Between local culture and school science: The case of urban and provincial students in Eastern Colombia.

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Abstract A lack of congruency between the teaching and learning of science and the student’s personal worlds has long been recognised by the international science education community as an issue deserving space in the research agenda. The purpose of this study was to explore the diversity of student reactions when subcultures such as family, community peers, and personal worldviews are considered along side the subculture of school science. Two-hundred and fifty students from urban and provincial schools in the northeastern region of Colombia (South America) participated. From this group, 18 students were interviewed. It was observed that students adopt a compartmentalisation of knowledge that is evident as both an avoiding strategy in the classroom and as a mechanism to differentiate between the natural world of their everyday situations and the one portrayed by a Westernised science instruction in the classroom. The findings reflect how multiple worldviews correlate with student frameworks as implanted by school science.

Keywords Subculture of school science · Worldview · Western modern science · Cultural border crossing · Fatima’s rules

Introduction

The concurrence of often irreconcilable subcultures in science classrooms provokes serious discrepancies within students’ perceptions about science and the natural world. A good deal of research has documented the difficulties experienced by non-Western students in learning Western Modern Science (WMS) (Baker and Taylor 1995; Jegede 1994; Okebukola and Jegede 1990; Pomeroy 1994; Snively and Corsiglia 2000). Even Western students face the same challenges (Aikenhead 1996; Cobern 2000) in their own attempts to cross the cultural border that separates their personal worlds and that of school science. In
this paper, the concept of Western Modern Science will align with the definition by Ogawa (1989) as “a collective rational perceiving of reality, which is shared and authorised by the scientific community” (p. 589). It has been noted (Dart 1972; Pomeroy 1994) for instance, that the transition from one subculture to another is almost always a frustrating and slow process because students with traditional backgrounds are forced to learn a subject matter grounded in Western culture and furthermore, because the mythology of school science (Smolicz and Nunan 1975) dictates that true knowledge is solely produced via WMS. According to Baker and Taylor (1995), even educational systems in Less Developed Countries (LDC) accept implicitly the superiority of the scientific view (Western) of the world and the concomitant inferiority of the learner’s (alternative) worldview. In LDC, the emulation of foreign models is pervasive and long-standing due to national educational agendas (Kyle 1999). According to Gray (1999), the quality of science education in most developing nations has been deteriorating during the last decades. One of the key reasons, besides the scarcity of resources, is the dominant educational perspectives from industrialised societies. Presumably, these influences limit the decision making process of those heading the educational system in these LDC.

The prioritisation of Western-science instruction over the student’s worldview remains generally ignored in the school science context. Avoiding strategies occur when students have been officially assigned unavoidable pre-requisites they must fulfill to become literate and responsible citizens at the end of the schooling process (Aikenhead 2006; Atwater 1996; Larson 1995; Pomeroy 1994). As students circumvent assimilation, they become gifted in gaming the system. Such resistance is perceived in various forms. For example, Fatima’s rules are a well documented evasion tool as named after a participant in Larson’s (1995) study. This tactic is exemplified by the ability to: collect right answers for tests and homework, prepare for tests by repetition and memorisation of facts, target bold-faced information on textbooks, seek teachers for help at minimal difficulty, silently pretend to understand lectures, and take notes on only key dictation. All of the abovementioned characteristics of Fatima’s rules function to project the idea that significant learning has occurred. In fact, often only a temporarily observable knowledge has occurred which is usually dismounted and rendered useless after the test takes place.

As a general observation, most researchers in the science education community suggest the consideration that students must somehow bridge their every day life-worlds and those of globalised science. Established bridges must constitute a central concern in the development of a community of learners to offer effective science education and opportunities to all cultures, classes, and individuals around the world. According to this perspective, a cultural border crossing approach is suggested (Aikenhead and Jegede 1999) to allow students to travel comfortably from their own life-worlds into the world of science found in their science classrooms.

