Indigenous knowledge in the Science Curriculum

Analysis of the text "*Out of Place: Indigenous knowledge in the Science Curriculum*"

"Out of Place: Indigenous knowledge in the Science Curriculum" is a chapter of the Second International Handbook of Science Education authored by Elizabeth McKinley and Georgina Stewart (McKinley & Stewart, 2012). It was selected to integrate the Science in the Community environment for bringing an important issue for reflection: the adequate treatment of indigenous knowledge or any other local cultural knowledge in the classroom. It comprises a 14-page text inside the Part IV of the Handbook, which joins different chapters within the theme "Equity and Social Justice".

In the beginning of the chapter the authors give a meaning for indigenous knowledge and introduce how it has been addressed in New Zealand schools:

1st) Indigenous knowledge is a way of knowing derived from relations with a specific geographical location, which is accumulated over a long period of time;

2nd) Its treatment in the secondary-level science classes in New Zealand schools presents the problem to be superficially addressed, decontextualized and without relations with its social, historical and political aspects, assuming a distorted form as "caricature".

This problem points to teachers' teaching and education:

> Indigenous science education and research occurs at a nexus of complex philosophical, historical, psychological, sociological and political relationships that tend to overwhelm the focus on achievement. Unfortunately, these understandings are not held by most of science teachers, education officials, or education academics. It is on the latter group, as Graham Smith (1995) argues, that the primary responsibility lands for initiating the work towards ameliorating this lack, despite its limitations (McKinley & Stewart, 2012, p. 541).

Indigenous science education fits into the discourse of multicultural science education, which has aroused a fierce debate in the international literature involving topics such as: its place and role in the curricula, if it is science or a distinct and equally valid form of knowledge, epistemology of science and indigenous knowledge, issues related to ecology, contributions of indigenous knowledge and others. This debate revolves largely on the need to define and distinguish key terms like "science", "Western science",

"Indigenous science" and "school science". The debate seems to have been initiated by the Snively & Corsiglia article (2001) published in the Science Education journal special edition on multiculturalism, as these authors considered the indigenous knowledge as being science. Although their original intention was to find a place for Traditional Ecological Knowledge in the science curricula, the problem is that it was translated by some as a rationale for inserting indigenous knowledge in the science curricula with the possibility of replacing the traditional content of science, especially in indigenous education.

Mckinley and Stewart note that although the literature in the field of indigenous science education has expanded recently, the theoretical issues underlying the relationship between indigenous knowledge and science have not yet been completely resolved, there are few reports of actual experiences in classrooms and there is still the problem of indigenous students' failure in science. There is also in this literature a tendency to see the science teacher as a "culture broker" who promotes border crossings between culturally distinct knowledges. The authors also mention the existence of differentiated and pioneering experiences in the world. In New Zealand, for example, since 1980 there have been movements to integrate the indigenous culture of the Māori in the curricula, both in English language as Māori language schools. This group is the native population of this country since before its colonization by the British and currently accounts for around 14% of the total number of inhabitants in the Aotearoa, in Māori language.

The chapter of the Second Handbook shows the results of a survey on participation and achievement of Māori students involving three English language schools with 30-45% of Māori students and a Māori language school with 100% indigenous students. The researchers interviewed high school students and 18 teachers of science and mathematics. Before addressing the results of the inquiry, they characterize the research field of indigenous science education and describe a review of the main publications, themes and countries where researches have been developed: Canada, Australia, Aotearoa New Zealand and more recently the United States (Alaska and Hawaii), Africa and Japan.

Among the results of the interviews, teachers stated that indigenous knowledge is used as a resource in their classes to fulfill two functions: show the diversity of knowledge to students and raise self-esteem and motivation of indigenous students. The teachers believe that the achievement of these students in science is stimulated in this way. Regarding the Māori culture topics covered in classes, teachers indicated five common sets of knowledge and the reason for choosing them was the relationship with science, as the construction and operation of the hangi – an earth oven, which serves as initial context

for the teaching of latent heat transfer. However, a number of teachers see Māori contexts as only "window dressing to real science" (McKinley & Stewart, 2012, p. 548).

