Creation of meanings on the theme "nature of science" by chemistry graduates in electronic forum

Eveline Borges Vilela-Ribeiro[1], **Anna Maria Canavarro Benite[1]** , **Claudio Roberto Machado Benite[1]**

eveline_vilela@yahoo.com.br , anna@quimica.ufg.br

[1]*LPEQI- Laboratório de Pesquisa em Educação Química e Inclusão – Universidade Federal de Goiás, CP 131 CEP 74.001-970 – Campus Samambaia – Goiânia – Goiás*

Abstract

Investments in policies for science teachers, as well as their adaptation to new realities and technologies are essential, since the teacher is the key to changing mindsets and attitudes of their students. Thus, conceptual discussions are proposed between chemistry teachers in a virtual environment on the Moodle platform on topics previously chosen by the education teacher. The objective is to analyze the process of creating meanings of participants of the forum on the theme "nature of science." It was noticed that new media can help building students' knowledge and motivate them to expand their research and scientific readings; however, rules must be pre-established so that a real interaction and mediation could occur. Initiatives like these are useful for the understanding of scientific and technical fields, and may also facilitate communication and interaction between teachers and students.

Key words: Teaching strategies, Philosophy and History of Science, Cooperative learning, New technologies

Elaboraçao de significados sobre o tema "natureza da ciência" por licenciados em química em fórum eletrônico

Resumo

O investimento nas políticas de formação de professores de ciências, assim como sua adaptação às novas realidades e tecnologias é primordial, já que é o professor, a priori, o elemento fundamental para a mudança de mentalidade e atitude de seus alunos. Assim, são propostas discussões conceituais entre professores de Química em formação em um ambiente virtual na plataforma Moodle sobre temas previamente escolhidos pelo professor da disciplina de Didática. O objetivo do trabalho consiste na análise do processo de elaboração de significados dos participantes do fórum sobre o tema "natureza da ciência". Percebeu-se que as novas mídias podem auxiliar na construção do conhecimento dos estudantes e motivá-los a expandir suas pesquisas e leituras científicas, mas é necessário o pré-estabelecimento de regras para que aconteça uma real interação e mediação. Iniciativas como essa corroboram para a apreensão dos domínios técnicos e científicos, podendo inclusive facilitar a comunicação e interação entre professores e alunos.

Palavras chave: Estratégias de ensino, História e Filosofia da Ciência, Aprendizagem cooperativa, Novas tecnologias

Elaboration des significations sur le thème "Nature of Science" pour les diplômésen chimie dans le forum électronique

Résumé

L'investissement dans les politiques de formation pour les professeurs de sciences, ainsi que

leur adaptation aux nouvelles réalités et des technologies est essentielle, comme l'enseignant, a priori, l'élément clé pour un changement de mentalité et d'attitude de leurs élèves. Ainsi, sont proposées des discussionsconceptuelles entre les enseignants de chimie en formation dans un environnement virtuel Moodle sur des thèmes choisis par auparavant professeur de l'enseignement.L'objectif de cette étude est d'analyser le processus de construction du sens des participants du forum sur le thème «nature de la science." Il a été noté que les nouveaux médias peuvent aider à construire vos connaissances des élèves et les motiver à élargir leurs recherches et de lectures scientifiques, mais vous devez vouspré-établissement des règles de ce qui arrive à une véritable interaction et la médiation. De telles initiatives servent à soutenir la saisie des champs scientifiques et techniques, et peut également faciliter la communication et l'interaction entreenseignants et étudiants.

Mots-clés: Stratégies d'enseignement, histoire et philosophie des sciences, l'apprentissage coopératif, les nouvelles technologies

La construcción de significados sobre el tema « la naturaleza de la ciencia » por estudiantes de química en foro electrónico

Resumen

Inversiones en las políticas de los profesores de ciencias, así como su adaptación a las nuevas realidades y tecnologías son esenciales, ya que el profesor es la clave para cambiar modos de pensar y las actitudes de sus alumnos. Por lo tanto, los debates conceptuales son propuestos entre los profesores de química en un entorno virtual en la plataforma Moodle en temas seleccionados previamente por el profesor de educación. El objetivo es analizar el proceso de creación de significados de los participantes del foro sobre el tema "La naturaleza de la ciencia." Se observó que los nuevos medios pueden ayudar a la construcción de conocimiento de los estudiantes y motivarlos a ampliar sus investigaciones y lecturas científicas, sin embargo, las reglas deben ser fijadas de modo que una interacción real y la mediación podría ocurrir. Iniciativas como éstas son útiles para la comprensión de los ámbitos científicos y técnicos, y también puede facilitar la comunicación y la interacción entre profesores y alumnos

