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CONTRIBUTIONS OF SCIENCE, TECHNOLOGY AND SOCIETY TO THE DEAF STUDENT IN THE TEACHING OF MATHEMATICS FROM THE PERSPECTIVE OF VISUAL PEDAGOGY

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Adriano Aparecido da Silva[1], Calixto Júnior de Souza[2], Renata Lima Cardoso[3], Érica Maria Juvencio[4], Jean Pablo Nery[5], Consuelina Souza Santos Malheiros[6], Mírley Ferreira Silva Tragancin[7] and Alexsandra Silva Amancio e Souza[8]

ABSTRACT

This text is of a theoretical nature and aimed to present considerations about science, technology and society (STS) in the teaching-learning process of mathematics from the perspective of visual pedagogy, a pedagogical proposal focused on visuality. Theoretical references were analyzed that highlight visual practices in the education of the deaf and the contribution of STS as important elements for the scientific literacy of this subject. It is concluded that this pedagogy can contribute significantly, as an initial action, in order to provide the deaf with a critical and conscious look at their social and political commitment.

Keywords: Education of the deaf. Visual pedagogy. Mathematics teaching. CTS.

[1]Master of Science and Mathematics Education
Federal Institute of Goiás – Rio Verde Campus
[2]Doctor of Special Education
Federal Institute of Goiás – Rio Verde Campus
[3]Master in Genetics and Biochemistry
Federal Institute of Goiás – Rio Verde Campus
[4]Master of Science and Mathematics Education
Goiás State Department of Education
[5]Specialist in Teacher Training and Educational Practices
Goiás State Department of Education
[6]Libras Specialist
Goiás State Department of Education
[7]Libras Specialist
Goiás State Department of Education
[8]Specialist in Specialized Educational Service
Goiás State Department of Education

Revista ARACÊ
ISSN: 2358-2472

INTRODUCTION

This text is of a theoretical nature and raises discussions about the contributions of STS in the education of the deaf. It is based on authors such as: Fourez (1995), Jarrosson (1996), Ianni (1998), Cachapuz (2005), Quadros (2006), Campello (2008), Gesser (2009), Perlin and Strobel (2009).

Through the readings, it was intended to understand how the STS focus contributes to the critical formation of the deaf student, in order to exercise his role as a citizen in society, in which most are hearing people and do not know the Brazilian Sign Language (Libras). This obstacle implies a language barrier that affects the access of the deaf community in various spaces of society and in the information conveyed in everyday life.

In view of this, the school is one of the spaces that allows the deaf student to reflect and develop a critical sense about their visual experience acquired in their social environment, but it has contributed little to the integral formation of the student.

For Fernandes (2016, p. 27) "it is necessary to overcome the current teaching model present in schools that still offers decontextualized and insignificant teaching for students." Thus, the central question that justifies this article is: how to characterize the teaching-learning process of mathematics considering visual pedagogy and the STS approach to enable the deaf student to be aware of his social and political commitment?

To answer the question, I will start from a historical retrospective of the education of the deaf, reflecting on the bilingual perspective that occurred from Decree No. 5.626/05 as a possibility of structuring the proposal of inclusive education to serve students with deafness. In a second moment, to reflect on the proposal of visual pedagogy, as a pedagogical action, in order to perceive its practice for the teaching of mathematics. In the third part of the text, I present the contribution of STS in the transformation of teaching practice to change the reality of deaf students in the school context. In the fourth and last part, I present some final considerations about the analysis developed throughout the reflections raised in the text.

THE EDUCATION OF THE DEAF

The education of the deaf occurred with several educational impasses that ended up determining the educational actions adopted in their path. Historically, they have been based on three approaches: oralist, total communication, and the approach through bilingualism.

Revista ARACÊ
ISSN: 2358-2472

In Brazil, the advances took place from Federal Law No. 10.436/2002, which made the Brazilian sign language (Libras) official as the language used by the deaf. However, the most important contribution was Decree No. 5,626/2005, which instituted the teaching of sign language to the deaf as a first language and Portuguese as a second, including making the use of sign language mandatory in various public spaces and motivating the presence of a sign language interpreter.

In this context, reflections on the education of the deaf with their own linguistic and cultural characteristics began. In 2008, with the National Policy on Special Education in the Perspective of Inclusive Education, it was emphasized that teaching for the deaf in regular schools has to take place in a bilingual approach (Libras and written Portuguese). With the deaf student in regular school, the presence of the sign language interpreter became essential and in 2010, this profession was regulated with the publication of Law No. 12. 319. However, despite the progress of legislation, much has to be done to make bilingualism effective and research shows that this approach has not really been effective and the deaf face an inequality in the school context in relation to hearing people (QUADROS, 2006).