Nevertheless, what can be attested – by means of conversation with students and observation and evaluation of their performance – is that there is ample evidence of a disjunction between the Westernised worldview addressed in the science classroom and the multiple events that students encounter in their everyday experiences (Cobern 1997; Eger 1992). Again, the effect may be a lasting chain of dissociations that prevent the student from integrating learning beyond just a passing grade, a fleeting moment.

For this study, Western-based school science and students’ personal worlds are assessed in urban and provincial communities in Colombia. The main research question was: What is the characterisation of urban and provincial students in eastern Colombia towards the subculture of school science according to the theories proposed by authors Phelan et al. (1991), Costa (1995) and Aikenhead (2001)?
Theoretical Framework

It is well-accepted that learning science is by itself an exercise of transitioning between subcultures (Aikenhead 1996; George 1999) and that the transition from one worldview to the other creates substantial cognitive dissonance. It is also important to recognise that science itself is a subculture of Western or Euro-American culture (Baker and Taylor 1995; Cobern 1991; Jegede 1994) and that consequently, WMS can be thought of as a subculture of science (Aikenhead 1996). George (1999) points out that learning science is learning that extends from across the boundaries of home, family, and culture into the grounds of Western concepts, and in so doing, students are inducted into a larger dominant community through WMS.

The term culture is extensively debated in academia. For the purpose of this study, this concept will be used as employed by Phelan et al. (1991) who delineate it as the combination of norms, values, beliefs, expectations, and conventional actions of a group. From the science education corner, the culture debate revolves around whether to embrace WMS or local or “ethnic” science as the guiding force of instruction in science classrooms around the world. On the one hand, supporters of a universal perspective about the natural world (e.g., Mathews 1994; Siegel 2002) maintain that whilst recognising other forms of seeing reality, WMS is the only approach that has proven to render testable, predictive and deep explanatory knowledge about nature, and thus the one that should be considered as the essential tool for doing what they term ‘good science.’ On the contrary, those on the multicultural ‘localist’ side (Ogawa 1989; Snively and Corsiglia 2000; Stanley and Brickhouse 2000) challenge the universalist tradition by claiming that although phenomena in nature are expected to occur in a consistent-oriented fashion, their understanding and interpretation are mediated by language, culture, environment features, and events. However, and despite the heated disputes, the two traditions agree in that the understanding of the natural world is not the exclusive business of WMS, and that the combination of WMS, “local,” “indigenous,” “traditional,” and “ethnic” ways of understanding the natural world should be embraced as a memorable initiative to make science education a more inclusive enterprise.

Nevertheless, the disparity between school science and the students’ worldviews has been attributed to a mismatch of subcultures of science and the particular life worlds of students (Aikenhead 1996; Baker and Taylor 1995; Costa 1997; Okebukola and Jegede 1990). Currently, it is well known that most non-Western pupils, as well as Western ones, respond by employing avoidance strategies when forced to operate in foreign frameworks. The manifestation of such resourceful and resilient strategies by students can be observed for instance in the manipulation of scientific knowledge and the aesthetical appreciation of nature by labeling them separately and keeping them compartmentalised as school and personal world knowledge. Metaphorically, Costa (1995) alludes to this behaviour as forcing the students to “leave their personal life at the door of the classroom and take it up again like a backpack when they leave” (p. 331).

Educational researchers have extensively addressed the inter-border transitions when the subcultures of school science and the student’s worldviews come into play. Initially, anthropologists Phelan et al. (1991) developed the “Students’ Multiple Worlds Model” (p. 16) which accounts for the negotiations that take place as students travel between their everyday life-worlds and the world of science and school science. The characterisation of each occurring transition as smooth, manageable, hazardous or impossible is based on the easiness with which students go from one world to another.

