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Scientific communication in Brazil: the relevance of Mikhail Bakhtin

Comunicação científica no Brasil: a relevância de Mikhail Bakhtin

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Abstract: Historical-social psychology has great relevance in different areas of knowledge, including discourses involving Scientific Communication (SC). In this sense, this paper made a literature review about the publications on SC relate to the process of Scientific Education (SE) that used Bakhtin as a theoretical reference, in order to show the author's relevance to the area of Popularization of Science and Technology (PS) in Brazil. This is because it is understood that the SC process is rooted in ideologies and interests in its discourse. Thereby, this papers will be presented, briefly, in chronological (and alphabetical order within the same year) of publication. It can be said that Bakhtin has great importance in the discussions for the construction of a more critical society in relation to SC and SE practices, which in turn are directly related to the processes of PS.

Keywords: Bakhtin; scientific communication; science education; popularization of science and technology; Brazil.

Resumo: A psicologia histórico-social tem grande relevância em diversas áreas do conhecimento, inclusive nos discursos que envolvem a Comunicação Científica. Nesse sentido, este artigo revisou as publicações sobre Comunicação Científica que utilizaram Bakhtin como referencial teórico. Foi feita uma revisão bibliográfica de obras que relacionam Bakhtin ao processo de Comunicação Científica, uma vez que se entende que esse processo está enraizado em ideologias e interesses em seu discurso. Assim, uma revisão de trabalhos publicados no Brasil, que relacionam a questão da Comunicação Científica com a Educação Científica, e que utilizam Bakhtin como referencial teórico, a fim de mostrar a relevância do autor para a área. Os trabalhos serão apresentados, resumidamente, em ordem cronológica (e alfabética dentro do mesmo ano) de publicação. Pode-se dizer que Bakhtin tem grande importância nas discussões para a construção de uma sociedade mais crítica em relação às práticas de Ciência e Tecnologia (C&T).

Palavras-Chave: Bakhtin; comunicação científica; educação científica; análise do discurso; Brasil.

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1 The issue of ideology in education and scientific communication

According to socio-historical or socio-cultural psychology, the student has a central role in the teaching-learning process, since he is seen as an active and participative being. The focus of this psychology is on special attention to the dialogical relationships that derive from the interaction between students and students with teachers.

From the student's social interaction it is possible to refer to their intellectual development during the teaching and learning process, as defended by the authors who follow this line of socio-historical psychology, such as Bakhtin and Vygotsky.

In this sense, it is important to study the media, especially when one understands education as a process of dialogic construction of knowledge. In this way, the learning process would occur through the negotiation of meanings in a communicative space (in this case, discursive interactions are considered as constituents of the meaning making process), and not as a simple substitution of previous conceptions.

Thus, the process of meaning is related to the construction of meanings (conceptualization), since meanings are understood as polysemic and polyphonic, created from social interaction, so that they can be internalized by individuals. It should then be taken into consideration that the student builds in his daily social practice a knowledge of the world around him. This everyday knowledge or common sense allows him to interact very effectively with his natural and social reality (ROCHA, 2010).

Thus, contemporary education has been adopting different paths to its realization, not restricting itself anymore to the school environment, so it is becoming increasingly common to use various means of communication to achieve educational goals. As an example of this new form of education, socio-historical or socio-cultural psychology has influenced, in recent years, research in Science Education on the issue of meaning, especially in the classroom (MORTIMER; SCOTT, 2002).

That is, we intend to understand how the discourse is related to the construction of meanings in Science Education. Thus, a tool presented in the study of language in science classes would be through Bakhtin's definition of "discourse genre", since for Bakhtin "Every sphere in which language is used develops its type's relatively stable statements. This we may call discourse genres." (BAKHTIN, 1988, p. 60).

According to Marandino et al. (2004), science education is a social practice that has been increasingly developed in the so-called non-formal spaces of education, and there is practically a consensus regarding its importance for the understanding of scientific knowledge. It is thus

understood to be important to understand how the dialogical aspect is perceived in the communicational processes of science.

This is because, as defended by Rocha (2010), with the growing importance of science today, the need for a scientific culture must be increasingly reinforced, so that the individual develops scientific notions that represent subsidies for the formation of critical subjects. This leads to the questioning of the notion of science as a set of absolute truths. According to the author, for this, it is necessary to work with students to demystify the role of science, showing that this is a permanent process of construction, historically situated and influenced by specific socio-cultural constraints.

