



FOSTERING A GROUP OF SCIENCE TEACHERS SUPPORTED BY AUDIOVISUAL RESOURCES TO APPROACH THE NATURE OF SCIENCE IN TEACHING SITUATIONS

^aEdson Rodrigues SANTANA & ^bAgnaldo ARROIO

^aDoctoral Student in Science Education, Faculty of Education, University of São Paulo, Brazil,
edsonrodriguessantana@hotmail.com

^bProf. Dr., Faculty of Education, University of São Paulo, Brazil, agnaldoarroio@yahoo.com

Abstract

We seek to work with this approach the topic of the nature of science (NOS) in a process of teacher training supported by a community of practice, where filmic resources were used to subsidize both the understanding of the subject as to sustain the practices of teachers in situations teaching. The data presented support this approach, as teachers take ownership of the film and the contributions of other teachers to elaborate prior planning and material guiding their practices. This plan is called Teaching and Learning Sequences (TLS). The methodology used was based on the references of qualitative research in education, as well as the analysis and discussion of the data. For the construction of this work were developed two courses for teachers of basic education in the state of São Paulo, and what happened in the Faculty of Education, University of São Paulo, Brazil with the initial participation of 14 teachers, and 5 completed the second course. The two courses took place during the year 2012.

Keywords: *cinema, nature of science, in-service teachers*

INTRODUCTION

The purpose of this paper is to discuss how the subject nature of science (NOS) is inserted in a process of teacher training in a community of practice perspective. So that the objectives were achieved introduced the idea of resource use filmic as methodological support. As to the materialization of ideas we used a teaching and learning sequences (TLS) where they contributed to guiding the intentions of the teachers during the didactic training sequences.

The nature of science (NOS) approach is not a new issue. Akerson, Abd-El-Khalick and Lederman (2000), emphasize research over 85 years and the ramifications of this area, according to Harres (1999), originated in the 50's. The literature identifies four areas of research on conceptions of the nature of science (CNS). These are: student conceptions, conceptions pertaining to curricula, teachers' conceptions, and interactions between teachers' conceptions in their classrooms and students' conceptions.

Bell, Lederman and Abd-El-Khalick (1998) demonstrated that it is not enough that teachers only have adequate conceptions of the NOS, it is, instead, necessary to understand how this theme is incorporated in teaching and learning situations involving scientific concepts. For this we raise the issue of the use of filmic resources as methodological support for addressing the NOS in a process of continuing education.

One of the characteristics of the scientific enterprise is the production of discourses based on problem solving. In developing explanations, these are transmitted to the scientific community, governments, businesses and society in general, so the explanatory power of argument is essential, especially when the goal is to convince the groups mentioned above, thus understand how Aikenhead (2006) about human scientific enterprise and that this should be incorporated in science education especially when it approaches with the NOS.

In this sense science is a means by which circulating arguments and explanatory models of reality, and the communication of what is produced is through text with their own concepts and part of this textual production is selected and incorporated references to science education curriculum.

Even the activities of teaching and learning in its entirety does not express what the scientific community experiences, there is no denying the bias argumentative and investigative scientific enterprise which is incorporated into the teaching of science.

Argue thus is a task to be taught, because it allows the subject to make critical judgments before the world. However learning and teaching to argue are not the easiest of tasks. The same can be said with regard to the NOS, so we are faced with two important content and degree of difficulty regarding the objectification sharp practice them.

Researchers such as McDonald and McRobbie (2012) highlight the importance of the use of argument associated with explicit instruction of NOS in the learning processes of NOS. These researchers also cite authors as Rosalind Driver, Paul Newton, Jonathan Osborne, Maria Pilar Jimenez-Alexandre as sources in the literature that discuss the relevance of argumentation in science education.

If we regard the teacher as facilitator and motivator of learning is to think how to do this? Resources or methods that could assist you in these processes?

Driver, Leach, Millar and Scott (1996) highlight the importance of the NOS. as a mechanism for learning science itself, for that feature investigative proposal and to consider what students understand about NOS. The researchers also point out difficulties in curriculum structures that do not address this issue in line with the teaching of research and argumentative.