Drawing upon the contributions of authors Phelan et al. (1991), Costa’s (1995) research addresses the unseen degree of congruency that may exist between the worlds of family,
friends, school, and science. As a result, she suggests five categories reflecting students’ relationships between these varied worlds and their observable performance in school science: **Potential Scientists**, for whom the worlds of family and friends are congruent with the worlds of both school and science; **Other Smart Kids**, whose worlds of family and friends are congruent with the world of school but inconsistent with world of science; “**I Don’t Know**” **Students**, whose worlds of family and friends are inconsistent with worlds of both school and science; **Outsiders**, students whose worlds of family and friends are discordant with the worlds of both school and science; and **Inside Outsiders**, depicting a group of students whose worlds of family and friends are irreconcilable with world of school, but are potentially compatible with the world of science. In addition to these five groups, Aikenhead (2001) suggests a new category described as “**I Want to Know**” **Students.** Learners in this group have a “self-image and lifestyle that resonates with the world of science, but the intelligibility, plausibility, or fruitfulness of Western science concepts is often a challenge to them” (p. 186), therefore their border transitions are likely to be adventurous, yet resulting in an acceptable and efficient level of understanding of science.

Borrowing from the work of Costa (1995) and Aikenhead (2001), this study focused on the interplay (inter-border transitions) that emerges when students from two school communities interact between the worlds of school science and their personal worlds.

### Design and Methods

This study used an interpretative design (Erickson 1986), including: a hermeneutical approach in that the resulting interpretations are supported by what was already known (Eger 1992; McRobbie and Tobin 1995); a revision of related literature in the area (Aikenhead 1996, 2001; Aikenhead and Jegede 1998, 1999; Costa 1995, 1997) personal experience in the field; and a continuous analysis and interpretation of the gathered information.

### The Students

This descriptive case study included the participation of an original group of 250 middle and high school students aged between 11 and 17 years old enrolled in science classes (chemistry and biology) from which 18 students, as well as two science teachers, accepted to participate in interviews with the investigator. The participating students represent four different socio-economic statuses (SES), 1 to 4 (On a 1–6 scale according to the National Department of Statistics). There were 74 females and 176 males distributed as follows: 19 grade 7, 77 grade 8, 105 grade 9, 64 grade 10, and 6 grade 11 students. There were also 57 students enrolled in chemistry classes and 193 in biology. The participating students were enrolled in two urban schools from the state capitol (both, private schools) and one provincial-public school located 45 km from the city. Concerning the ratio of female to male students in this study, the imbalance can be explained as a result of the historical enrollment practices in Colombian schools. Private, military and religious schools are only recently transitioning into co-educational institutions. The remaining imbalance of gender remains strongly tied to beliefs of prestige and “quality” to many Colombian citizens who are able to choose where their children attend school. While the current imbalance of 74 females to 176 males is seen as a weakness of this study, it is an inevitable consequence of Colombian tradition. Although a weakness, the gender distribution of the sample group is in fact representative of many institutions with private, military or religious orientation, even if public.

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The researcher is native from this region of Colombia. His childhood roots are from semi-rural communities and later, he spent 10 years teaching in secondary Colombian schools. The schools were selected based on the resulting network of known school colleagues. Participating students were from these schools.

The Urban Community

The city, with a population of approximately 700,000 inhabitants is the state capital and located on the border with Venezuela. There is also a considerably large floating population due to its geographical position as an obligated destination in the transit to and from the neighboring country. Recent violence has also forced migrations of internally displaced people (IDPs) to this city as a consequence of guerrillas and paramilitary groups operating in the northern rural zones of the state. Up to 22,000 IDPs arrived during 2002 to this city. Whilst the city’s shoe industry is a common vocation, earning a living wage is still difficult for many low-income families. Thus, many of them make their living by smuggling goods from Venezuela where gas and other prices are lower. A local journalist defines the residents of this city as, “hard workers, industrialists...attached to their families, sincere, respectful, and above all, honest with a great sense of humour” (La Opinión (the Opinion) 2004, p. 5).

This is the physical scenario in which two of the three participating school communities are located. The two urban schools are widely distant in terms of their facilities, background, and educational programs. One of them is religiously oriented and primarily serves high class families; the other functions as a military school that enrolls students from mid and low socio-economic statuses. Both are private and include elementary and secondary levels. The religious school is run by a community that also owns other universities and schools across the country. The educational emphasis in the religious school is on the science program and promoting moral values and virtues. The other military school is relatively new. At present, only 2 years have graduated. The school serves about 200 students and bases its teaching in “military training, English,” and creating an “educated citizenry for a culture of peace,” as written in a publicity brochure.