Generally, the deaf child starts his school life without proficiency in his mother tongue and at school all content is transmitted exclusively in Portuguese as a first language, causing significant damage to the formation of the deaf. Perlin and Strobel (2008) describe that the proposal is to place only the student in the classroom, as a form of assistance, as many deaf subjects complete basic education without knowing how to write a note.

For Perlin and Strobel (2008) there is an impasse in relation to the treatment of deaf students. According to the authors, the rulers do not respect the deaf, treating them like other students. Article 59 of Law No. 9,394/96 establishes the conditions for students with disabilities, global developmental disorders and high abilities or giftedness to have access to an education with equity, but the result in practice does not match the mechanisms offered to these students.

In fact, one of the failures of the educational system towards people with deafness is the disqualification of the teaching professionals who are present there, who most of the time signal a "hi" believe to be sufficient for inclusive educational practice. It is necessary to accept differences and more than that, to build with differences. According to Sartoretto (2010):

Revista ARACÊ
ISSN: 2358-2472

> The school that welcomes and takes advantage of differences seeks to collectively build a pedagogy that starts from the differences of its students as drivers of new ways of organizing teaching. By taking into account these differences, pedagogical and accessibility resources help people with disabilities to actively participate in the school process (SARTORETTO, 2010, p.8).

School education, which guarantees the deaf equal rights and conditions, needs to be differentiated, with a complete and adequate curriculum that bases their cultural and linguistic specificities. The bilingual approach is understood as a path to be followed to favor essential learning conditions for deaf students and for Gesser (2009, p.76) "it is not deafness that compromises the development of the deaf, but the lack of access to a language". With the growing proposal for the inclusion of students with special educational needs in the school environment, the school is the target of several policies that aim to minimize the exclusion of these students to a new dimension of teaching in the educational process. In this sense, for Oliveira et al. (2015, p.66)

> The function of teaching requires an integration of knowledge, in order to facilitate (mediate) the constitution of the students' subjectivity, that is, this function should not be understood simply as the transmission of knowledge, but rather as a support to provide strategies and resources to the students, so that they can interpret the world in which they live, through its own history (OLIVEIRA et al. apud HERNÁDEZ, 1998, p...).

In this way, it understands the concerns regarding the teaching process of students with deafness and in terms of educational strategies, we must advance in methodological issues and visual pedagogy is a way to enable the deaf to teach contextualized with the current social imagery practices. Campello (2008, p.13) describes the importance of "pedagogical proposals based on visuality in order to reorient the processes of teaching and learning", thus valuing the peculiarities of the deaf subject.

Therefore, the school is the space to articulate information to form critical subjects and as an analysis instigates us to think about how to articulate the peculiarities of the deaf and the STS approach, in order to contribute to the teaching of mathematics to stimulate the criticality and emancipation of the deaf student.

VISUAL PEDAGOGY AND THE TEACHING OF MATHEMATICS

Visual practice in mathematics classes is considered of paramount importance to favor the student's teaching and learning process. When it comes to a proposal for inclusive education, this practice becomes even more necessary. However, it is not always

Revista ARACÊ
ISSN: 2358-2472

worked as it should. In many educational situations, the teacher leaves the deaf in the "hands" of the sign language interpreter, who does not always have mastery of the contents to be taught and even if they did, this would not be their function. Knowing that deaf people communicate through sign language, which has a visual-gestural structure, it is understood that their interaction with the world takes place through visual experiences. Thus, we call attention to the contribution of visual pedagogy as a pedagogical proposal focused on visuality to offer learning conditions in the teaching of mathematics for students with deafness.

For Campello (2008, p. 17) "Visual Pedagogy is nothing more than a pedagogy elaborated and aimed at the Deaf-Mute community, based on their own understandings and visual experiences." Thus, reflecting on the visual and its contribution to the teaching of mathematics includes producing meanings through images and languages (Libras and written Portuguese) allowing a reflection on the teaching methodology for the teaching and learning process covering a more inclusive educational practice.

Bringing such a proposal to the teaching of mathematics provides students with a favorable environment to apprehend the role of mathematics in their daily lives, attributing more semantic meanings in the construction of a more investigative and effective interpretation in the society in which they live. Megid (2009, p.198) points out that it is important for the mathematics teacher to mediate "the discourses, experiences of the students and the fusion between scientific knowledge and common sense, directing the work towards the organization and systematization of the knowledge that is produced".

Thus, in order to give meanings to the experiences of deaf students, visuality is pointed out by researcher Campello (2008) as the most effective means to combine images with educational proposals for the deaf subject, as he conceives the world through visual representations with many possibilities to express both simple and complex concepts. According to Campello (2008, p. 13):

> It is a new field of study with an important demand from society that pressures formal education to modify or create pedagogical proposals based on visuality in order to reorient the processes of teaching and learning as a whole and, particularly, those that include Deaf-Mute subjects. This movement of visuality studies needs to be considered, therefore, when talking about Visual Pedagogy and Education of Deaf-Mute subjects.

