USE OF NEW LEARNING TECHNOLOGIES AND MULTIMODAL INTERACTIONS TO FAVOR THE PROCESS OF KNOWLEDGE’S MEDIATION IN INCLUSIVE CLASSROOMS WITH DEAF STUDENTS

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Abstract

This paper discusses the relevancy of New Learning Technologies (NLT) to favor knowledge’s mediation in inclusive classrooms with deaf students. The research was motivated by the project developed in the Coordination of Distance Education (CEAD) at Federal University of Viçosa (Brazil), focusing the inclusion of deaf student in the Civil Engineering course. Then, it was discussed the importance of NLT, the use of different mediational means and multimodality, such as gestures, images, videos and animations, to foster interactions and construction of concepts in inclusive classrooms. To give meaning to the specifics terms of Civil Engineering, it is important that the Interpreter of Brazilian Sign Language (Libras) and teacher establish a partnership, exploring different visuals mediational means, such as images, concrete models, graphs and classifiers in signal language that enable spatial description of scientific concepts, besides gestures, which represent bodily actions inherent to discourse.

Keywords: Multimodal interactions, knowledge’s mediation, inclusive classrooms, deaf students.

1 INTRODUCTION: NEW LEARNING TECHNOLOGIES AND DIFFERENT FORMS OF KNOWLEDGE’ MEDIATION IN CLASSROOM WITH DEAF STUDENTS

The use of New Learning Technologies (NLT) foster the development of new teaching methods and strategies to Knowledge’s mediation in classroom are being improved to favor students development, considering that daily access to an amount of information has become part of everyday life. Thus, in order to follow and maintain the interest of students in the specific subject, advances in education are also being explored. The human need to establish communication networks to adapt at social space, as well as to make use of instruments that facilitate their survival and development. In this sense, there is a massive use of technologies to improve interactions and communication between people. The NLT are increasingly present in society and classrooms, especially when we consider the diffusion of access to different modes of knowledge’s expression (SCHOFIELD, 1995). This can favored a greater circulation of information, modifying the relation of people to knowledge in space-time, which generated a cognitive change expressed in the collective consciousness and in the way distant events affect the local space (CASTELLS, 2000).

The visual perspective mobilized by deaf people can organize their language and structure the perception of the world. Thus, the use of NLT in education becomes fundamental to favor the teaching and deaf’s learning processes (STUMPF, 2006; MORAN, 2007). Such mediational means can favor communication, teaching and learning compatible with the linguistic modality and the way to abstract its relation with the world from different visual experiences.

Thus, it is important that issues related to the inclusion of deaf in University guarantee them equal opportunities and the necessary conditions to stay in the courses, to favor the full personal and professional development. In addition, one must consider the schemas of symbolic representations that support the understanding and significance of the world, these being mediated by language, by different representational modes and by culture, within fields of meaning that are symbolic and socially produced. This situation can be explicated considering that access to knowledge occur indirectly, being mediated by language and other semiotic artifacts (WERTSCH, 1997; 2007).

In this sense, Brazilian Sign Language (Libras) is required as a means of meaning and recognition the "deaf culture" (STROBEL, 2009), and this right is guaranteed by Brazilian Legislation (BRASIL, 2002, 2005, 2015). In this paper, legal issues will not be discussed, even acknowledging their importance for many advances in the educational studies. However, it is worth noting that all current laws seek to consider deaf people to have a visuospatial language modality (QUADROS & KARNNOP, 2004). So,
the arrangements involved in deaf education permeate linguistic aspects that must contemplate and respect the cultural relations of these subjects. The inclusive perspective present in the Brazilian Legislation brings at school the Language and Interpreter of Sign Language (ISL), as shown in the diagram presented in the Figure 1. However, the presence of ISL in classroom is not enough to effective educational inclusion. It is also necessary to adapt didactic materials and improve the visual character of the classes, in order to favor the process of equalizing opportunities for deaf students. In addition, it is important that ISL establish an effective interaction with the teacher and different semiotic means presented (images, formulas, graphs, tables etc.) during the process of knowledge’s mediation in classroom.

Figure 1. Regular inclusive school in Brazil with deaf students and Interpreter of Sign Language: importance of a new structural organization in classroom to favor deaf students’ actively participation of knowledge’s social construction and to have access to different modes of multimodal interactions.