Palabras clave: Estrategias de enseñanza, Filosofía e Historia de la Ciencia, aprendizaje cooperativo, nuevas tecnologías

1. INTRODUCTION

The relevance of science education for students is a matter already addressed by several authors and from different perspectives (Cachapuz et al 2005; Fourez 2003; Krazilchik 1992). However, although there are disagreements about why to teach science, there is a "basic convergence of different authors on the need to go beyond the usual transmission of scientific knowledge, to include an approach to the nature of science and scientific practice, and especially, to emphasize the science-technology-society-environment relation, to promote citizens' participation in making reasoned decisions" (Aikenhead 1985 apud Cachapuz et al 2005, p.23).

Science education produces educated citizens (Chassot 2000) able to make decisions and participate actively in a pluralistic and globalized world, being professionals with a solid foundation on scientific knowledge to apply it to develop solutions and collaborate for the growth of the country. Our results are in line with Hodson (1998), who reported that science education should involve three aspects: learning science, learning about science, learning to do science, permeated with ethical and political issues (Cachapuz et al, 2004; Unesco 1999; Hodson 1998).

However, for that to happen, it is essential to invest in training policies for science teachers and their adaptation to new realities and technologies, since teachers, a priori, are the key to change mindsets and attitudes of their students (Levi 1999). In addition, teachers should be prepared to deal with a generation that has more contact with new technologies and easier access to new sources of search, such as the Internet. These adjustments imply profound changes in the educational paradigm, focusing on new technologies as tools for interaction and pedagogic mediation (Faria 2004).

Information and communication technologies (ICTs) are tools with high possibility of application in education, not replacing the teacher, but rather modifying and expanding their roles in the educational process (Moran 1995). The teacher's task to just delivery the subject's content to students has become obsolete, since there are databases with vast amounts of information to search for, and their role has become more complex, mediating the information between students and technology (Demo 2001).

Data from literature suggest that in most undergraduate courses in Brazil, there is no basic training in computers or technology, and that this deficiency contributes to disinterest in the use of ICTs in teaching / learning processes (Barreto 2003). Besides the deficiency in basic training, there are

teachers who are already in office and have no interest in any update, added to poor conditions of schools, which discourage any initiative. These are some of the reasons listed to explain why there are only few teachers who use ICTs as work tools (Brilha et al 1999).

Among the various possibilities of using ICTs in schools, computer stands out, since it is a tool that allows great interactivity and easy access to various data types (Martinho and Pombo 2009). In this context, the Brazilian government has donated funds to computerize the schools throughout the country, arguing that students need to learn computation to meet new market needs (Brasil 1999). However, researchers wonder how schools should be computerized if teachers are not prepared to deal with the application of ICTs in classroom, since they do not have theoretical / practical training to use them (Faria 2004).

Therefore, it is plausible to make use of these new technological tools including in training courses for teachers, since they offer differentiated educational opportunities, including discussions in virtual environments, enabling collective knowledge construction with technology as a tool for teacher-mediated activity. It is then expected that discussions involving ICTs can be useful to the teaching practice (Ponte 2000, Davis 1999; Freitas 1999), being used as teaching, dialogical and cultural tools in this process.

1.1- Virtual learning environments

Studies on the interaction in non-live educational activities mediated by the Internet have been increasingly important in research on the inclusion of information and communication technologies in education (Giordan and Dotta 2008, p.127).

The focus of studies on the use of technology in classroom has been the interactive action in teacher-student and student-student relationships in activities held in virtual learning environments. These activities can be understood according to their temporal characteristics (Santos and Rodrigues 1999) as follows:

a) Synchronous or synchronized activities: provide opportunity for joint activities happening at once. Examples are: Remote Control (Telnet), IRC-chat and Voice and Search - (ICQ - I-seek-you), Audio and Video - Videoconferencing, Whiteboard - GroupWeb; Virtual Reality text - MOO; Collaborative Virtual Environments - CVE.

b) Asynchronous activities: they do not depend on a given reference time. Examples are: electronic mail (email) mailing lists; Newsgroup; File Transfer - FTP, WWW sites - World Wild Web, forums, video on demand.

Virtual learning environments (VLEs) are considered shared spaces of coexistence, which support the construction, integration and exchange of information by participants. The principle of shared learning is based on sharing knowledge, authority, mediated learning, appreciation of diversity and differences, and construction of meanings and re-meanings in the learning process (Magalhaes 1998). Without this combination of factors, technology alone is not enough.