Linked to this, for Rocha (2010), technological advances eventually democratize access to information, generating new paradigms in the field of education, losing the sense, for example, of offering a segmented education based on the accumulation of information. The concepts presented, according to the author, should now consider the social, economic, historical and technological contexts present in the student's reality, generating possibilities for insertion in a society permeated by scientific discourse, with the objective of developing the conditions for exercise of citizenship.

Thus, science education, carried out through scientific communication, for example, by having the ability to stimulate curiosity, ends up helping to develop the skills needed to debate the issues of Science and Technology (S&T) present in the citizen's daily life, thus assisting in the construction of the so-called scientific culture.

Specifically regarding the non-formal education process, several authors define it according to the adopted spectrum of analysis. Thus, the importance of communication interaction in the educational process must be taken into account (GOHN, 1999).

According to Gohn (1999), non-formal education is related to a broader conception of education, associated with the concept of culture. Thus, this modality deals with a process with several dimensions related to: political learning of civil rights; job training; learning skills and exercising practices for collective problem solving; learning the contents of formal schooling, in different forms and spaces; and education developed in and by the media.

The author also highlights the various spaces where non-formal education activities are carried out, such as neighborhood associations, unions, non-governmental organizations, cultural spaces and schools themselves, that is, in interactive spaces with the educational community. Thus, non-formal education would presuppose the formation of citizenship, and learning would take

place through social practices, so that citizens have the competence to understand information and to be able to make a critical reading of the world, so as to be able to read the exercise of citizenship.

Thus, there is evidence today that the process of non-formal education, such as what happens in public S&T exhibition spaces, science magazines and newspapers, for example, contributes to students' interest in science and also to scientific learning (SABATINI, 2007).

Therefore, disseminating science would not only be limited to informing about its practices and advances, but also assisting in the construction of a theoretical knowledge that involves the population to the point of involving it in the S&T discussion spheres. This is in line with science teaching with an emphasis on CTS (Science-Technology-Society).

According to Santos and Mortimer (2002), the central objective of STS education would be to develop citizens' scientific and technological literacy, helping to build the knowledge, skills and values needed to make decisions about S&T issues in society, not actively. restricting this debate necessarily to traditional education, since the most important is the formation of a participatory citizen to act in the solution of such questions. However, as pointed out by both Marandino et al. (2004) and by Santos and Mortimer (2002), one must take into account the range of interests contained in the S&T discourses, including ideological ones, so that the general population should be alerted and informed about the possibilities and risks inherent in scientific practices.

It is also worth linking the terms related to the process of scientific communication with each other and with the non-formal education process. First, according to Jacobucci (2008), various expressions have been used by Brazilian researchers to bring science and the population closer, such as scientific literacy, scientific literacy, scientific dissemination, scientific communication and popularization of science, and abroad are in vogue the expression "Scientific Culture".

Specifically about scientific communication, according to Bueno (2009, p. 160), it refers to "The transfer of scientific, technological or innovation-related information, elaborated from a specialized discourse and directed to a select audience, formed by specialists".

In this sense, at first, the communication process would occur in a certain way for a specific target. There would actually be three terms directly related to science communication: diffusion, dissemination, and dissemination.

The author understands that these terms, even if articulated in common ground to the universe of science, assume their own contours. In this case, diffusion would be divided into dissemination and dissemination, and dissemination would be more focused on scientific communication among scientists (entrappers), while dissemination would be communication

directed at the lay public. Thus, scientific dissemination would be the term related to communication to the general public.

2 Bakhtin as a referencial theory in scientific communication works

It´s going to be show now a bibliographic review of works that relate Bakhtin to the process of Scientific Communication, once it is understood that this process is rooted in ideologies and interests in his discourse. Thus, a review of works published in Brazil, which relate the issue of scientific communication with scientific education, and which use Bakhtin and his Circle as a theoretical framework, in order to show the author's relevance to the area. The papers will be presented, briefly, in chronological (and alphabetical order within the same year) of publication.