Based on discussion presented, it is important to emphasize that researches in the Science Education have pointed out a growing interest in understanding the role that semiotic modes can play in the discursive process of knowledge construction in classroom (KRESS et al., 2001; KRESS, 2003; GILBERT, 2005; PRAIN & WALDRIP, 2006; KRESS, 2009; JEWITT, 2009; KLEIN & KIRKPATRICK, 2010).

The theory of semiotic modes falls within the field of Multimodality studies, especially in the perspective of Social Semiotics. One of the presuppositions of this perspective is the fact that the characteristics of language emerge from its social use. This implies that the modes of communication and thought do not have meanings in themselves. The process of articulation and construction of meanings occur through the insertion of the subjects in a determined culture demarcated by a set of social practices and symbolic instruments. Thus, to understand communication it is necessary to extend the social interpretation of language and its meanings to a set of representation modes and communication, or semiotic resources (JEWITT, 2009).

About interactions established in classroom, as in every process involving communication between people (face to face), it is common to use several modes to present different information. Teacher and ISL when want to call student's attention through speech or signals, they use prosody (non-linearity of signs), facial expression and voice / force intonation or emphasis on signs. It is also possible to use gestures / classifiers, images contained in didactic material, screen projection, among others.

About classifiers used in signed languages, they are usually hand shape that functions as morphemes, and classifier constructions are complex predicates that may express any or all of the following actions: motion, position, static-descriptive, or handling information (EMMOREY, 2002). All these forms used by the teacher in the communication processes (spoken words, written words, gestures, voice intonation / emphasis on signs and images) are examples of modes of communication (KRISS & BEZEMER, 2009). The Figure 2 presents some functions of classifiers in sign language and
scientific models (images or another mode of express an idea) used to teacher and ISL during the knowledge's social construction process in classroom.

Semiotic modes are means of communication resulting from a work throughout history, used by a community that starts from material bases to construct signs, with the purpose of communicating, organizing and structuring the thought. The modes use different and varied semiotic resources, that is, actions, materials and artifacts that aid in communication and represent objects, events and their relations.

The potential of using gestures as a semiotic mode is vast. The main types of gestures can be divided into imaginary and non-imagistic. In this group, there are gestures that do not refer to images, such as the deictic and the beat. In that other, the gestures refer to some concrete or abstract image, as the iconic and the metaphorical ones. According to McNeill (2005), gestures it was classified as: iconic - actions or images of concrete objects; metaphorical - abstract images or use of metaphors; pulse - fast movements that give rhythm or emphasis to speech/sing language; and deictic - point to something. Connected with Libras and use of NLT to describe knowledge, gestures can favor the representation of the dynamic scientific processes. Considering the Social Semiotics, modes of representation refer to mediational means that make communication possible. A mode is a social and cultural shaped resource for meaning-making: speech, writing, gestures, still and moving images are examples of modes used in representation and communication. Thus, the process of knowledge’s mediation presupposes involvement in organized activities, in which the different modes play key roles. In the case of the deaf, the process of semiotic mediation is related to the use of linguistic signs articulated through the hands, facial expressions and body actions, which communicate any idea that one wishes to express. These linguistic signs establish a link between signifier and meaning, where there is an association of two mental images: the signifier is a visual form and meaning is the concept attributed to that sign. In this way, communication implies in a speaker (people signaling) and a message that wants to communicate to the interlocutor, being realized through these linguistic signs. These semiotic relations mediated by NLT can favor the appropriation of signs, since communication is established through social interactions. The relationship between agents and mediational means can be characterized in terms of domain and appropriation. Wertsch (1997; 2007) distinguishes domain and appropriation as two processes related to the Vygotskian concept of internalization. According to this author, domain is related to "knowing how to do" skillfully use the mediational mean. The idea of appropriation is related to the process of taking something from the other and make owner. Thus, the learning of deaf in inclusive classrooms can be understood characterizing this process as a form of knowledge’s appropriation in the social dynamics that involves the meanings making. For this, the teacher interaction with the sign language interpreter is necessary, being
mediated by NLT and their different semiotic modes. McNeill (2005) points out that most gestures are multifaceted, and may be the iconic combined with the deictic, the deictic with the metaphorical, and so on. The gestures are combined in some moments. The same author proposes in these cases a hierarchy, because it is not possible to say which category is dominant or subordinate.

Kendon (2004) classifies the gestures in two types: referential and pragmatic, as presented in the diagram below (Figure 3).