VLEs integrate the facilities of the web in network structures and enable the provision of tools that make the performance of cooperative tasks within collaborative philosophy possible. In these environments, it is possible to objectively perform, according to Bianchini (2003, p.63, 64), the following:

• Remote-Control - Telnet: to run it, the program establishes the connection to the target computer and takes control of the recipient computer.

• File Transfer protocol - FTP: it offers the possibility to transfer files across computer networks, useful for both sending and receiving files

• IRC (Internet Relay Chat): chat-system in textual form allows two network users to exchange messages with each other simultaneously.

• MOO - Multi User Domain Object Oriented - text-based virtual reality. A MOO is an imaginary world in which users use words and language programming to improvise and simulate worlds, with the possibility of including emotions.

• GroupWeb - corresponds to a browser that allows a group of users to visually share and navigate together through Web pages in real time.

• CVE - Collaborative Virtual Environment - allows real-time simulation of a real or imaginary world, where groups of geographically separated users interact in real time. The user in this environment is represented by an avatar.

• Voice and search - ICQ: (I-seek-you) - a program that allows users to establish conference network to chat, send messages, transfer files, participate in interactive games.

• Electronic mail – email: corresponds to the sending and receiving of messages through the network with the ability to attach varied files.

• Newsgroup: similar to mailing lists, it allows the exchange of text messages, sending attachments. It establishes an asynchronous forum and allows sending (joining) and receiving (from other participants).

• Videoconferencing: it allows the use of audio and video signals for point-to-point and point-to-multipoint modes. It is necessary to use resources such as sound card, loud speakers and video camera to capture and process these signals.

• Whiteboard: it enables users to share a "whiteboard", or a graphics area, allowing them to interactively draw pictures, write, insert pictures, make notes etc.

There are several possibilities offered by online communication through which teachers and students can interact discursively. These interactions enable the symbolic mediation, which is effective in a discursive exchange and the technical mediation of cultural tools shape the process.

Discursive interactions produced in VLEs are fundamental for the construction of knowledge, which according to Vygotsky (1984, p. 64), occurs through the "internalization of activities historically constructed and socially rooted".

According to Rezende and Ostermann (2006) and Benite and Benite (2008), focusing linguistics at the expense of other forms of dialogues, communication in the form of statements in writing, the time intervals between turns (much higher than in a live class), the speech much less linear, time for the participant's utterance, and the possibility to consult other persons or bibliographic sources to build up his statement are specificities of electronic forums that can affect communication and the social construction of knowledge.

In this context, the aim of this research was to analyze the process of creating meanings on the theme "nature of science" by undergraduate Chemistry students, participants in an online discussion forum.

2. METHODOLOGY

Under the epistemological focus of historical and dialectical materialism, this research was an action research (Elliot 1994), configured as a strategy for teachers and researchers to use their research to improve their teaching practice. Thus, a new space for conceptual discussion is proposed, which uses technological and cultural tools to mediate this process.

In 2009, the discipline Didactics II was offered in the second half to students from the fifth period of Chemistry (15 students) - State University of Goias, taught by a professor of science education (graduate, Master in science education and PhD in the same area). Prospective chemistry teachers were invited to participate in conceptual discussions on issues previously selected by teachers. The forum was used for two purposes:
a) to extend the time of conceptual discussion beyond live classes;
b) to enable the development of technical and educational mastery to future teachers by the planning and management of education system in VLEs.

Prospective students took turns in the various topics proposed for conduction of the forum (each topic lasting one week) for discussion as mediators (tutors) of the teaching and learning process and thus experienced new relationships with the computer as a mediated action tool.

The themes proposed for the conduction of the forum were:
i. Exploring the motivation to teach Chemistry, ii. What is scientific knowledge?, iii. The teaching - learning process iv. Training of science teachers: a challenge without borders; v. Science education in the times of Internet. The themes defined analysis episodes that produced a total of 439 turns of written discourse. It was observed that the first two episodes were composed of an average 15 turns and in the others the production of written discourse has grown considerably to an average 136 utterances. This new reality seems to be a result of the subjects' understanding of the technological context in the pedagogical practice through experience.

The conceptual discussions were held in a VLE called Moodle (Modular Object Oriented Dynamic Learning), which is a free access software used to support the education system. This plataform is aimed at the online communication among users and is available by the State University of Goiás. Teachers and students must register in the system to initiate interactions. Once registered, the participant defines a password and has access to the system that is configured by the tutor student and the discipline teacher. These Moodle's interactions produced a database, which only one episode was analyzed.

Teachers under training were instructed (by discipline teachers) before playing the role of mediators to conduct the keynote of the process that was the production of

symmetrical dialogue, i.e., those where several participants have supposedly the same right to authorship and to decide on their participation time (Marcuschi 1999). Participants were asked to produce a counter-word, i.e., to give their opinions on the topic under discussion and could also share new bibliographies with other individuals in the group.