Zamboni (1997) discusses the representations of Scientific Dissemination (SD) found in dissemination materials, both from a sociocultural and textual-discursive point of view, detecting some problems of dissemination from the source discourse "D1" (that of science) and the second discourse "D2" (quotidian). It concludes that SD is a particular genre in the set of other discourses of different areas of language functioning, subject to different production conditions in relation to scientific discourse, depending on the target audience, the discourse and the treatment given to the subject.

Zamboni (2001) states that SD presents itself as a new discourse, "which does articulate itself with the scientific field - and does so in various forms - but does not emerge from this interference as the product of a mere language reformulation." (Ibid., P. xvii). For the author, in the case of SD discourse, compared to scientific discourse, the scientist's language goes through a process of "facilitation", in order to adapt to the listener, favoring the interlocutor's understanding of the subject.

Grigoletto (2005) investigated the functioning of SD in the magazines "Superinteressante" and "Ciência Hoje", starting from the conception of science as a social and ideological practice, using Discourse Analysis as a reference, working simultaneously with Bakhtin, Michel Foucault and Michel Pêcheux. In this paper the author analyzed how the different subjects (in this case, journalist, scientist and reader) constitute themselves in the discourse of SD, as they are challenged by both the power / truth of science and the media, which, for the author, makes clear the heterogeneous profile of speech.

El-Hani and Sepúlveda (2007), by presenting theoretical frameworks and methodological procedures used in research on the relationship between science education and culture, use Bakhtin's language theory to study the way religious students react when appropriate scientific

discourse in order to understand the way religious and scientific voices interact in the construction of discourse on nature.

Ferraz (2007) analyzed the genres of SDC, but now on the internet. The author studied the way in which the discourse of SD is constituted in this space, specifically in the genres article and report, through the dialogical relations established by the use of links. The author found that the use of links is established according to gender, determining for this different semantic-axiological relationships through hypertextuality.

Cunha (2008) analyzed the conceptions of science present in scientific journalism from the theoretical perspective of the Bakhtin Circle, concluding that journalists eventually bring a view of the scientist as a bearer of indisputable truths, such as those that populate the social imaginary, leading to understand that science is an activity performed by geniuses, seen as an essentialist practice and without discussion, which would eventually lead to stereotyped, mistaken or even misconceptions of science.

In this sense, for the author, it is evident the importance of Bakhtin and his circle for the study of the process of scientific communication, considering that all communication process is, in fact, a dialogic process, where the way the speaker addresses to the recipient depends on the speech genre, and the speech depends on the specificity of the communication.

Giordan (2008), when researching human cultural development from the perspective of socio-cultural theory, studied the computer as a workstation that helps to mediate activities organized from different interfaces, which leads to the elaboration of discursive meanings and interactions, facilitating learning for science education. Thus, based on Bakhtin's theory, Giordan (2008) built analysis tools to interpret the meaning-making processes in order to organize computer-mediated teaching activities.

Grillo (2008), when investigating the relevance of the distinction between primary and secondary genres in Bakhtin and his Circle's work as a whole, understands that this dialogue has led to an important position that will serve to approach the methodology of literary genres in their inter -relation with the whole of culture and with the various spheres of everyday ideology, which was attested in the work of analyzing a genre of SD. The author concludes, then, that the reflection on CD, taken as a mode of dialogic relationship, highlights the characterizing traits of the expansion of the circulation of cultural products from an ideological (scientific) sphere, to other domains of Brazilian culture.

Cunha (2009), analyzing the aspects involving formal education and the media, developed a thesis about the perception that high school students from a public school in São Paulo had about

Science and Technology and the consequent relation of these perceptions with the SD, since, for the author, the individual lives in a sociocultural context that, through interactions, builds meanings. As a support he used Vygotsky's Sociocultural Theory and Bakhtin's studies on discourse analysis. According to the author, it is very useful the critical reading of the SD by the students, which can occur through interactions with texts in science classes. It concludes, then, that the meanings attributed by the individuals happened at the level of the perceptions as well as the formation of the concepts, which leads us to understand how these students interact with these perceptions and with the publications on S&T.

According to Cunha and Giordan (2009) the discourse of scientific dissemination aimed at the general public is one such that, due to its complexity and due to the change of a discourse that leaves the scientific sphere and goes to the media sphere, it must be analyzed by the theories. discourse analysis, seeking to understand how the construction of this discourse occurs. Thus, they use Bakhtin's concept of gender to verify the discourse structuring of scientific dissemination, which is now considered as a genre of discourse itself. In this case, the authors did a study on the implications of introducing science communication in the classroom.