According to the researchers, teachers address the knowledge about this oven superficially and disregard relevant aspects of Māori culture involved on its construction and use. They allege that the superficiality of this treatment is due to teachers' universalist view of science. It is interesting to note, however, the mention on the existence of support resources for teachers inclusion of Māori contexts in New Zealand schools, although it was not offered details about the characteristics of these resources and whether there is any relationship between them and the way indigenous knowledge have been addressed in classes. What the writing let us know is that the experiences involving the knowledge of the Māori people in classrooms depend largely on the contribution of indigenous students, because teachers have little knowledge about and resort them for help. A problem arising is that many students with indigenous descent have lost their connections with the native culture and end up feeling embarrassed for not having the required knowledge. The interviews also revealed that indigenous students in an advanced stage and with greater experience and knowledge on native culture do not see the need to include the Māori's knowledge and language in classes, suggesting that it makes more sense for students alienated with native culture.

In the conclusion, McKinley and Stewart remark that Aotearoa New Zealand is a leader in the research on indigenous science education and that schooling among Māori is part of a broader revitalization of their language, culture and identity due to their risk of extinction. According to them, the language carries identity and knowledge, but the revitalization of the Māori knowledge is not well succeeded in schools because of their distortion or "caricaturization". Due to this problem, the message of the authors is that indigenous knowledge is "out of place". Other reasons that contribute to this feeling are: science and indigenous knowledge are seen as distinct knowledge; the purpose of science classes is to teach science; science teachers are educated to teach science and therefore are not the right teachers to address indigenous knowledge in schools.

The problem highlighted shows a concern of the authors regarding the correct treatment of the indigenous culture by teachers, in one side, and the problems of teachers' education and the aim of science classes in the other. If the science classroom is not the correct place nor the science teacher is the right professional do address the Māori culture in school, will this resolve the problem of teachers' education? If science teachers' education does not enable them to address adequately the knowledge of other culture in the classroom, what discipline or teachers will do? The authors' point of view suggests

losses for the scientific education of students. The non-indigenous students will lose an important cultural context in their science classes and the indigenous students will no longer have the opportunity to understand the scientific aspects of their culture.

Before everything, it must be said that it is formidable to realize that in New Zealand there are efforts for the inclusion and appreciation of indigenous culture on its national education system and that there are teachers doing this. Although there are significant actions for the improvement of indigenous education in Brazil, with the proliferation of indigenous undergraduate courses, setting guidelines and national curricular parameters for indigenous schools, there is no such initiative in the national education system or among teachers and neither teaching support materials available in schools, but this could be a problem also. There are around 120 indigenous ethnic groups in the country and to contemplate all their knowledges would involve enormous effort. However, there are common knowledge that could be considered as representatives of the Brazilian indigenous cultures for insertion in the science curricula. What effect this would have on students? What indigenous people can teach and what science exists in their knowledge? The text of McKinley and Stewart does not comment on the effect of the Māori knowledge in non-indigenous students and this is probably due to their focus on the achievement of indigenous students in science.

The authors are right in their concern about the correct treatment of indigenous knowledge by teachers, but it sounds strange to know about that as the country leads the world research on indigenous science education. This earmark suggests that there is a gap between research (researchers) and education (teachers), besides the problem of teachers' education. It also suggests that there is inadequacy in the resources available for teachers or the need to prepare suitable teaching support materials and put them at disposal. A successful experience highlighted by the authors is that that happens in Alaska/USA. In the *Handbook for culturally responsive Science curriculum*, Stephens (2003, p. 7-8) gives the following characteristics for a culturally responsive science curriculum according to the educational experience in this American state:

• It begins with topics of cultural significance and involves local experts.

• It links science instruction to locally identified topics and to science standards.

• It devotes substantial blocks of time and provides ample opportunity for students to develop a deeper understanding of culturally significant knowledge linked to science.

• It incorporates teaching practices that are both compatible with the cultural context, and focus on student understanding and use of knowledge and skills.

• It engages in ongoing authentic assessment, which subtly guides instruction and taps deeper cultural and scientific understanding, reasoning and skill development tied to standards.

An analysis of the reported New Zealand experience in the light of the above features suggests the absence of "local experts" in the school experiences, little time dedicated to deep Māori knowledge and cultural contexts and absence of an assessment practice that could ameliorate the praxis. However, Stephens also points to difficulties or barriers that seem to be not restricted to science teachers:

• Cultural knowledge may not be readily available to or understood by teachers.