For this investigation and due to space limitation, the forum entitled "What is scientific knowledge?" was selected, in which 11 students were included. The students were named A1, A2, ... A11, and 15 utterances were produced, i.e., turns of written discourse (numbered in ascending order):

> "We understand any meaningful discourse as having a form (materiality, sound or image) and content (understood as signification, sense, sense effect, etc.). The analysis must be someway relating them, leading them, a form and content – none of them preexisting nor is the natural thing (Possenti 2001, p.234)."

It is worth stressing that the written speech, as well as the spoken language, is full of intentionality (Giordan 2003; Benite and Benite, 2008). However, "the written word requires double abstraction: the sound aspect of language, requiring a symbolization of sound symbols, and the interlocutor, which is imaginary or idealized" (Benite and Benite, 2008, p.4).

Considering also the "appropriation" as the "possibility of taking something from someone and make it your own" (Wertsch 1998, p.53), tries to explain the discursive appropriation of the students in terms of internal and external actions mediated by cultural tools, in this case, online discussion forums (Giordan 2005a).

The speech produced was analyzed from the perspective of content analysis (Bardin 1994) in order to elucidate general discursive features, heterogeneity manifestations, intertextual relationships, sense effects and clarity of the concepts covered. For this, we quantified the speeches by participating in a forum, examined the discursive flow of participants and the production of enunciation. In addition, we also analyzed the influence of the speech of different individuals on the counter argument.

Still from the perspective of content analysis, we conducted a thematic analysis (Bardin 1994), which is the quantification of one or several significance items, so that meanings are seized in the speech of the participants; speeches that portray the vision of the science. For this, we sought expressions that referred the characteristics of scientific knowledge.

3. RESULTS AND DISCUSSION

It is necessary to clarify that although expected to be held from 14 to 21 September, posts dated from 17 to 20 September, mainly due to: once registered in the system, the user needs to attend a presentation forum that reveals the social tissue that makes up the research subjects. This step is part of the exercise to dominate the tool. The last day has been reserved by the class teacher to carry out the live activity to recover the discussion and guide to encourage the

mapping of individual and collective productions held in the VLE.

Our results show that most students participate only once. Of the fifteen speeches produced, four were made by A2, two were made by A4 and the other subjects participated in the forum only once as in figure 1.

Figure 1 - Number of participations per student (A1 - A11) in the 1st discussion forum.
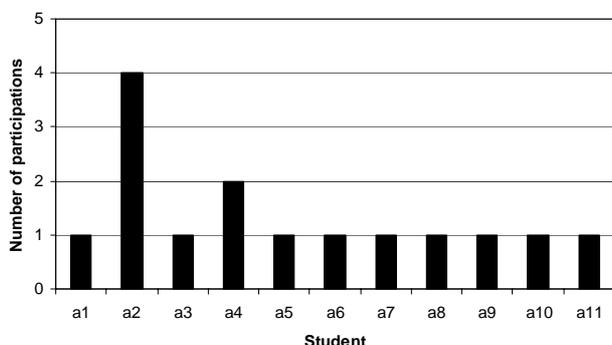
The student who plays the role of mediator began the interaction process by calling the subjects to express their understanding of the subject. It is interesting to clarify that this student will need to make use of strategies to accomplish the verbal interaction in the production of utterance forms.

The interaction process continues with a bibliographic citation widely used on the subject (BORGES 1996) by A1 on the importance of the scientific knowledge for the scientist.

In addition, in turns 2 and 3, A2 continues the discussion, but makes no comment on any previous statement, that is, on the others' voice. A2 cites another author (MORDEGAN 2005) when he talks about what is science and argues about the difference between common sense and science.

In turns 2 and 3 A4 makes a summary of features that characterize science and tries to establish a relationship between science and economy through a text taken from the internet. Again, this subject makes his speech without considering the previous turn. A2 continues in the forum making two quotes from Bachelard. In turn 7, A4 makes a quote from SANTOS (1989); he issues his opinion on this quote. At this point, we noted the influence of communities in the own discursive formation and its several segments, which ultimately defines a discursive practice that includes, in our case, the production of textual discourse.

In turn 8, A5 makes citations without issuing his opinion, but he attached two texts to the forum. Similarly, A6, in turn 9, attached two texts and mentioned other authors (Carvalho and Kaniski 2000).

In turn 10, A4 puts a new contribution to the discussion, making a short quote about the dynamism of scientific knowledge and expresses his knowledge on the topic under discussion.

