Virtual Gas Lessons for Medium Chemistry: Use of Interaction Cycles and Multi-Representation

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Abstract
The intention is to clarify whether the learning material "Real Gases", in digital format and with use of interaction cycles (C) and multi-representation (M), would enable learning gains and increased representational competence in chemistry students of the 11th year. The interaction cycles are resources that will allow variations in the communicative approach classes, using the dialogical, authority, interactive and non-interactive dimensions. The objective is a progressive transformation of the content of discourse, from everyday ideas to the development of an empirical generalization. With the use of multirepresentation, a strengthening of the representational competences of the students is envisaged, with emphasis on the treatment and conversion of representations. The sample will be divided into four groups of more ou less 32 students each, submitted to the treatments: Web class, web + C, web + M and web + C + M. Pre-test and post-test will be used in all groups, with essay questions in the assessment. The production of text and the use of multiple modes will be analyzed, according to a previously validated script. The research focusses itself on only part of the gas content, which is a limitation. On the other hand, the understanding of some relations between aspects of the construction of discourse in science teaching may contribute, in future studies, to the extension of applicability of research to other contents and a support for future discussions in other sciences and in other levels of schooling, including higher education. Finally, it is hoped that the experience derived from this research in science education may contribute to timely discussions also in the field of science dissemination.

Keywords: Chemistry teaching, Discourse, Semiotics.

1. Introduction
The concept of meaningful learning is related to new knowledge that acquires meaning through interaction with specific knowledge already existing in the learner's cognitive structure (Moreira, 2012). Ausubel (2003) points out that the learner's cognitive structure can be substantialy influenced by appropriate methods of presentation and appropriate use of organized and pretested instructional material. In this approach, some themes acquire importance, such as progressive differentiation, integrative reconciliation, sequential organization of content, consolidation, use of previous organizers and the language involved in the exchange of meanings (Moreira, 2012). All these components are interconnected and make up the discourse that occurs in the study environment.In education, it is important to characterize the discourse of the classroom, focusing on enunciative strategies and the different types of text that circulate there, with attention to the value and importance of a rhythm around the repeated stages of discussing / working / reviewing, reinforcing the dialogical character of the process of understanding. Each student needs to have the opportunity to work out the new ideas by specifying a set of his own words in response to these ideas so that he can take ownership of them and make them his own. In any teaching sequence, it is advisable to have variations in the communicative approach classes, covering both the dialogic/authority dimension and the interactive/noninteractive dimension. Moreover, the content of the discourse must undergo a progressive transformation from the everyday ideas of students about the ways and conditions in which phenomena occur to the development of an empirical generalization about them in terms of the essential conditions (Mortimer et al. , 2007; Mortimer and Scott, 2002).In the constitution of scientific discourse is language, Wartha and Rezende (2011) point out that, in chemistry, most objects (chemical entities) are represented, and represented objects work semiotically. Semiotics can thus contribute to a better understanding of the processes involving representations in chemistry teaching and shed new light on the problems of learners with the understanding of these representations, as well as being a starting

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point for the elaboration of new pedagogical tools that try to face them. Transforming information and producing new representations becomes a central issue (Koehler and Mishra, 2009).Laburú and Silva (2011) emphasize that the nature of scientific knowledge is necessarily linked to a particular type of language that employs a variety of representations and uses several discursive modes to communicate them. Students subject to a process of negotiation of representational issues arising from the challenge of transformations of records and the need to re-represent the same concept in different ways, whilst simultaniously they are instigated to integrate them into an understandable discourse, thus demonstrating better understanding than those who have no occasion to do so. The diversification of forms of representation provides more favorable conditions for the establishment of relations of the subject's preexisting knowledge with the new knowledge being taught.Current digital technologies can contribute to this scenario. Digital technologies are of particular interest for multi-mode representation, providing a wide variety of modes and allowing new inter-semiotic relationships with one another in order to reshape practices and interaction (Carey, 2013).However, the application of new technologies alone is uncapable of changing the peculiar nature of the teaching-learning process. It is necessary to adapt strategies, provide resources and innovate the applied pedagogy, in order to make the best use possible of the distance learning modality.