To perceive the deaf student as a visual subject is to think about the possible possibilities, because the presence of the sign language interpreter alone does not mean

Revista ARACÊ
ISSN: 2358-2472

that the difficulties of the deaf have been solved, it goes beyond the sign language, and deafness is not the reason for not learning. Barbosa (2014, p. 163) reports that "deafness is not a cause of low school performance in the area of mathematics. Thus, it seems to be necessary to think of forms of pedagogical intervention that can guarantee successful learning in mathematics [...]".

It should be noted that the use of various imagery approaches allows the student to relate his experience of the world and associate linguistic knowledge for the construction of a more investigative interpretation in his social environment. Understanding that the deaf develop differently from the hearing, the use of visual experiences in mathematics teaching is a way of respecting their cultural identity, therefore, care must be taken not to use the image as a mere simple representation, illustrative without questioning to develop a critical look and understanding of the world.

Lebedeff (2010, p. 180) emphasizes the need for teachers to reflect on the use of imagery and the "need to use the appropriate image as a cultural resource that permeates all fields of knowledge and that brings with it a structure capable of instrumentalizing thought."

Therefore, on the proposal of visual pedagogy and the teaching of mathematics, we can direct our gaze to the contributions of STS in order to investigate the possibility of the deaf problematizing their reality, thus aiming to have a meaningful class to develop their criticality and more conscious social participation.

CONTRIBUTIONS OF SCIENCE, TECHNOLOGY AND SOCIETY TO THE DEAF STUDENT

In the 1970s, a new perception and understanding of the relations between science and technology and their manifestations in society began. From this perspective, approaching scientific and technological knowledge in the classroom favors to stimulate the formation of the individual as a citizen with intellectual autonomy and aware of his social role. However, for this perspective to be expressed in the educational context, it is necessary to be guided by a critical reflection on reality and to propose activities of everyday situations.

To understand the influence of STS in education, the following authors are used: Ianni (1998), Jarrasson (1996), Fourez (1995) as the main sources in the contributions discussed on the historicity of science, politics, economics and their relations with society.

Revista ARACÊ
ISSN: 2358-2472

For Ianni (1998, p. 47) "man comes to the world unfinished with needs, needs, which he needs to meet. You need to work to live." These needs are built throughout each era and processing the transformations in society. Thus, men build their history, unconsciously and consciously. Unconscious by a dominated class, the working class, to its mode of production and conscious by the bourgeois class projecting its domination and exploitation to the worker. It is a process in which Ianni (1998) analyzes in depth to explain social antagonism and also the formation of capitalism.

The author describes the latter (capitalism) as a social phenomenon where the economic and political relationship stands out from the relationship of domination that characterizes the bourgeoisie in society. For Ianni (1998, p. 17) "when examining capitalism, Marx catches the facts as total social events, in which the economic and the political stand out, as two combined and more important manifestations of the relations between people, groups and social classes". In this analysis, it certifies the importance of recognizing situations captured by the eyes of the deaf from a critical perspective of the imagetic conditions conveyed in social environments as market situations to be explored in the teaching of mathematics to analyze the capitalist mode of production and its contradictory relations of maintaining *the status quo.*

For Ianni (1998, p.20), analyzing a commodity involves analyzing fetishism. Which, according to the author, "analysis makes relationships, processes and structures transparent." Understandingthis political domination and economic appropriation manifesting itself, it becomes necessary to convert information into knowledge and in the teaching of mathematics enables the construction of critical looks for subjects to deconstruct the false ideas emitted by visual advertisements. According to Silva (2012, p.74)

> Inserting activities that consider the STS focus in the teaching of mathematics is not restricted only to debating the role of mathematics as a science that is involved in all contexts of our society, but it is also necessary for the student to understand what science and technology itself are, in order to be able to judge the role of mathematics.

It is noted that science and technology are socially constructed, so the idea of neutrality is erroneous, since each scientist and specialist employs their beliefs and values in the search for scientific knowledge and technological production. Thus, questions arise: To what extent are we learning these technologies? What are the influences of science and

Revista ARACÊ
ISSN: 2358-2472

technology on us? And what can be done to reduce the barrier between information and knowledge among those who are domesticated? For Fourez (1995, p. 13) "workers could be much better situated in their militancy when they were introduced to the sciences and techniques without being mystified by them." Showing this more humanized vision of science and technology is of paramount importance to deconstruct false ideas. For this, teachers have a fundamental role to consolidate what CTS proposes. Linking problem situations, whenever possible, to real actions, concrete examples from the students' own experience and reformulating them appropriately.