Turn 11 brings more quotes about why scientific

knowledge has to be more reliable than other types of knowledge. The following turns (12, 13 and 14) show characteristics of the scientific knowledge from the viewpoint of different authors (Parente 1990; Santos 1989). The discussion ends on turn 15 with two articles being attached by A11 on the dynamism of the scientific knowledge and the production of enunciation in which A11 listed the topics about what is scientific knowledge.

It is interesting to note that students do not relate to the various posts with each other and we can attribute this to the fact that there is no need for linking them in the initial rules attributed to the use of the forum.

Thus, when the computer is the mediated action tool, the textual exchanges make up the communication process and this feature reflects the social roles played by subjects of action. Therefore, how the verbal interactions are developed in this environment is a direct function of the organization and structure of the activities developed. Thus, for discussions of the upcoming topics, we define the establishing of such relationships as a rule, so that participants could issue more clearly what they think about certain subjects, further enriching the discussions.

The results allow inferring that A2 did not act, ultimately, as a mediator, since to play this role, the subject must be placed in a position of challenger of interactions in the learning environment and in turn, he must have the ability to communicate: to be open to questions and online constructions, to propose and lead discussions and be connected most of the time during the activity. A2 had only four appearances that could not be characterized as provocative interactions.

In addition, it is noteworthy that for a mediator to be able to break with the logic of the one-way communication, it is necessary to establish the online interaction between subjects. There are three reasons for interactivity: participation-intervention (the users interfere with the logic of the communication); bidirectionality-hybridization (all transmitter is a receiver and vice versa), and substitutability-potentiality (communication is defined by multiple inputs and outputs of the moving speech) (Silva 2002, p. 101).

The little participation of A2 also shows that there was no understanding of the social role he should play, since he did not contribute significantly for the generation of the dialogue. This fact can be understood, since the virtual environment is not widespread in training courses for teachers and this was the first experience of these future teachers involving interactive processes and technological resources.

In this context, we realize that most of the posts are citations, and the subjects rarely explain their own opinions. Of the fifteen participations posted, only three made use of value judgments of the subjects over 12 who were quotes from other texts (Figure 2). According to Maingueneau (1997), the multiple sources of explicit enunciation of speech production such as the use of reported speech, different statements and assumptions, quotation marks, metadiscourse of the announcer, paraphrase, free indirect discourse, irony, consensual knowledge, proverbs, etc. are

the heterogeneity enunciation. In turn, heterogeneity reveals the polyphony of discourse analysis.

The concept of polyphony was developed by Ducrot, retaking the term used by Bakhtin to refer to multiple visions included in the novels of Dostoyevsky. The term is used referring to "the chorus of voices that usually manifests itself in discourse, since the thought of another is constitutive of ours, not being possible to separate them radically" (Koch 2004, p.23).
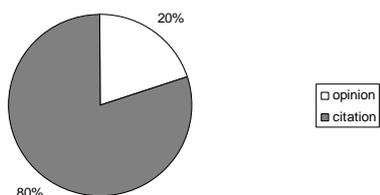

Figure 2 – The way students participate in the forum: opinion or citation

It is noteworthy that the participation of students in the form of opinion or citation does not disqualify the forum, because each individual can express his knowledge according to his cognitive skills. In this sense, both types of participation show distinct processes regarding the interaction process: the quotation reveals that students were interested in researching the issue and that there was a minimum of reading about, and also indirectly reveals how subjects feel about the issue, since the citation will only be collected if there is a minimum of consensus and agreement with what is written, the opinion of the subjects is an explicit way to see how each one thinks about the issues in question as well as to check if there was apprehension on the issue or not.

Regarding the type of bibliography researched, the results reveal that the majority was drawn from scientific articles or specific books (88%) and few references were derived from popular sites (12%).

The value given to the consultation of scientific sources is related to the fact that it is an academic discipline that gives priority to scientific education and therefore the ideal situation is to research knowledge validated by science. The access to non-scientific sources can happen at certain times in the classroom, when the characteristic rigor of science is not required. We agree with Maingueneau, (1997) that the scientific discourse is only meaningful within a certain group, which is its own purpose.

Our results reveal that participants have different perceptions of what science is, and this fact is perceived in quotes or statements that they post to the forum. The understanding of how scientific knowledge is built affects the attitudes of students as future teachers, since we believe that the attitude of teachers is also defined by their vision of science (Medeiros and Bezerra Filho 2000; Vilela-Ribeiro et al 2009). Therefore, we analyze the vision of science of every teacher in training.

This analysis was outlined by grouping the propositions that they express to the interpretation in terms that they make explicit the thinking of the subject, and according to the Content Analysis, called as items of significance (Bardin 1994). In this investigation, the items of significance were assigned as keywords converged for each post that referred to some characteristic of scientific knowledge.