Referential gestures are part of the referential content of a statement, subdivided into: (I) Representational gestures, which refer to an aspect of the content of the statement and are sub classified in: (i) modeling gestures, when a body part is used as a model for some object; (ii) gestures of figurative description, when the speaker sculpts and / or outlines the shape of the object described, that is, "creates" the object in the air; (iii) gestures of action, when the parts of the body that are gesturing present a pattern of action similar to the one on which the idea is intended to be expressed. (II) Deictic gestures (or pointing), when the speaker points the object (concrete, virtual or abstract) of reference in the statement.

Pragmatic gestures are related to aspects of the meaning of a statement that are neither part of the referential meaning nor of the propositional content. The pragmatic gestures are subdivided into: (I) mode gestures, when the speaker emphasizes what is being said in the statement. In these, usually the movement of the hands is usually alternated beating the hand up and down, like a drumstick movement; (II) performativity gestures, show the type of action that the speaker or ISL assumes in the speech shift. They indicate a request, a plea, an offer, an invitation, a refusal, and so on; (III) partition gestures, when they punctuate speech and show their different logical components.

Microanalysis of communication conducted in face-to-face interaction shows that visible bodily action, including gestures, can play a crucial role in the process of interaction and communication. Gesture is a form of expression that humans have and can be used for a number of different expressive purposes. The way gestures are created and used depends on the circumstances of use, the specific communicative purpose of the person and what other modes of expression are available (KENDON, 2004).

2 METHODOLOGY OF PRODUCTION BILINGUAL DIDACTIC VIDEOS FOR DEAF ENGINEERING STUDENTS

This article present part of a project articulated by multidisciplinary group at Federal University of Viçosa (Brazil), related to educational technology used to favor inclusion of deaf students in the Civil Engineering course (production of bilingual videos). These didactic materials were adapted for deaf students, focusing the process of educational inclusion by adaptive technologies. Technical subjects were translated from Portuguese to Brazilian Sign Language (LIBRAS), using a visual design and
language adapted to favor deaf learning and professional development in the engineering field. The methodology used to describe the project steps was an ethnographic research and participant observation. It was analyzed the use of NLT in the production of technical process of "signed didactic videos", as well as the linguistic transposition and the steps of the content production, planned to attend the first deaf student in this course. To achieve that purpose, it was structured a discussion group, as well as meetings with Sing Language Interpreters, and the deaf student. We also had been visit TV INES, a TV complex that deals exclusively with production of bilingual videos contents (www.tvines.org). After these steps, the production process of "signed didactics videos" were planned to implement the content of three Civil Engineering subjects to the LIBRAS. The didactic materials were intended to be available on line and make download: the signed didactics videos bring content in LIBRAS and animated images, mixing videos and dynamics slides. Finally, it was possible verify that perception and deaf knowledge's construction prioritize the imagery, gesture and bodily actions, same anaphoric process and shifting or role-play. These visual strategies related to the sign language feature that enables the narrator, through a change of body posture, to incorporate different characters from a narrative. Therefore, the NLT was used in combination with other visual tools to permit the educational inclusion, favoring the learning process and professional training of an engineering deaf student.

3 PRESENTATION OF SOME RESULTS

Based on what was discussed in this article, it will be presented and described excerpts from two signaled classes that were produced for the "Transportation" and "Engineering Geology" disciplines, both geared to the Civil Engineering course of the Federal University of Viçosa. For this analysis, the general context related to signed didactics videos production was verified, in order to elaborate a more detailed analytical structure of the Bilingual teaching material developed by the team involved in the Project previously described. Then, it was presented in the following Tables some frames of signed didactics videos and, next to them, the analytical description of the content represented.

Table 1. Description of some frames obtained from the class on Transportation (ISL 1).

<table>
<thead>
<tr>
<th>FRAMES</th>
<th>ANALYTICAL DESCRIPTION</th>
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<tbody>
<tr>
<td>![Frame](Gerenciamento do sistema de transportes)</td>
<td>These frames show the use of a text written in Portuguese to present topics and explain important components for the management of transport systems. In this case, the ISL 1 uses different bodily gestures to relate the explanation in Brazilian Sign Language (Libras) with the topics described on the screen. He uses deictic strategies (pointing) to correlate the explanation in Libras with topics that appeared written. This gesture, associated to Libras, is essential to demarcate the object (concrete, virtual or abstract) of reference in the statement, according Kendon (2004) and McNeill (2005) and favor the knowledge’s construction by deaf students, attributing meaning to the ideas expressed in certain concepts.</td>
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Table 2. Description of some frames obtained from the class on Engineering Geology (ISL 2).