An understanding of the scientific approach to enquiry, as we have already pointed out, involves an epistemological dimension: all empirical enquiries are planned and carried out within a framework imposed by the conceptual and theoretical structures which the enquirer brings to bear on it. Indeed, the failure to recognize and incorporate this epistemological dimension is a major weakness of many curriculum treatments of scientific enquiry (Driver, Leach, Millar, Scott, 1996, p.25).

In this regard we understand that resources can favor filmic processes of argumentation in school, because they facilitate exemplify situations, contexts and ideas through words and images “It is, indeed, more; for not only can the film amplify (orally)... can picturize upon screen the more subtle aspects not always permitting of treatment by words alone” (Ottley, 1935, p.5).

The use of filmic resources and commercial circulation may contribute to discuss internal and external aspects of scientific activity and thereby stimulate debate around the scientific work, because the movie production as a cultural narrative shared between producers and viewers, provide elements that generate controversies, agreements, disagreements, sense of belonging, as well as mechanisms of identification and projection. With that leverages the speeches.

This has the potential benefit of stimulating interests, i.e., inspiring what teachers are willing to teach and what is attractive to students with the cinematic language, due to its sensory and emotional appeal. It is still important to consider appropriate levels of complexity at each stage of learning and teaching, cultural and social factors of students, their previous ideas and possible relations with the curriculum and the planned scientific content

Why choose this resource? First we share with Franco (2010) about affective and emotional argument that movies give us, and the physical stimuli of images and sounds permeate one sensory pathway cognitive and cultural matrix coupled to the universal act of seeing films and pleasurable.

Second, because we understand that the narrative potential in this film has elements that are common to both teachers and students, because in the process of sending and receiving narrative requires the presence of references to common subject within a historical, social, and cultural, or according to Baccega (2003) “so there is communication, it is necessary that the partners have a common memory, participate in the same culture”.

In this sense the differences that exist between teachers and students, such as age, tastes, intentions, are not limiting factors when we put the elements of fictional narrative in the communication. This is because both, teachers and students can share social signs and

symbols common to both. For example, travel to other planets is not yet part of the real world, but in the fictional narrative through mechanisms of projection-identification-transfer (Morin 1970) this would be possible, at least in imagination, just make dozens of movies with this example (*Star Wars, Le Voyage dans la lune, Mission to Mars, 2001: A space Odyssey, Star Trek: the motion picture, Apollo 13*).

Therefore were organized two courses for working teachers and who taught in basic education, where the films were used to address the NOS in classroom situations.

To that end, contributions of Akerson, Donnelly, Riggs and Eastwood (2012) were important because they allowed us to understand how teachers give meaning, in practical terms, to their conceptions about science and education involving the NOS in a real classroom.

Films and nature of science

Movies, such as "Back to the Future", were not produced for the purpose of discussing the NOS, nor prepared for use in teaching and learning situations. They are commercial products with the intention of entertainment and, therefore, have no pedagogical commitment. They can be used to contextualize scientific concepts by analyzing the scientific activity and its relationship with society and technology, but this process is not so simple. These ideas are so fundamental in meaning that, to be fully understood, they require the same processes of teacher training.

This is why we developed the idea of providing audiovisual and methodological support for addressing the NOS in a process of continuous training for teachers. This training took place during the first half of 2012 and then was extended. Including the initiative of teachers participating in the second half of this year, the Faculty of Education, University of São Paulo, highlighted three areas of interests and sought to articulate them as they pertain to the teaching of science, these are: NOS, audiovisual use, and teacher training.

The issues highlighted above are recognized in different bibliographic references, although the connection between them is still rarely found, especially between film and nature of science.

Our contribution is to demonstrate why this approach should be used, although some care is needed. First, we must address what training is required and, then, how it would be carried out (Tardif, 2001).

Shulman (1986) emphasizes the importance of articulating the knowledge of the teachers' practice with respect to the theories developed in academia. It is necessary to understand the formation of the professionalization movement and seek to renew the epistemological foundations of the teaching profession.