The Provincial Community

The provincial community is home to approximately 6,000 residents. Geographically, it sits in the eastern Colombian Andes and is connected to the state capitol by a paved road. As for the natural setting, the town provides its residents with excellent lands for agricultural vocation, being coffee, bananas, sugar cane, and vegetables the main products. In this locality families make their living with informal businesses, such as neighborhood stores, cafeterias, billiards, bakeries, saloons, restaurants, or as employees of the agrarian bank, the National Federation of Coffee Growers, the National Ministry of Agriculture, National Police, teachers, and farmers, or as day laborers.

The provincial community centers on church activities. Priests visit the countryside, the local hospital and also reach to the whole community through the parochial radio station. In schools, the clergy not only lead religious celebrations, but often teach subjects such as religion, ethics and philosophy. Mrs. López, a well-known local resident and a diligent member of church committees comments on the devotion of the town’s people: “The fervor

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1All participant names are pseudonyms.
for our religion is special here...we pray daily, but there are celebrations throughout the year, like in the month of May. We do what the priest says.” This view is also maintained by Mónica, a junior student in the local high school, who like Mrs. López, also participates in church events. “This is a sign of the devotion and fervor of the people in our town; it is really outstanding, especially in my school.”

The provincial Catholic school is run by a community of nuns since its establishment. The original emphasis of the curriculum was in vocational pedagogy. Later the school’s mission changed to an academic emphasis. In the mission statement, the school envisions the education of the local community as an evangelising and humanising work to incorporate local citizens into the Colombian social system which distinguishes itself as a Christian culture.

Research Design

Students’ perspectives were collected using an instrument (Attitudes Towards School Science), two questionnaires, and interviews with volunteer students and science teachers. A set of sample questions are given in Tables 1 and 2. Interviewees and their parents were informed that the conversations would be recorded for future codification and analysis. The materials for the study were translated between Spanish or English overseen by two bilingual individuals. Member check procedures were also used with each participant in the interviews. The interpretation of the data was made first in the native language, Spanish, and then shared with participants so that they too provided their own feedback and comments on the accuracy and plausibility of the interpretations made of their views and reported results. Later, the interpreted concepts were translated back into English. Initially, a 30-item instrument provided information about the sentiments that students held for their science classes, science content, school environment, and family context. This instrument was created and administered previously by this author with a similar population of students in this region of Colombia. The reported Alpha reliability coefficients for the instrument were all over 0.75. The Alpha reliability coefficient was 0.77 for the total score, 0.80 for the female population and 0.75 for the males. By grades, the Alpha reliability coefficient was 0.77 for grade 9 and 0.80 for grade 10. The instrument is organised in four sub-scales (school environment, family support, student academic interests, and teaching methodology). Instrument items were developed by this author and also modeled from exiting examples: The Iowa Assessment Handbook (Enger and Yager 1994); Attitude Toward Science Among Secondary School Pupils (Francis and Geer 1999); Science Achievement and Attitude Toward Science in School (Germann 1988); Qualitative Study of Attitude Towards Science (Piburn and Baker 1993) which are intended to measure students’ attitudes towards school science. The advantage of administering this instrument can be seen as a preliminary or exploratory step which provided insights to important features and moods in the responses given by the students (e.g., excessive pessimism or optimism, end

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<th>Table 1</th>
<th>Example of items in the instrument (Attitudes Towards School Science)</th>
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<td>Sample questions</td>
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<td>Students from my school participate in science fairs, science contests, and ecology clubs.</td>
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<td>I read about scientists’ lives and their inventions.</td>
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<tr>
<td>I can see how scientific content is related to my life outside the school.</td>
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<tr>
<td>Our science classes are complemented with extra-curricular activities (i.e., field trips, visit to museums and botanical gardens, meetings with leaders of the community).</td>
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comments of the questionnaire, incompleteness of the test). Such salient subjects were considered as one of the criteria for choosing students for personal interviews, and as focal points in the organisation of the semi-structured interviews.