<table>
<thead>
<tr>
<th>FRAMES</th>
<th>ANALYTICAL DESCRIPTION</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>In this sequence of frames, a part of the content discussed in the discipline Geology of Engineering stands out. In the introduction, ISL 2 uses dactylology (manual alphabet in sign language) to express the name of the subject (G-E-O-L-O-G-Y O-F E-N-G-I-N-E-E-R-I-N-G). He then makes a sign for &quot;Geology&quot; (agreed with the deaf enrolled in the discipline) and proceeds to discuss the subject related to Plate Tectonics Theory and its effects on Earth. The combination of signals established between the deaf and the ISL is due to the lack of technical terms expressed in pounds. In this way, we choose to create a signal for a particular educational context, which will be the reference for an idea or concept. It is worth noting that many of these signs are related to the iconic aspects of some ideas or concepts (KENDON, 2004; MCNEILL, 2005), being defined as classifiers or didactisc/teaching models (EMMOREY, 2002; GILBERT, 2005; JUSTI, 2006).</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>When the concept of Geomorphology is presented in this signalized video, the ISL 2 makes the dactylology of the expression &quot;Tectonics Plates theory and its effects on the surface of the Earth&quot;. Then, it gestuality expresses a way to present the idea regarding the concept of &quot;Tectonic Plates&quot;. In addition to this explanation using the Brazilian Sign Language, the image next to the ISL 2 expresses an animation highlighting what would be the Tectonic Plates.</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>In addition to imaging, ISL 2 uses classifiers to highlight the context of some signals (EMMOREY, 2002). In the video, it was observed synchronization between the text in Portuguese, the use of the signals for &quot;Sol&quot; and the image projected simultaneously to the right of the video is verified in the video. This brings important elements to the process of constructing meanings from the imaginary character present in the proposed explanation.</td>
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Table 3. Description of some frames obtained from the class on Engineering Geology (ISL 3).

<table>
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<tr>
<th>FRAMES</th>
<th>ANALYTICAL DESCRIPTION</th>
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<tr>
<td><img src="image1" alt="Image" /></td>
<td>In these frames, we have the introduction of the signaled video 2 referring to the discipline Geology of Engineering. This lesson was produced from the script prepared in Portuguese by the teacher, and later revised and adapted in a slide by the monitors of the discipline. All this process was done under the direct supervision of the teacher responsible for the discipline and by professionals who are fluent in sign language. Then I script was translated by ISL 3, which started by signaling the title of the lesson. Following, begins the discussion about the geological structures of the Earth, highlighting the origin of the rocks. For this, the image of a volcanic rock (extrusive magmatic rock) was presented. This type of rock is formed from the terrestrial magma, which reaches the outside by means of the volcanic eruptions, as shown in the image presented in the upper right part of the screen.</td>
</tr>
<tr>
<td><img src="image2" alt="Image" /></td>
<td>There is a sequence of signs related to the appearance of the rocks. In addition to the image showing the layers of sediments (right photo), the ISL follows explanation using a drawing representing a cut of the planet Earth. This image draws attention to the geological structures that make up the Earth, demonstrating the importance of using different multimodal resources and mediational means to favor the construction of meaning (KRESS et al., 2001; WERTSCH, 2007; JEWITT, 2009; KLEIN &amp; KIRKPATRICK, 2010).</td>
</tr>
<tr>
<td><img src="image3" alt="Image" /></td>
<td>Another example of resources’ use is the gesture of symbolic demarcating, which relates to pointing. This gesture is accompanied by the movement of the body. This ensures that the ISL 3 interacts with the mediational means (WERTSCH, 1997; 2007), present on the slide, making the signalized video contemplate didactics aspects to facilitate the understanding of the content mobilized.</td>
</tr>
</tbody>
</table>

The set of frames present some of the characteristics of the didactic material produced to meet the demands of the deaf student in the Civil Engineering course. The didactic proposal sought to respect its linguistic specificity of the deaf and prioritize the visual character in the presentation. It is possible to observe the predominance in the use of Sign Language and imaging resources that enhance the signalized content. The three ISLs interact with the images, highlighting the conceptual schemes or terms mobilized, as can be observed in the Frames presented previously.

It is also highlighted, in relation to Figure 2, that the ISL uses different linguistic resources besides the dactylology for the expression "Plate Tectonics Theory and its effects on the Earth", seeking to mobilize a signal to give meaning to the term "Tectonic Plates". This has a close relationship with the
construction of meanings, through a conceptual articulation that goes beyond simple signaling. All this process occurs from the interaction that occurs with, the image presents next to the ISL, which expresses an animation highlighting what would be the Tectonic Plates. These strategies show the presence of Brazilian Sign Language in consonance with the use of images and animations that favor abstraction through the use of signs, classifiers, dactylography and writing of the Portuguese Language, thus mobilizing concepts and terms present in the content of the subject under study.