That is why, in the training of teachers, the key moment is the critical reflection on practice. It is the practice of thinking critically, now and previously, that we can improve on in the next practice. The theoretical discourse necessary for critical reflection should be so concrete that it may almost be confused with the practice itself (Freire, 2001).

We intend to contribute a selection of film episodes that have the potential to reflect issues of the NOS to be used as a methodological resource for teachers working in practice.

A teaching strategy based on film language allows learning to go beyond a purely rational process. Instead it develops the sensory side of learning, including creative, imaginative, and critical views of the information contained in films (Arroio, 2010).

To illustrate the educational value of audiovisual materials, some questions about this medium need to be addressed, including "What is the reflected image? Is the image an expression of reality or is it a representation? What is the possible degree of image manipulation?" (Navarrete, 2008). Such questions are important so that the students and the teachers do not analyze the film material naively, as if it were a fact, devoid of intent and/or opinions.

Santana and Arroio (2012) present a proposal to use films with themes related to the nature of science, highlighting potential uses, but warning against using them simply for graphics or just to draw the attention of students.

Morin (1990) discusses the idea of big science, in which science has developed titanic powers, often concentrated in government or large corporations. Many scientists believe it is possible to separate these powers of scientific activity, because this type of situation presents a simplistic view, or in the words of Morin, "These scientists say the following: science is very good, it is moral" (Morin, 1990, p.127). Thus, these and other representations of science also permeate the vision of science teachers.

Gil-Pérez, Montoro, Alís, Cachapuz and Praia (2001) discuss the distorted views of science presented by faculty, such as empirical-inductivist, neutral and naive, linear, elitist, ahistorical, and cumulative.

Bell et al. (1998) not only highlight problems in conceptions about science, but also point to another problem: the lack of importance given by teachers in teaching this subject.

With respect to materials, Santana (2009) presents a complaint of teachers, the lack of specific material and training. In this sense, it is not enough just to have access to movies, training is needed to guide the work with this material in order to articulate aspects of audiovisual epistemological understanding of the nature of science (Arroio & Farias, 2011).

Given the propensity to use the cinema, Wertsch (1998) developed the term 'cultural tool' to describe the importance of symbolic mediation between people in a communication process that involves cultural group relations.

So, we try through a course of continuing education to explore the theme by gathering questions from teachers in order to conceptualize how they understand the relevance of the proposal. From this, we developed the idea of using cinema as a methodological support for addressing questions of the nature of science. Furthermore, it is worth remembering, as highlighted by Rezende (2008) apud. Sutton 1997:

“Generally films reflect no scientific practice or controversy. Like textbooks, audiovisual materials tend, because of the language used, to present only the results of scientific practice and present hypotheses (or theories) as proven fact, omitting the procedural and political character of scientific practice”.

Thus, we justify the importance of training processes that propose to use the resources of audiovisual considering these specific concerns.

METHODS

We present partial results of a research project that is in progress, involving basic education teachers. This project is part of the continuing education system and proposes the notion of using audiovisual and methodological support to address the nature of science. Thus, we developed a course load of 60 hours, organized into twelve fortnightly meetings on Saturdays. These meetings take place at the Faculty of Education, University of São Paulo.

The course began with a group of eighteen teachers from different areas: nine in biology, three in chemistry, three in physics, one in geography and two in pedagogy. The films used were: *Lorenzo's Oil*, 2001 - *A Space Odyssey*, *Jurassic Park*, *Back to the Future*, *Rise of the Planet of the Apes* and a commercial advertising in Brazil of the brand Pantene shampoo.

The strategy for data collection was made in accordance with the qualitative research approach, which may be conceptualized differently over time. For this study "we can offer a generic definition, primarily: Qualitative research is a situated activity that locates the observer in the world" (Denzin & Lincoln, 2005, p.17). Data analysis also followed the guidance of this kind of research, and relied on the contributions of Bardin (2010) for content analysis and on Foucault (2012) for the analysis of discourse.

The selection criteria of these excerpts were based on the ability to reveal content and situations that could potentially stimulate thinking about the topic under discussion. Our aim was to highlight elements of visual language (potential communication with young

people), content addressed (scientific content, in particular the NOS), and possibilities for contextualization in the classroom (Arroio, 2010).