Table 1 shows the results of the grouping of discourse propositions that converge to features that relate to the nature of scientific knowledge and characteristics that do not relate to scientific knowledge.

The results reveal that some participants (a1, a6, a9, a10) show some deformities in their vision of science (Cachapuz et al 2005), which are simplifications or interpretations that assume a single and universal method for the scientific development, leading to a naive picture and away from what is proposed for a critical science education. Subjects A1 and A11 refer to experimentation as the main characteristic of science. However, although experimentation is one of the methods used for the production of scientific knowledge, it is not the only that defines it (Hodson 1985). The valuation of experimental activities in science can lead to the idea that the experimental data are meaningful by themselves; however, they only make sense in certain contexts and interpretations. Thus, every experimentation is preceded by theories or coherent visions articulated in practical research (Benite and Benite 2009).

Subjects A6, A8, A9 and A11 define that rigor, clarity and precision as characteristics of science (turns 9, 12, 13 and 15, Table 1). These attributes relate to the positivist description of the scientific method as a sequence of steps rigorously defined, and the results are objective and accurate, this position is called as naive realism, and the truths of science have the status of "unquestionable" (Bezerra and Medeiros Filho 2000). The scientific logic is not always based on the accuracy and absolutism, but also in transient truths that oscillate, since new discoveries are made and new theories are developed. Moreover, the presence of systematic doubts is common in the search for new solutions, noting, therefore, that science is not always precise and rigorous, but made of assumptions (which are not always confirmed) and uncertainties.

Some participants (A2, A3 and A4) define observation as the initial step in the development of scientific knowledge (turns 2 and 3, Table 1). The logic of observation - formulation of hypotheses – conduction of experiments – acceptance or rejection of hypotheses is traditional in science (empiricist). Following the reasoning of traditional science, the problem arises from a theory and ends when the solution is found by adopting a continuistic sense of logic that scientific knowledge grows over time (Praia et al 2002). However, unlike his colleagues, A10 suggests that science is not cumulative and A11 (despite considering science as consisting of rigorous methods) emphasizes that science is not governed only by observation (turns 14 and 15, Table 1).

Participant	What is science	What is not science
1	Value to experimentation	-
2	Comes from observation	-
	Specialized knowledge	-
3	Specialized knowledge	-
	Observation – Hypotheses – experience – Acceptance or rejection of hypotheses	-
4	Valuation to theory	-
	Unreliable	-
	Observation – Hypotheses – experience – Acceptance or rejection of hypotheses	-
5	Full of scientific revolutions	Static
6	Clear, precise, explicative, absolute	-
7	-	Ordinary knowledge, common sense
8	Clear and precise	-
9	Rigorous	-
10	-	Cumulative
11	Temporary truths	-
	Rigorous Methods	Not ruled by observation only
	Creativity	-
	Value to experimentation	-

Table 1 - Items of significance relating to the issue "What is science?"

For Popper (1983), science begins with a problem (and not with an observation), to which an attempt of resolution is offered, seeking to refute the theory from experimentation (and never to support it). The observation in science cannot be neutral because it depends on the expectations of the beholder and is fallible, and as a human creation, is subject to errors and interpretations and thus, it could not be the first step to develop a rational understanding of the world. Similarly, simple steps may not accurately represent the construction of scientific knowledge, since its construction is almost always the result of a winding path, with methodologies developing interpretations, formulations, models up to the temporary creation of an explanation, which could be accepted or not.

Participant A5 also mentions that science is not static, but permeated by scientific revolutions (turn 8, Table 2). The model of knowledge construction proposed by Kuhn (1979) points out that science does not progress through accumulation. Rather, there is a period when no changes occur (normal science) and the current paradigm coherently explains all questions relating to the theory, but over time problems arise, so that theory no longer meets the scientific community, with the emergence of new theories that can effectively explain the anomalies, being a period of abandonment of an old theory and emergence of a new one so-called "scientific revolutions".

The positivist view of science, which considers the development of science explained solely by experimental data, is seen in the utterances of nine of the 11 participants. Only participant A5 presents evidence of readings of epistemologists of science such as Kuhn (turn 8, Table 2). This is a sign that the teacher training institution, i.e. the graduation courses need to include this discussion in the formation of future teachers.

CONCLUSIONS

The use of cultural tools such as conceptual discussions on Moodle platform or in blogs and the access to discussion forums can provide new opportunities for teacher training, since the barrier of distance is overcome by the access to new information technologies and these can happen at times that are most convenient for each student.