• Cultural experts may be unfamiliar, uncomfortable or hesitant to work within the school setting.

• Standard science texts may be of little assistance in generating locally relevant activities.

• Administrative or community support for design and implementation may be lacking.

• It takes time and commitment.

Notwithstanding, the problem brought by *Out of Place: Indigenous knowledge in the Science Curriculum* is the representation of knowledge in the classroom and this, in my point of view, requires a discussion on parameters or criteria for an adequate representation. What features an approach on a particular cultural knowledge in classroom needs to be adequate? In Brazil, in general, science teachers usually teach scientific content using the textbook and this does not always occur in a contextualized way. Science contents are simplified to facilitate students' learning and although there are efforts to improve science education in the country, this is the predominant school culture. The same way, teachers are not historically and culturally accustomed to teach other knowledge or ways of knowing in the classrooms. For the most part, teachers have no scientific research experience either. In a teaching based on the transmission of lots of scientific concepts, what view of science is expected from the students? Would it not be a distorted one? In this type of teaching students will probably see science as a caricature also, such as in the case of the indigenous knowledge treatment in New Zealand. If they cannot represent science adequately in their classes, how could teachers do this regarding indigenous or other cultural knowledge? What characteristics must be taken into account for a good representation of knowledge?

In the case of the studies on the soap ash and the orange wine making, a theoretical and methodological guide was that of ethnography from Anthropology and an initial criterion was to describe the procedures as observed. Another was to capture and include the community's voices in the description of the practices or people's "thought-language" (Freire, 1983, p. 103). A third criterion was to integrate the relationships and contexts in the ethnographic discourse as identified by discourse analysis. Then, the images of the practices were combined to these data resulting in texts, a video and a hypermedia that joined texts, images, videos, voices, relations and contexts. In the *Science in the Community* environment this was expanded with the incorporation of the knowledges' scientific interpretation resulting the hybrid narratives "The women from Minas Gerais and the ash soap" and "Mr. Zé, Mrs. Ná and orange wine", but by no means we can consider these resources and strategies as bearers of authentic expressions of the observed realities. Can we consider the accurate description of the procedures, the inclusion of voices, images and contexts/relationships as sufficient for a minimally adequate approach of indigenous or local cultures knowledge in classrooms?

The definition of the aforementioned criteria and actions involved dedication, research and time and as George (1992) mentioned it is not expected that science teachers do it for themselves; researchers can play a role here. However, not every researcher of science teaching is prepared to build such database. It takes specific training, to carry out fieldwork in a specific manner, record data in written, imagery and audiovisual formats, interpreting the knowledge scientifically and develop ethnographic writing skills (which is not easy or simple), besides text editing and joining of images and audiovisuals resources aiming the transport for classrooms. This is a research work!

On the other hand, if the teacher cannot rely on the help of an expert or does not have a teaching resource nor proper education, which is better: let the indigenous/community's knowledge stay out or insert them in the classroom the way they know? Caricatures can display fun images for students as they carry a load of humor and we cannot say that they are completely disconnected from reality. They can often highlight characteristics of a person by increasing them too much. Moreover, any context is relevant for science education as it allows to approximate scientific knowledge of life. Isn't it better to have these distorted contexts than no context in the perspective of the required reintegration work of all peoples and cultures that were historically confined and reduced to the peripheral status (Said, 1993 cited McKinley and Stewart, 2012, p. 545)? Of course, things are not so simple like this and it is necessary to have respect.

According to Homi Bhabha, the identity or identification is always associated with the creation of images and hence to the transformation of the subject by creating its image. As mentioned in the text "The knowledge and their representations", there will be always limitations in this process depending on the eye of who is seeing and, it must be added here, of the language that describes. Thus, it is created an "atmosphere of uncertainty" about what is being represented, but with its conscious perception it attests its existence and, at the same time, threats to desmember it. The image as identification defines a place of ambivalence. It makes present what is absent and represents the repetition of a time that is always elsewhere (Bhabha, 1994, p. 45, 51). Representation and identity will never match. The problem then is not to build an image, but how this is done discursively and how it is strategically and institutionally placed. In other words, whether the teacher is dealing with science, indigenous or local cultures' knowledges, he/she has to discuss with the students that they are looking at representations of realities that are not there and there are always losses and something that remains invisible in the transport to the classroom.