4 CONCLUSIONS

The expansion of mediational means beyond gestural discourse allows us to analyze with more ownership the activities that involve the construction of knowledge. In this case, besides the use of sign language, it is possible to evaluate the orchestration of multiple modes of communication (visual, visual, imaginary and linguistic), seeking to give meanings to these objects that give meaning to phenomena and abstract processes of science. Kress et al. (2001) characterize the selection and integration of the different semiotic modes by the teacher as a central aspect in the task of promoting the understanding of concepts and allowing the appropriation of scientific culture by the students. It is believed that this can be extrapolated to deaf students, who prioritize the imagery issues during conceptual construction. When the different semiotic / mediational means are explored as priority didactic resources in the process of instruction of deaf students, the work of ISL is widely favored.

Kress et al. (2001) also point out a clear differentiation between the modes and means or resources used. Means (medium) represent the material support that is articulated or molded by the culture, and can use a given mode of communication. These modes of communication are defined as particular systems of semiotic resources, which operate to construct meanings and make communication possible. This can be verified in Figure 4, where the possible interactions established in the classroom with deaf students were schematized, being all this process orchestrated by the teacher and mediated by ISL.

![Figure 4. Multimodal interactions in an inclusive classroom and possibilities of knowledge mediation using different modes.](image)

Thus visual modes are presented spatially as units of meaning which are experienced simultaneously rather than sequentially, unlike what occurs in the linguistic mode and with the materiality of a written text. Several authors have been characterizing the different semiotic modes for the purpose of analyzing communication in the classroom. In this paper, we chose not to go into detail about such systems, which present analysis tables and possibilities of signification for each of the modes and mediational means.

Kress (2009) emphasizes that the functional modes, the focus of this work, are communication resources that are distinguished from the gestures by their connection with the objects. As for the visual modes, in this work they were present in the drawings and graphs presented in the signaled classes. Thus, Social Semiotics seeks to discuss the importance of contemplating representations, especially the communication of ideals through multiple semiotic modes.
This multimodal approach, according to Jewitt (2009), may offer advantages over works that focus attention on analyzing only speech / signaling aspects of the deaf or writing. Among these advantages, the following stand out: (i) the research contemplates different modes of communication that are particularly important and valued in the curriculum of different curricular subjects, such as interaction with experiments, concrete models, images and body actions, from which meanings are available, negotiated and shared in the classroom; and (ii) to show a set of interactions established between students / students and students / teachers, especially when incorporating in the interpretative work data that do not originate from what was spoken / signed or written by the subjects involved in that process.

It is important to highlight that the use of NLT allows to bring into the classroom symbolic elements that facilitate the process of sense construction by deaf students. This is due to the abstraction of many concepts and the need for concrete approximation of some ideas. In addition, it is worth noting the lack of signs to express different concepts or processes. In this way, images and other visual resources bring new meanings to the deaf and the sign language interpreters, who can use classifiers and later to agree signals to concretely represent the ideas discussed in the classroom.

Finally, it is emphasized that from the point of view of Social Semiotics, images, gestures or simulations do not have meanings by themselves. Meanings are created and shared around an activity performed by a particular group or a material that addresses the linguistic specificities of deaf students. When thinking about the teacher's performance, Kress et al. (2001) characterize the task of selecting and integrating semiotic modes as a central aspect in the task of promoting the understanding of concepts and allowing the appropriation of scientific culture by students. Thus, the meanings constructed in the classroom do not depend only on the potentialities and limitations of the various resources used, but also on the way they are orchestrated by the teacher during the process of knowledge mediation. This is what supports the work of the sign language interpreter, thus favoring an effective inclusion. And the supporting materials, such as signed didactics videos, would be an important complement to this meaning making process that originated in the classroom, orchestrated by the teacher and mediated by ISL. Finally, as technology continues to transform human experience, our classrooms must also be transformed.

ACKNOWLEDGEMENTS
Coordination of Distance Education (CEAD) at Federal University of Viçosa (Brazil) and the team of Translators and Interpreters of Brazilian Sign Language and Portuguese involved with the project of production signed didactic materials adapted to the deaf student of the Civil Engineering course.

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