2. Research problem

COLUNI is a college of the Federal University of Viçosa (UFV), located in Viçosa, Minas Gerais, Brazil, and has been one of the best high schools in the country, obtaining good results in the National High School Examination (Enem). The fulcral problem is the absence of chemical learning material available in the virtual learning environment (PVANet) used by the college. The research hypothesis is that the use of cycles of interaction and multirepresentation promotes learning improvements and increases the representational competence of students who use this material. The interaction cycles will be resources used in the material that will allow variations in the communicative approach classes, using the dialogical, authority, interactive and non-interactive dimensions. The aim is progressive transformation of the content of discourse, from everyday ideas to the development of an empirical generalization.The objective of using multirepresentation is a strengthening of the representational competences of the students, with emphasis on the treatment and conversion of representations. Through this work, the intention is to achieve the following specific objectives: (i) Identify which cycles of interaction can be used in a virtual classroom and how to proceed to its operation; (Ii) Describe the use of multirepresentation in a virtual class, establishing the possibilities and situations of use; (Iii) Evaluate whether the approach to the subject "Real Gases" through these resources provides the students with a learning context that favors the acquisition of concepts; (Iv) Evaluate whether the approach to the subject "Real Gases" through these resources provides students with a learning context that favors the development of representational competence. The virtual class will be appreciated and evaluated by peers, prior to its use in research.

3. Methodology

Because it is a correlational study, Carmo and Ferreira (2008) recommend a minimum of 30 subjects to establish whether or not there is a relationship between two variables. The sample, in this study, will be composed of 128 high school students of COLUNI. COLUNI has a total of 480 students, of which 160 are from the 2nd grade, divided into 4 classes (identified by A, B, C, D) of 40 students each, in alphabetical order. According to the problematization of the study, the sample will be divided into four groups, each submitted to different treatments:

- Traditional web class (X1), with presentation of content using hypermedia resources;
- Web class containing cycles of interaction (X2), incorporating resources that allow variations in the classes of communicative approach;
- Web class with multirepresentation (X3), with emphasis on the treatment and conversion of representations;
- Web class containing, simultaneously, cycles of interaction and multirepresentation (X4).

A pre-test and a post-test will be applied. The data will be collected through the administration of an evaluation with discursive questions and the information collected will refer to the production of text, use of multiple modes and the way of incorporating these modes into the text, according to a script used by McDermott and Hand (2013) (Figure 1).

TEXT PRODUCTION (TPS)

	All(3)	Most(2)	Some(1)	None(0)
Grammatically Correct	______	______	______	_____
Accurate	______	______	______	______
Covered Required Topics	______	______	______	______
Completeness	______	______	______	_____

TP SCORE ______

MODAL REPRESENTATIONS (MRS)

Number of DIFFERENT Mode Types Used (other than text) ______(a)

___ Picture ___ Graph ___ Table ___ List ___ Diagram ___ Math

Number of TOTAL Modal Representations ______(b)

Number of INAPPROPRIATE Representations ______(c)

Number of TOPICS Related to Modal Representations ______(d)

MR SCORE = (b – c) + a + d = ______

AVERAGE EMBEDDEDNESS SCORE (AES):

KEY: (N) = Next to Text (R) = Referred to in text (A) = Accurate

(C) = Complete (CA) = Caption (O) = Original

1) TYPE_______________

N____ R____ A____ C____ CA____ O____ TOTAL ______

2) TYPE_______________

N____ R____ A____ C____ CA____ O____ TOTAL ______

3) TYPE_______________

N____ R____ A____ C____ CA____ O____ TOTAL ______

TOTAL EMBEDDEDNESS SCORE_______ # of MODES______ AES: ______

EMBEDDEDNESS INDEX (EI) = TP_______ + MR_______ + AES:_______ = [ ]

Figure 1: Script used by McDermott and Hand (2013).

Initially, the groups will be compared in order to identify the differences between samples. To determine if there is any degree of association between the use of mentioned resources and the achievement of those competences, a correlation test will be used.

4. Discussion

The research's focus is on only part of the gas content, which is a limitation. On the other hand, the understanding of some relations between aspects of the construction of discourse in science teaching may contribute, in future studies, to the extension of research applicability to other contents of chemistry, other sciences and other levels of education, including higher education. Finally, it is hoped that the experience derived from this research in science education may also contribute to timely discussions in the field of science dissemination.

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