation and writing are not natural gifts (Vygotsky, 2008), but need to be developed through formal education, the difficulties related to (or attributed to) students may be due to the non-encouragement of the use of these practices in classes or to the way they are used.

This study advances by pointing out difficulties related to other aspects (besides students), with emphasis on teacher training and School Culture (Figure 2). The voice of the teacher participating in this research has dialogic resonances of moments of training

that seem to have been significant in his view about this type of activity, however he still points out a difficulty that is the teacher training in general related to the specific knowledge of the subjects (mastering the different aspects of knowledge to propose activities that generate questions coming from students).

Regarding School Culture, from the literature review that focus on more specific issues and activities involving reading (Almeida, Silva, & Machado, 2001; Assis, & Teixeira, 2005; Pagliarini, & Almeida, 2014; Silva, 2013) or writing (Charret, & Krapas, 2008; Paula, & Talim, 2015), and others who point out teachers' difficulties with this type of activity (Andrade, & Martins, 2006; Assis, & Carvalho, 2008), it was sought to insert activities involving reading and writing, in the context of a quarter, activities integrated to the usual work of a teacher, starting from Steps A and B. This way, it was possible to build the reflections on School Culture in the Stage C of this study. This perspective and analysis allowed us to expand the results already reported in the literature, emphasizing the influence of School Culture in the development of this type of activity, in order to be able to configure the perspectives of teachers and students on school practices in the discipline of Physics.

This study was developed in a class of the last quarter of the third year of high school, a context in which the influence of school culture can become even more significant. The specific school culture of the third year of high school (extraverbal context), also affected by the proximity of assessments such as the National High School Exam (ENEM) and/or college entrance exams - although not explicitly mentioned in the voices of the teacher or students interviewed - may have influenced the results of this study. This is because there are traditional practices recognized as important in learning such a subject, also valued in these assessments outside the classroom and with significant impact on the lives of some students.

Thus, practices such as reading and writing texts, emphasizing other aspects about knowledge, may mean difficulties in the perspectives of the subjects, which may decrease their potential to favor learning. Thus, the adoption of reading and writing as a significant pedagogical means to teach and learn Physics at school requires, in addition to thinking about the context of teaching and learning and how to integrate them organically into the discipline, to take into account that we are dealing with a school culture and culture of the school issue.

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Joselaine Setlik

 <https://orcid.org/0000-0003-3242-2550>

Universidade Federal de Santa Catarina
Programa de Pós-Graduação em Educação Científica e Tecnológica
Florianópolis, Santa Catarina, Brazil
joselaine.setlik@posgrad.ufsc.br

Ivanilda Higa

 <https://orcid.org/0000-0002-7277-3198>

Universidade Federal do Paraná
Setor de Educação, Departamento de Teoria e Prática de Ensino
Programa de Pós-Graduação em Educação
Curitiba, Paraná, Brazil
ivanilda@ufpr.br

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