To exemplify, we will analyze a description about the Pyaretsi brewing that was written and photographed by a Brazilian indigenous teacher of the Ashaninka people from the state of Acre, located in the frontier with Peru. This report was written after interactions in chemistry classes within a teachers' undergraduate course on natural sciences in the Federal University of Acre, where I asked students to write reports on the chemistry of their communities. Click here to see the report of the teacher Shãtsy and images of the Pyaretsi brewing, also known as "Caiçuma". What can be said on the adequacy of the Pyaretsy brewing report by the Ashaninka teacher for a science classroom? There are many things but does it promote some distortion or an image in the form of caricature? The problem here is that the representation using a written text accompanied by photographs already introduces a transformation of the original knowledge. The description and the photographs give an idea of the Pyaretsy brewing, but it is not the same as to witness the preparation of the beverage. Several elements are lost: we do not hear the songs and instruments played in the Pyaretsy party, do not feel the smells, do not share the emotions, do not take the cassava from the ground and do not peeled it; we did not observe the carbon dioxide gas release in the alcoholic fermentation and did not taste the beverage to check its alcohol content either.

A more biased teacher probably would neglect the possibility of using this writing-imaged narrative as a context for teaching about alcoholic fermentation, as the act of putting the dough in the mouth and spit it back counter against the "white" norms of hygiene. However, this is not a problem for the Ashaninka people and is associated with a requirement of the cassava starch alcoholic fermentation. The starch molecules making up the cassava are large molecules that need to be broken by enzymes of

the mouth in order to release lower sugars for the fermenting microorganisms to carry out the alcoholic fermentation. The act of chewing and spitting the mass of cassava is part of the Pyaretsy brewing and cannot be disregarded simply because it hurts the standards of another culture. It must be understood and respected but this does not mean we must accept it without contesting and discussing in the classroom. Note also that the display and the size of the photographs in the PDF file could be different. It could blur the act of chewing and spitting by minimizing the correlated image and even delete it, changing the gaze on the Pyaretsy making.

Thus, we are led to think that in the encounter of different cultures there is the possibility of confrontation and the risk of neglecting some issues and an authentic representation will only be possible through a deeper and not biased immersion in the Other's culture; even so our eyes will fail to perceive it entirely. It will be required then a continuous immersion to capture it more fully. If we are rigorous this would be the minimum necessary to build an adequate representation of the Pyaretsy drink or any other cultural knowledge or artifact. If we are less rigorous, however, the report made by teacher Shãtsi would be enough, but it could never be brought into a classroom without the students' awareness on its limitations. McKinley and Stewart are right in calling attention to the problem of the correct reconstruction of knowledge in the classroom, but we should not overlook the difficulties on this process. Maybe it is not the case that indigenous knowledge are "out of place" in science education in New Zealand, but "out of their original place" in non-indigenous schools situation. Hence, it has to be re-presented by an image with inevitable losses. What also seems to be "out of place" are the support materials available for teachers in New Zealand and the distance between research and teaching. However, the authors state firmly that science classes are not the correct place to address indigenous knowledge in New Zealand schools, but where should this place be?

References

Bhabha, H. (1994). *The Location of Culture*. New York: Routledge.

Freire, P. (1983). *Pedagogia do Oprimido*. 12 ed. Rio de Janeiro: Paz e Terra.

George, J. (1992). Science Teachers as Innovators using Indigenous Resources. *International Journal of Science Education*, 14(1), 95-109.

McKinley, E.; Stewart, G. (2012). Out of place: Indigenous Knowledge in the science curriculum. In: Fraser, B. J.; Tobin, K. G.; McRobbie, C. J. (Eds.) *Second International Handbook of Science Education*. New York: Springer Dordrecht Heidelberg, 541-554.

Snively, G.; Corsiglia, J. (2001). Discovering indigenous science: implications for science education. *Science Education*, 85, 6-34.

Stephens, S. (2003). *Handbook for Culturally Responsive Science Curriculum*. Fairbanks: Alaska Native Knowledge Network.