In this way, he understands that "Mathematics is in everything". It is also present in technological and scientific development, since Mathematics is present in the various areas of knowledge and there is a need to overcome teaching unrelated to the development of science and technology. According to Cachapuz et al. (2005), in order to understand the structure of society and the impacts of STS, it is necessary to promote scientific literacy to:

> Practical scientific literacy, which allows us to use knowledge in daily life in order to improve living conditions, knowledge of ourselves, etc. Civic scientific literacy, so that all people can intervene socially, with scientific criteria, in political decisions. Cultural scientific literacy, related to the levels of the nature of science, to the meaning of science and technology and their impact on the social configuration. (CACHAPUZ et al., 2005, p. 21-22)

In this way, scientific literacy is a proposal presented that articulates the development of science and technology with real social facts. When it comes to a mathematical education for the deaf student, it is essential to start from the knowledge of real situations, in order to improve the conditions of inference of the contents and the STS favors this possibility in order to promote debates without getting tangled up with false ideas. Jaramillo apud Monteiro (2009) questions the decontextualization of teaching in school education. For the author, "in the school, the teaching of the knowledge of the exact sciences predominates, but historically and socially decontextualized, under a theoretical approach, in which such knowledge is transformed into codes and devoid of meaning" (JARAMILLO *apud* MONTEIRO, 2009, p. 157).

There is still a predominance of decontextualized teaching and of little importance to the academic life of the students. However, blaming the teacher would not be the answer to this "meaningless" teaching. Fourez (1995, p.26) raises a question that makes us problematize why not have a natural sciences course for a mathematician?

Revista ARACÊ
ISSN: 2358-2472

> Why a natural sciences course for a mathematician? There is no scientific answer to these questions: the answer lies within the scope of a *university policy*. Subjects are imposed on a syllabus because "if" (i.e., those who have the power to impose syllabus) considers that these subjects are necessary either for the good of the student or for the good of society; it is always about the "good" of the way in which the organizers of the training represent it, according to their own projects and interests.

It is known that "the organizers" are not neutral, as they are people who have ideologies and are constituted by their networks of interests. So, knowing that mathematicians will be opinion makers, he observes that the scenario that will be built will meet the interest of someone, therefore apolitical students. Most teachers bring few reflections in the transmission of content, helping to hide the influence that science and technology have on our daily lives, whether they are good or bad things for society.

Thus, in an approach that relates science and technology, mathematical teaching transcends the traditional with debates on social aspects. Perceive the influences of STS to create conditions and situations for the student to be the main figure of his knowledge and know how to judge, question and interfere in what supposedly comes to him all the time as absolute truth. For Gesser (2009), the acquisition of knowledge by the deaf should take place through sign language and it is in the school, most of the time, the place where the understanding of what is happening in the world is provided.

Therefore, education needs to propose an education that allows students to understand the mathematical language through debates where STS permeates in order to modify their reality in fair and egalitarian conditions. When it comes to the inclusion of the deaf, the responsibility is even greater, as they are minorities and often unnoticed in the school environment. It is necessary to have changes in the education system, which fully accepts the linguistic difference of the deaf, in order to meet their visual specificity in teaching not only mathematical, but of all contents.

FINAL CONSIDERATIONS

One of the ways to think about the education of the deaf is to make important considerations about their peculiarities, not only in sign language, but in their way of apprehending the world around them. With the advances in science and technology, a lot of visual information seduces us, influencing our choices, and for the school it is a challenge to problematize the hidden ideological discourses that aim to meet economic desires.

Revista ARACÊ
ISSN: 2358-2472

In this context, the teacher needs to educate his gaze to be able to perceive the proposal of visual pedagogy to build significant actions in the teaching of mathematics and to be able to deconstruct imagetic representations produced by the media, breaking with the student's passivity.

Taking images as a way to be problematized and contextualized as teaching strategies makes it possible as a starting point in the constitution of a scientific literacy of the deaf subject, since their reality is given by the visual. A proposal that constitutes possibilities to contextualize situations-problems that go beyond submission to textbooks. Thus, contextualizing real situations and raising questions to listen to the voices of silence, which are often not perceived in the classroom.

Thinking about a society where there is an objectification of images, a critical interpretation of the fetishism of the commodity is necessary. Critically and mathematically analyze these impacts on society for the student to reflect and participate more actively in the construction of their knowledge.

Therefore, although deaf students have many difficulties in reading written Portuguese, the use of visual representations in a proposal of visual pedagogy provides an opportunity to break the passivity of this subject. For this, it is necessary to problematize them with a critical stance on the role of science and technologies in the development of society and to provide the deaf with a critical and conscious look at their social and political commitment

Revista ARACÊ
ISSN: 2358-2472

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