Two weeks later, and as part of a written questionnaire, students were asked to express their opinions about issues such as creationism and evolution in schools. In order to obtain students’ perceptions without necessarily forcing or insinuating certain responses, excerpts of two articles were offered for discussion: “Darwin Banned from Italian Classrooms” (El Tiempo (the Times) 2004) and “Six Significant Court Decisions Regarding Evolution and Creationism Issues” (National Academy of Science (NAS) 1998).

The participant’s views were solely guided by an emerging procedure. In this case, elicitation devices inserted in the questionnaires (excerpts from articles) set the tone and direction of upcoming conversations without the investigator introducing or insinuating scientific terms. It was only up to the participant to mention key words (i.e., science, nature, scientists) and when it happened, the investigator followed with probe questions, and requests for explanations and examples. Interviews were basically conducted in a four-phase model that consisted of: (1) reminding the student of his/her responses on the survey and written questionnaire, (2) asking a guiding question, (3) re-telling specific statements and (4) confronting the student’s claims with other views expressed by others in the field.

This method resulted not only in creating a case example profile for each student but also in constructing a rich description at different dimensions: (a) from a very broad standpoint, a liberated opinion that informed about the main distinctions of the home and school environments; (b) from a more controlled perspective that was aimed at insuring the trustworthiness of prior responses, students went over situations that, once again, portrayed key issues (i.e., class environment, the role of the teacher and peers, perspectives on nature, and the use of non-scientific approach to health problems); (c) and then at a very specific stance, whereby students manifested their feelings to the learning environment in science.

Interviews were also held with science educators from non-study neighboring schools; however, these data sources were not used directly in this project. Instead, they served for piloting interview questions and also, gaining insights that could be employed as a support of reference for the interpretations made of the original data. Conversations with teachers revolved around classroom strategies, lesson plans, analysis and evaluations of their students (i.e., descriptions of the most salient attitudes in their classes, specific interest in certain topics), and the influence of the external factors upon the environment of the science classroom (i.e., education policies, economy, society). One eliciting tool used during these conversations as a discussion device was a set of two articles “5th and 9th Graders Failed in Science” and “Rural Schools Defeated their Urban Fellows on the National Test of Achievement in Science” published by a national newspaper (El Tiempo (the Times) 2004).

Table 2 Example of items in the questionnaires

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<th>Sample questions</th>
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<td>Describe a typical day in your science class (biology, chemistry). You may want to include aspects related to the building, your group, friends, or daily activities. Someone said that both scientists and students practice science the same way. What can you say about this statement? If a new student comes today into your classroom, what would you tell her/him about your group? In countries such as Brazil, some educators have proposed that scientific contents be studied with the support of other subjects such as philosophy, religion and ethics as an integration of subjects in the study of scientific issues. What do you think the results of this policy would be in Colombia?</td>
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Data Analysis

Narrative analysis (Erickson 1986), which illuminates the dynamics of what takes place in the classroom environment, was the major tool used to describe the findings of this study. The decision of presenting the results of the study in a narrative format is grounded in the humanistic quality of the project. Since the voices of students and teachers are fundamental in conveying the findings of the research, it was believed that narrative accounts would best emphasise their sentiments, opinions and feelings. Recorded interviews were first translated into English, then word-processed, and coded. The preparation, identification and manipulation of the data involved: (1) a translation process, overseen only by the Spanish-speaking investigator due to dialectal and cultural subtleties; (2) a transcription process using voice recognition software (Dragon Naturally Speaking 7.2); and (3) a coding process applied to each set of data in the audiotapes. Each interview was coded with a pseudonym to insure confidentiality, and permit the researcher quicker access to particular segments of the transcript.