During the first half of the course, teachers were instructed to plan a teaching and learning sequences (TLS) of activities that used the audiovisual resources, such as movies. The aim of this was to identify whether the NOS in the audiovisual resources were incorporated. In the second half of the course, the goal was for teachers to apply what was planned during these (TLS) encounters and the results were discussed with the course tutors.

FINDINGS

During the first year we collected and systematized data. It was possible to produce a work which was presented at the National Research in the Teaching of Chemistry (Santana e Arroio, 2012), where we presented the following aspects: firstly, a considerable proportion of teachers did not recognize elements of NOS inserted into an audiovisual product; a smaller group of teachers made reference to NOS, but with stereotypical views that were similar to those of people who are not science teachers, or very similar to what Gil-Perez et al. (2001) call distorted views of scientific work.

Despite the problems cited, progress was made during the courses. In Table 1 we present some examples from the speech of teachers.

Table 1. Excerpts from speeches of three teachers attending the courses

Teacher	Excerpts from the speech of the teachers
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T1 *"I did not realize before that science was like this"*

T2 *"I was not aware of what science is found in movies"*

T3 *"I never taught using the NOS in movies for my students"*

T4 *"I thought it was enough to watch the movie to learn the things of physics such as speed and acceleration. Using a film to question with the students what science is, never really thought about it "*

T5 "I graduated in Biology and in no time we played in no matter whether you worked here in the course, just imagine. These epistemological aspects, never in my graduation were treated also these discussions of science and society or how it would be important to student learning either. Chalmers, Popper, Lakatos, Kuhn and Gil-Perez were all authors who met here on the course, no one ever wants quoted some of them. "

Caption: T1 (teacher 1); T2 (teacher 2); T3 (teacher 3); T4 (teacher 4); T5 (teacher 5)

Identified in the speech of teachers their newness in relation to NOS inserted in films, there is also the absence of this topic in teaching practices, so two skills worked on the course are recognized by teachers, these are: to understand and recognize elements of NOS the existence of this content in some movies.

Other relevant information is that T5 is newly formed, so it seems that research in science education that recommends the use of history philosophy and sociology of science, have not yet been incorporated into teacher training institutions.

After this stage of raising awareness, it was possible to expand the discussion beyond the fact that the teachers had not yet appropriated the importance of this theme in the teaching of science, i.e., we introduced the second course, at the request of the teachers, in which the theme of practice situations in the classroom was introduced. In Figure 1 we exemplify with an excerpt from a speech teacher:

"I would like to make a suggestion: I think it would be important for us to continue discussing this issue and it would also be interesting to have a community discussion on the internet, where we discuss things from the classroom on the nature and science films we are using."

Figure 1. excerpt from a speech teacher participant

We also found evidence of changes in the (TLS) produced and applied by teachers in classroom situations with students. The following is an excerpt from the outstanding didactic sequence produced by the same teacher and an analysis regarding the answer given by one of his students about the question: What is science?

The relationship between science and discovery established by most of the students can be explained by the way that scientific theories are transmitted to them, providing an idea that science happens through invention.
(Kuhn, 1998)

An example of this manifestation can be seen in the following quote from a student:

Figure 2. Following completion of TLS's teacher participant course

Ciências pra mim é uma arte de descobrir coisas novas, remédios, estudar e espaço descobertas diversas coisas é isso pra mim que é ciência

Figure 3. Answer from the student of the teacher, who prepared the TLS, highlighted above.

Translation: *Science, to me, is the art of discovering vaccine things, like medicine, and astronomy. Finding fun, things. That's what Science means to me.*

In this sequence the teacher uses clips from the movie Jurassic Park, to discuss scientific concepts related to the study of fossils and also takes the opportunity to reflect some elements of the NOS, such as stereotypes of science and scientists, the role of theories in the construction of science, and science compared with society.