Cavalcante Filho (2010) also studied the reflexes of evolution regarding discursive genres (anticipated by Bakhtin) and the relations between language and society found in the texts of SD. According to the author, this is important, because the texts of SD constitute a genre that mixes different discursive domains, coming from different areas of science together with journalistic discourse and everyday discourse, aiming to adapt to interests and socio-historical needs of individuals. It would then be up to the school to improve genres that, normally, do not belong to the students' daily experience, aiming to broaden their universe of knowledge, which would make the student able to integrate new discursive modalities in their production and reception practice.

Almeida (2011) deals with interactions and literacy practices mediated by the use of the magazine "Ciência Hoje das Crianças – CHC" in the classroom, having as a theoretical-methodological perspective of analysis in Bakhtin's conceptions about verbal interaction and micro genetic analysis. We sought to understand the debate on the discourse of scientific dissemination and the polyphony of the term literacy to understand the interactions and practices of this discourse, in a science classroom with children of the 2nd cycle. The presence of the magazine would evoke practices already consolidated in the classroom, but on the other hand indicate tensions and conflicts that allow the emergence of new practices.

Cavalheiro et al. (2011) analyzed the transposition of the discourse of science to that of DC, based on Bakhtin, Authier-Revuz and Orlandi (2001), analyzing publications from the

electronic magazine "Amazonas Faz Ciência", from the Amazonas State Research Support Foundation (FAPEAM), which dealt with the health issue in the state of Amazonas. The authors conclude that although there is a transposition of scientific discourse to SD, there is still a maintenance of the effect of science on the language used, and question if in fact the diffusion of science is occurring, i.e., whether the journal has been able to reach the reader. and make it able to grasp the expected meanings, whether those re-signified by the disseminator or the scientists.

Fonseca (2011) analyzed a public school, in the 4th and 5th years of elementary school in Portuguese Language classes, in which we selected for analysis the written productions of a student related to the genre of SD. According to the author, the DC genre has social relevance because it is read and discussed inside and outside the school, contributing to the student's scientific education by bringing the language of science and the observation of the real with the scientific and technological advances, despite being a genre little studied and explored by teachers of the early years of elementary school.

Prado (2011) sought to understand how the reading activity of the genre of scientific dissemination occurs in 2nd and 4th grade classes (currently called 3rd and 5th grades) of elementary school in two state schools of the Marília-SP Region Board of Education. The research was ethnographic and the data generated were analyzed according to the methodology of micro genetic analysis and according to the assumptions of the Historical-Cultural Theory, from Bakhtin's language perspective. With the result of this evaluation, it was possible to locate the schools that obtained the best performance and the worst performance in the evaluation of the Portuguese Language of the São Paulo State School Performance Assessment System (SARESP) of 2008, in the items concerning the reading of the informative text of scientific dissemination.

Socoloski (2011) evaluated the role of language and interpersonal relations in the popularization of science (PC). According to the research, the PC news genre can play an important role in the context of language teaching and learning for high school students and / or university students as a tool for language education from the perspective of the development of scientific literacy. Therefore, we sought to discuss a didactic proposal for scientific literacy by analyzing reading activities published in an English-language textbook approved by the National Textbook Program 2012, through a critical analysis using, among several authors, the discursive genres theories in Bakhtin.

Firme (2012) investigated how chemistry teachers construct their discourses when working on scientific concepts of thermochemistry in a Science-technology-Society (STS) approach, seeking to understand the conditions of production of these discourses and the discursive constructions

for the process of constructing meanings of scientific concepts worked for the experience of STS approach in the classroom.

The methodology followed the parameters of an interpretative qualitative research and the analysis used Patrick Charaudeau's Semiolinguistic Theory and Bakhtin's Theory of Enunciation. The results showed that the discursive construction emerged due to institutionally legitimized psychosocial identities for the teacher and the students that implied an asymmetrical relationship in the classroom.

Gruzman (2012) analyzed the production of expository discourse of professionals who assume the role of designers in science museums, using as a theoretical framework the socio-historical approach to the study of Bakhtin's language and his Circle. The research was based on two complementary stages, the first focused on the study of exhibitions of science museums as a sphere of activity and the second stage sought to focus on the enunciative-discursive dimension of discursive productions of professionals who participate in the conception and development of science. Exposition of the Museum of Microbiology. The authors conclude that the exhibition of science museums could be considered a hybrid discourse genre, from the enunciative-discursive point of view.