The emergent quality of this type of research assisted the code system construction as advocated by authors Cobern (2000), Erickson (1998), Merriam (1998), and Strauss (1997). As the participants made their views known in each conversation, the interview and coding procedures were continuously enhanced. As pointed out by Merriam (1998), “qualitative research is not a linear, step-by-step process, data collection and analysis are simultaneous activities” (p. 151). That is, the researcher pays attention to insights, hunches and tentative hypothesis built during and after each interview which serve the purpose of re-directing the formulation or refinement of questions in upcoming interviews and phases of the data analysis. The code designations that had initially been planned upon, as suggested by Cobern (2000) were re-shaped by sifting constantly through the information obtained from each source. Subsequently, each transcript line was assigned a code that embodied pieces of information within a particular segment of the data. Codes that identified certain pieces of information were also found in other transcript lines, which in turn were co-coded. (4) The fourth step of the analysis included a ranking procedure that was conducted on each coded segment in order to establish a potential order for the preparation of the narratives; (5) a translation process of each narrative into English. In this case, another bilingual individual revised and commented on the final products between the English and Spanish translations.

Results

In both school contexts [provincial and urban], events such as attending after-school remedial courses, being trained in military tactics, getting prepared for standardised tests, and solving in-class assignments make up the ecologies formed in the targeted school settings, which although not being completely predictable do influence the school life introduced to students (Roth et al. 1999). The vision of being a protagonist in this scenario has a ritual-type connotation. A getting-through attitude guarantees not only collecting grades and diplomas, which in part dictates the paths after the secondary school, but also provides a surviving mode (i.e., Fatima’s rules) in academic experiences throughout the schooling process.

The school world of these students function under the proliferation of social and economic forces that in one way or another emphasise the ideal of school science as a “passage point” (Costa 1997, p. 1019). Diverse opportunities and constraints within the same urban educational system nurture the purpose-bound objective of school science. Students showed a pragmatic focus on attaining good grades in school when interested in
content-related careers. Lina, for instance, a grade 9 student at the Military-urban school, does her best to maintain average grades. Although she reports no interest in excelling, she does recognise the value of a Military school as a passage point to her future career (police or military). Lina comments that she enjoys “everything about weapons and all things related to the Army.” Ana, a grade 8 student at the same school, also envisions a career in the Army. “I have members of my family in the Army, it is interesting to me. If you think of the future, this [Army] is the only career that at this time guarantees you a job.”

The incentives created in the education business attract students who will see innovative educational programs as their chance to achieve a stable socio-economic status. The catch may come in the form of belonging to a military school which in turn will propel its clients into the job market (in the military forces), or as members of a high class community whose future careers are secured with the commitment of the school to guarantee the perpetuation of their status in socio-economic spheres. Since urban students are more likely to transit with certain ease from their own subcultures to that of school science does not necessarily mean, at least in this case, that a meaningful and pleasant transition has occurred. These students are apparent border crossers in that getting through school science allows them to remain active in or access their desired social context. Again, a pragmatic learning is central in the socio-economic aspirations of students and families, and in consequence, a profitable accomplishment for schools especially in urban centers, that compete more intensely for prestige and recognition based on the national ranking on standardised examinations, and on programs and facilities that can entice potential clients [families].

Mr. López, a school administrator at the urban Catholic school guarantees that the majority of their graduates will continue their college career after their secondary education. He also equates school and career choice by saying that:

> It is a matter of interest on the part of the parents. If they send their kids to a good school, it is seen as an investment and should be done with the purpose of giving those students the opportunities to do well at college level. Not everyone does that, and so that is why students from other schools lag behind.

The promising future that Mr. López forecasts for his pupils seems quite the opposite for other families in the provincial community. This is the case of Victor, a grade 10 student who, due to economic difficulties, as he explains, will not be able to attend college. Instead, as many other young high school graduates do, he will enroll in the National Institute of Penitentiaries as a prison guard. Mr. Rodríguez, his science teacher, describes this trend:

> Now, my students just want to graduate and get a job right away, school is worthless for them. We are seeing that, for instance, most of our graduates immediately enroll in the National Institute of Penitentiaries, or join the police or military. They are comfortable having a job, making some money, and going to college is not appealing to them. From a number of fifty graduates, I would say, only five go on to the university.