<p>Represente com desenho o que você pensa que faz um cientista nos horários abaixo</p> <p>Domingo as 10h00min</p> <p>Domingo as 16h00min</p> <p>Domingo as 23h00min</p> <p>Autor: FRANCISCO SOUSA</p>	<p>JOANA</p>	<p>Represente com desenho o que você pensa que faz um cientista nos horários abaixo</p> <p>Domingo as 10h00min</p> <p>Domingo as 16h00min</p> <p>Domingo as 23h00min</p> <p>Autor: M. A. B.</p>
<p>Free drawing on the theme</p> <p><i>I made many inventions I invented: it is a radar and a dishwasher baskets</i></p> <p>author student: F. S. S</p> <p>date: 29/11/2012</p>	<p>Free drawing on the theme</p> <p><i>I drew a scientist, her bed and the sun.</i></p> <p><i>She's waking up.</i></p> <p>author student: J. C. R</p> <p>date: 29/11/2012</p>	<p>Free drawing on the theme</p> <p><i>I drew a gelatin castle like of the filme</i></p> <p>author student: M. A. B</p> <p>date: 29/11/2012</p>
<p><i>“Observed that works present aspects of the discussions: that the scientist has domestic life as anyone else;; the creative ability of children to build utilities equipment demands of everyday life and the fantastic universe of make believe this in the minds of students”.</i></p> <p>Inference by teacher</p>		

Figure 4. excerpt of TLS's teacher participant course

In this passage the teacher worked with students in early childhood education, so students aged 4 years, , although characteristics of this stage of education, an emphasis on learning through playful aspects, it was possible to work NOS considering the cognitive aspects related to this group of students.

In order to it the teacher approached the subject after getting the students' previous conceptions about what they understood about the NDC identified so that students always made reference to using science aspects of daily life, such as a walk with the family, mealtime or a joke and therefore do science for these students was always related to the external things of everyday life, so a toy or food itself would not be for these students constructs generated by scientific knowledge.

The teacher shared this information with the group of teachers of the course and another teacher from the same group suggested that the film: *"Cloudy with a change of meatballs"* would be interesting; therefore, to discuss the film would provide a playful and very close to the reality of the students of the teacher.

"I know a movie called: Cloudy with a change of meatballs and think it will be helpful for you to work with their students, because the language is suitable for children and talk about scientists and how science and drafted mainly because it highlights the science to build everyday things "

Figure 5. excerpt from a speech teacher participant

The figures 4 and 5 approach the that Akerson et al. (2012) calls Community of Practice to Support Teacher's Nature of Science (CoP to support NOS teaching), therefore teachers to participate in a community of practice can share best practices and ideas since you provide a supportive environment for this, so it is justified mediation and guidance of the trainer and especially the inclusion of films like feature that enhances interactions.

Another relevant aspect is the contribution of Zeichner (1986); (1993) about pre-service teachers and reference to reflective teaching practices, especially the characteristic of practice as social action, because "not enough power to assign to individual teachers, who need to see their situation linked to the colleagues" (Zeichner, 1993, p. 26).

We found that teachers gradually evolved into two aspects: first, the identification and appropriation of the concept of NOS, although very simplified, according to the introduction of this subject in practical situations with their students as a highlight in the data through excerpts of TLS.

CONCLUSION

Even with these results, there is still much to do, because the theme is initial and thus NOS stranger to our teachers. The probable explanation would be in the absence of this topic in the processes of initial teacher education, such an argument is sustained in the interviews by Santana (2009). As well as the reports of all the professors of these two courses.

Thus the use of audiovisual and methodological support to approach the NOS, coupled with a process of teacher training that involves these actions with their students, may favor the inclusion of this issue in science education.

We understand that the theme NOS subsidized for resources filmic and supported by a community of practice, may favor the approach this issue in two movements that are not mutually exclusive, ie, both for teachers to understand the historical, philosophical and sociological construction of science concurrently with the inclusion of this issue in situations of teaching and learning with the students of these teachers.

We emphasize that the use of this resource does not occur spontaneously, it is necessary to understand and map content of NOS in movies without deleting the narrative nature of the films, preserving the characteristic of entertaining films that contain. For this it is essential that the process of training teachers consider this and other aspects, such as giving protagonist to the group of teachers so that they feel confident to share ideas, practices and methods.

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