Souza (2012) sought to categorize the questions asked by the teacher in investigative classes and to see how these questions can help students to develop aspects related to scientific literacy, circumscribed to the discursive dimension of Bakhtin and Vygotsky, the epistemological dimension of Bachelard, the dimension of Freire and the discursive aspects of Mortimer and Scott. The categories of questions asked were classified as problematization, data, exploratory, process and systematization questions. The authors conclude that questions play an important role in the development of students' scientific literacy and can provide a dialogic and conducive environment for classroom argumentation, helping to construct meaning in investigative physics activities.

Lima and Giordan (2013) conducted a case study on the interference of discourses and the quoted discourses present in the discourse of DC, since this is produced in the midst of dialogic interaction between various spheres of action, such as scientific, journalistic and educational. The authors, analyzing a series of articles published, over a period of one year, on the site of the Ciência Hoje institute, pointed out some characteristics of the discursive genre of SD, based on the theoretical support proposed by Bakhtin and his Circle. For the authors, the use of quoted discourses serves to reinforce a dogmatic and authoritarian stance that considers modern science as the only true way to understand natural phenomena and the world, also serving to validate and legitimize the ideas defended by science.

3. Final considerations

Starting from the logic that every citizen must have a critical view on S&T, so that scientific education has as its objective the public understanding of science, this chapter started from the premise that the S&T duo is inherent to contemporary society, it is practically impossible to dissociate it from daily activities, considering the range of products available for the most varied applications.

Despite this great influence, and, in fact, in view of the need to understand S&T as a human activity, arising from a historical and social construction, in which its products derive from the most varied interests, including with ideological issues involved, is that it is understood that it is more and more necessary to integrate the common citizen in discussions in the spheres of S&T, considering it as an integral part of scientific culture.

Thus, a tool that is available, both inside and outside the classroom, would be through scientific communication (presented here under different terms, such as literacy, dissemination, literacy, for example), and that demonstrates its importance in view of the vast amount of information that scientific development presents. Therefore, non-formal scientific education is directly related to the commitment to learning, since it becomes effective in the process of citizens' scientific literacy.

Taking into account the relevance of Bakhtin's speech process and interaction, linked to the fact that the communicational process, inserted in an interactive context, can lead to the construction of meanings and the consequent conceptualization (as in the communicational processes that occur outside of the school environment, in the so-called non-formal spaces of education), an attempt was made to survey the research and studies carried out in recent years in the country on the importance of Bakhtin in the analysis of scientific communication practices, specifically those related to the teaching process. science learning

In the reviews presented on the terms used for scientific communication and scientific education, some variables were shown in relation to their practice and environments for their application, such as the relationship between education and culture, the transposition of discourse, virtual spaces, representations, always trying to relate the definitions presented with the theory of Bakhtin and his Circle. It is noteworthy here that, regardless of the term to be used in the process of scientific communication, the most important is to highlight the effort that must be made to bring scientific knowledge to the general population, so that it develops a theoretical basis for discussion in society of S&T issues.

Therefore, it is increasingly necessary to study the interests behind the discourses of science, and to verify how the educational aspect is presented. It should also be taken into account that this is a dialogical teaching-learning process, in which different types of discourses are presented, and, therefore, a correlation with Bakhtin and his Circle would be appropriate.

Starting from the understanding of scientific communication processes as a dialogical genre, it is clear the importance of the author as a theoretical tool in the analysis of the studies of the discourse processes of science, since, through dialogism, pointed out by Bakhtin and his Circle, it would be possible to relate the teaching and learning processes, important in science education, with the cultural development of the individual (more specifically the scientific culture).

From this perspective, the relevance of the relationship between Bakhtin's theory and his Circle with the processes of scientific communication is evident, due to the fact that the discourse developed through a debate produced from every day (non-formal) facts, when inserted in the (formal) classroom, becomes essential in the process of resignification of scientific knowledge for the individual. Therefore, the understanding of scientific communication as a modality of dialogical relationship demonstrates the strong ideological presence of science, which would further highlight the importance of Bakhtin in the scientific communication process.

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