Being subscribed to either an urban or provincial socio-cultural context makes students form these communities more or less privileged to access future stable careers in life. Of course, their decisions are not usually guided by academic interests, but forced by the opportunities ruling their contexts, which tells about how unprepared they are to fit into the modern society (Puryear and Olivos 2003). As reported by one student, “One cannot sleep in the laurels, if you are told of any job opportunity, you should go for it.” The perpetuation of this perspective can be observed in the practices, interactions and artifacts governing school contexts, which Donnelly (2000) identifies as “school ethos” exerting the power to “condition people to think and act in an ‘acceptable’ manner” (p. 136).
The Science Class

Science classes are described as a rigid and repeating collection of almost identical procedures, regardless if it is chemistry or biology class on which the students reported. Although these classes were outlined as an assortment of teacher-centered events, most of the students showed great sense of belonging and felt thankful and appreciative of the job performed by their teachers. “Thank God that we have teachers in our school who care about the education of the students,” states Mónica, a grade 10 student at the provincial school. Joaquin, a grade 8 student from the urban Catholic school is in accord with his fellow counterpart:

That is the reason I like my school. Not only are we taught about different things but also we are educated – through ethics and religion – as people, unlike in other schools, where the only thing they do is to teach and teach.

The Provincial School

In this Catholic-public school, there is only one science teacher, he is Mr. Rodríguez and has been in charge of the biology and chemistry classes from 6th to 11th grade for about 10 years. In conversations with Mr. Rodríguez, it was noticed that his observations were mostly related to the need to improve scores on national standardised tests, the allocation of resources for his classes such as textbooks and lab supplies, and the attitude exhibited by his pupils. He also feels alone and disempowered in the job he does and criticises the prevailing attitude on the part of the school administrators who do not seem too concerned with the renovation of textbooks and the allocation of lab supplies. “I think that this year I am going to have to charge students some money to buy textbooks,” he explains.

The implementation of the national curriculum is in the form of ‘academic goals’ [a set of interrelated contents] which Mr. Rodríguez has organised by quarter. His intention was to be able to deliver the same number of goals per quarter. However, his estimations were far from reality.

It depends on the grade, plus one has accustomed the students to ask any question if they do not understand, then it causes delays in the program. Sometimes one goes too slow so that we only go over two or three goals per quarter, at the most. For instance, in 10th grade, I planned four units for the year, but we just covered two and a little of the third one.

Descriptions of this type fit well into what Tobin and McRobbie (1996) call “the cultural myths” in which teaching science practices are heavily oriented towards the transmission of knowledge, being efficient, maintaining the rigor of the curriculum, and preparing students to excel on standardised tests. In general, the flow of science classes goes through a series of events that are constantly replicated. Step 1, as Mr. Rodríguez enters the classroom, students would automatically stand up as they respond to his salutation and would wait for the silence indicating that, step 2, it is time for the prayer. Step 3, then after taking the attendance the class will continue on a linear path. Step 4, in case of going over a new topic, Mr. Rodríguez would introduce it by giving a short speech and writing the title on the blackboard. In case of difficulties, he would be willing to help, which is something highly appreciated by his students. “He explains the theme over and over again so that the students understand what we are talking about, and if we have questions, he will help us...he goes by bits so that we understand,” adds Teresa, a junior student in the chemistry class.
As things move on, during step 5, the students are given a set of questions to work on in work teams, this is an activity that occupies a big portion of the class, and that according to Mr. Rodriguez is enjoyed by his pupils. However, he adds that it is also a little problematic, because only a few students do the work. As Mr. Rodriguez gives his long speeches, Teresa finds herself comfortable just by listening to him even though this is the part of the class [explanations] she does not like. “It is useful to me, because with only one question one understands everything, if one does not understand the first question then you cannot get over the rest, almost everything is related to the first question.” Step 6, there is then a revision of the assignment, in class, made by the teacher and the students who share the responses of the questionnaire by reading them aloud to the whole class. Nonetheless, there is not much room in the structure of the class for the participation of the student beyond answering the questions asked by the teacher. Tony explains that his involvement in class is limited only to the assigned oral presentations his teacher arranges for them. Other than that, he performs at a minimum pace, or at the pace imposed by his teacher. This type of sentiment corresponds with the findings in Delamont and Galton’s (1986) studies in high school settings. There, students experienced a culture of exclusion due to a differential treatment on the part of their teachers. Although these feelings were also highlighted quite often by the students in this study, it is possible that their teachers’ actions did not follow the exclusion model in which the less successful students receive less attention alongside their brilliant classmates (Solvason 2005).