It could be concluded that training teachers not only familiarize them with new technologies as tools in the teaching-learning process, but they can also make use of them in classroom. The use of new technologies makes the role of teachers even more important, who play a mediating role and no longer the holder of knowledge, especially when these tools are responsibly used and not merely their superficial dimensions, corroborating results of Giordan (2005b).

This study showed that new media can be useful to build students' knowledge and motivate them to expand their research and scientific readings. The utterances produced in the forum have as main feature the polyphony and dialogism, as the discourse brings the words of others, and in which context, expressed what students would like to say. Such initiatives tend to facilitate communication and interaction between teachers and students and new forms of assessment and communication may emerge.

Moreover, this forum can be an alternative to encourage students of exact sciences courses to express your opinions, overcome your difficulties within the written language and develop ideas about history and philosophy of science trough the dialogues with another students. The chemistry is an exact science, and some students don't develop abilities and skills related to argumentation on issues related to the humanities.

Finally, the "forum" interface has proved promising in the

sense that it is available for the research subjects, and they could read the ongoing discussions and give their contributions. Also, the availability of information allows us to reflect and to position ourselves in relation to the discussions.

BIBIOGRAPHIC REFERENCES

Bakhtin, M. (2006). *Marxismo e filosofia da linguagem.* São Paulo: Hucitec.

Bakhtin, M. (2003). *Estética da criação verbal.* São Paulo: Martins Fontes.

Bardin, L. (1994). *Análise de conteúdo.* Lisboa: Edições 70.

Barreto, R.G. (2003). Tecnologias na formação de professores: o discurso do MEC. *Educação & Pesquisa*, v.29, n.2, p.271-286.

Benite, A.M.C.; Benite, C. (2008). O computador no ensino de química: Impressões *versus* Realidade. Em foco as escolas públicas da Baixada fluminense. *ENSAIO Pesquisa em Educação em Ciências*, v.10, n.2.

Benite, A.M.C.; Benite, C.R.M. (2009) O Laboratório didático no ensino de química: uma experiência no ensino público brasileiro. *Revista Iberoamericana de educação*, v.48, p.1-10.

Bianchini, D. (2003). *SALVI – Salas de aula virtual: Contribuição para a comunicação sincrona em educação mediada por computador.* Tese (Doutorado em educação) – Faculdade de Educação da Universidade de Campinas, Campinas, São Paulo.

Borges, R.M.R. (1996) *Em debate: cientificidade e educação em ciências*. Porto Alegre: SE/CECIRS.

Brasil. (1999). Ministério da Educação. Secretaria da Educação à distância. *Programa Nacional de Informática na Educação*. Brasília.

Brilha, J.; Legoinha, P.A.R.; Gomes, A.M.; Rodrigues, L.A. (1999). A integração das TIC no ensino – perspectiva atual no domínio das ciências naturais. *I Conferência Internacional Desafios 99*, p.118-127.

Cachapuz, A.; Praia, J.; Jorge, M. (2004). Da educação em ciências às orientações para o ensino das ciências: um repensar epistemológico. *Ciência & Educação*, v.10, n.3, p.363-281.

Cachapuz, A.; Gil-Perez, D.; Carvalho, A.M.P.; PRAIA, J.; Vilches, A. (2005). *A necessária renovação do ensino de ciências*, São Paulo: Editora Cortez.

Carvalho, I.C.L; Kaniski, A.L. (2000). A sociedade do conhecimento e o acesso à informação: para que e para quem? *Ciência da Informação*, v.29, n.3, p.33-39.

Chassot, A.(2000). *Alfabetização científica: questões e desafios para a educação*. Ijuí: Editora Unijuí.

Davis, N. (1999). ICT educational research centre. In: Dias, P; Varela, C.D. *Actas da I Conferência Internacional de Tecnologias da Informação e Comunicação na Educação.* Braga: Centro de Competência Nônio Século XXI da Universidade do Minho.

Demo, P. (2001). *Conhecimento e aprendizagem na nova mídia*. Brasília: Editora Plano.

Elliot, J. (1994). Research on teacher's knowledge and action research. *Educational action research*, v.2, n.1, p.133-137.

Faria, E.T. (2004). O professor e as novas tecnologias. In: enricodone, D. (org.). *Ser professor*. 4ª ed. Porto Alegre: EDIPUCRS.

Fourez, G. (2003). Crise no ensino de ciências. *Investigações em ensino de ciências,* v.8, n.2.

Freitas, C.(1999). Desafios para a formação de professores. In: Dias, P; Varela, C.D. *Actas da I Conferência Internacional de Tecnologias da Informação e Comunicação na Educação.* Braga: Centro de Competência Nônio Século XXI da Universidade do Minho.

Giordan, A. (2003). Observation – espérimentation: mais comment lês élèves apprennent-ils ? *Revue Française de Pédagogie*, v.44, p.66-73.

Giordan, M. (2005a)A Internet vai à escola: domínio e apropriação de ferramentas culturais. *Educação & Pesquisa*, v.31, n.1, p.57-78.

Giordan, M. (2005b). O computador na educação em ciências: breve revisão crítica acerca de algumas formas de sua utilização. *Ciência & Educação*, v.11, n.2, p.279-304.

Giordan, M. (2008). Estudo das interações mediadas por um service de tutorial pela Internet. *Linguagem & Ensino*, v.11, n.1, p.127-143.

Hodson, D. (1985). Philosophy of science, science and science education. *Studies in Science Education*, v.12, p.25-57.

Hodson, D. (1998) *Teaching and learning science.* Buckinghan: Open University Press.

Koch, I. G.V (2004). *Argumentação e linguagem,* 9ª edição. São Paulo: Cortez.

Krazilchik, M. (1992). Caminhos do ensino de ciências no Brasil, *Em Aberto,* v.11, n.55, p.3-9.

Levi, P. (1999) *A inteligência coletiva: por uma antropologia do ciberespaço*. São Paulo: Loyola.

Magalhães, L.P.(1998) *SAPIENS – Ambiente colaborativo para apoio à aprendizagem.* São Paulo..

Mangueneau, D. (1997). *Novas tendências em análise do discurso.* 3ª edição. Campinas: Pontes.

Marcuschi, L.A. (1999). Gêneros textuais: definição e funcionalidade. In: Dionisio, A.; Machado, A.; Bezerra, M.A. (Orgs.). *Gêneros textuais & Ensino*. Rio de Janeiro: DP & A.

Martinho, T.; Pombo, L. (2009) Potencialidades das TIC no ensino das ciências naturais – um estudo de caso. *Revista Electronica de Ensenanza de las Ciências*, v.8, n.2, p.527-539.

Medeiros, A.; Bezerra Filho, S. (2000). A natureza da ciência e a instrumentação para o ensino de física. *Ciência & Educação,* v.6, n.2, p.107-117.

Moran, J.M. (1995) Novas tecnologias e o re-encantamento do mundo. *Tecnologia educacional*, v.23, n.126, p.24-26.

Mordegan, L. (2005). *A ciência num piscar de olhos.* São Paulo: Ática.

Parente, L.T.S.(1990) *Bachelard e a química no ensino e na pesquisa*. Fortaleza: Editora da UFCE.

Ponte, J.P. (2000). Tecnologias de informação e comunicação na educação e na formação de professores: que desafios? *Revista Ibero-Americana de Educação*, v.24, p.63-90.

Popper, K. R. (1983) *Conjecturas y refutaciones: el desarollo del conocimiento cientifico*. Barcelona: Paidos.

Possenti, S. (2001). *Discurso, estilo e subjetividade.* 2ª edição. São Paulo: Martins Fontes.

Praia, J.F.; Cachapuz, A.F.C.; Gil-Pérez, D. (2002) Problema, teoria e observação em ciência: para uma orientação epistemológica da educação em ciência. *Ciência & Educação*, v.8, n.1, p.127-145.

Rezende, F.; Ostermann, F. (2006). Interações discursivas on-line sobre Epistemologia entre professores de Física: uma análise pautada em princípios do referencial sociocultural. *Revista Electrónica de Enseñanza de las Ciencias*, v. 5, n. 3, p. 505-521.

Santos, B.S.(1989). *Introdução a uma ciência pós-moderna*. Rio de Janeiro: Editora Graal.

Santos, E.; Rodrigues, M. (1999). *Educação à distância:* conceitos, tecnologias, constatações, presunções e recomendações. São Paulo: EDUSP.

Unesco. (1999) *Ciência para o século XXI: um novo compromisso.* Lisboa: Comissão Nacional da Unesco.

Vilela-Ribeiro, E.B.; Benite, A.M.C. (2009). Concepções sobre a natureza e o ensino de ciências: um estudo das interações discursivas em um Núcleo de Pesquisa em Ensino de Ciências. *Revista Brasileira de Pesquisa em Ensino de Ciências*, v.9, p.1-23.

Wertsch, J.V. (1998). *Mind as action*. New York: Oxford Uni Press.

Eveline Borges Vilela Ribeiro

Possui graduação em Química (2008) e Mestrado em Educação em Ciências e Matemática (2011) pela Universidade Federal de Goiás. Atualmente é professora auxiliar da Universidade Federal de Goiás. Tem experiência na área de Química, com ênfase em Ensino de Ciências.