Normally, I do not go in front of the class to share my ideas. My teacher is the one who explains everything. We [students] stay seated, and if asked, we would raise our hand to be allowed to give the answer. If the answer is correct, we move on, but if it is wrong, then he explains so that we all write down the right answer.

Nevertheless, Tony suggests that Mr. Rodriguez makes the classes enjoyable by telling the students new things, and making them solve assignments in the laboratory. He also claims that if they had enough opportunities and space to make contributions to the class, they [students] would be able to develop oral skills. Having taken the final notes and the right answers, students are then ready to face step 7, a paper-and-pencil test. “I prepare a questionnaire by myself and learn it,” says Tony. In the case of Victor, a grade 10 student, he explains the algorithmic procedure he applies to prepare for a test about chemical reactions:

You have to be very careful, it [the method] has several steps, if you forget something, then everything is lost and you have to start over...you need to pay attention to the sequence so that you realise where each number comes from (Tony).

Step 8, if a student fails the test; she/he is given a second chance to obtain a passing grade for that particular ‘academic goal.’ Step 9, after the evaluation, the next class revolves around a new topic with another set of questions that is answered in the classroom.

The Urban Schools

In these schools, science classes revolve, once again, around a set of procedures that mostly indicate a teacher-centered approach. Students have a chance to participate in class in the form of home work revisions, or when working in groups to solve an in-class assignment arranged by the teacher.
The Military School

Daily interactions in Mr. Molina’s science class always follow this pattern: step 1, the teacher enters the room since in Colombia it is the teacher who changes classrooms from one period to another as students remain in their grade level classrooms, step 2, students rise to greet Mr. Molina and a designated student offers a daily prayer, then, step 3, the recitation of a patriotic motto takes place. Freddy, an eloquent grade 9 student at the military school relates the succession of these events as follows:

Well, first of all we would stand up and greet the teacher, and then we offer a prayer, only in the first period. There is also one student, in each classroom responsible for leading the class in saying the motto.

As Freddy continues highlighting the main episodes of his biology class, he mentions that after saying the motto, comes step 4, his teacher starts with a lecture, explaining the concepts with a synopsis on the chalkboard, and then he [teacher] tells students which notes to write down. For instance, if we are talking about the respiratory system, we would write down the name of each part with its definition, explains Paulo a grade 8 student, and he goes on to refine his description by saying, “from the notes, he [teacher] would explain parts with graphs, and then he would continue telling us more notes to write down.” When the lesson is over, step 5, Mr. Molina splits the class into groups of three or four, and assigns a set of questions that he would later revise and correct in the next period. Freddy explains, “On one day he lectures, and on the next one, he asks questions. Our class almost always ends up (step 6) with an assignment to be done at home.” After having finished the topic, step 7, he would give us a test, comments José, who prepare for them by “reading the text two or three times until I had all the notes memorised,” as he recalls.

Economical constraints in the Military school are evidenced in nonexistent, yet fundamental resources. This is documented by Laura, a grade 8 student who thinks that her school should be more spacious. The use of the textbook, at least in the biology class, is for the privilege of only one person, Mr. Molina, her teacher. Laura comments that, “he [Mr. Molina] is the one who uses the book.” She also adds that “from the book he would tell us what to put down on the notebooks.” Despite all these inconveniences, Laura still highly regards her biology class. “I like it because my teacher tells us about animals, about the reproduction of living things, and about many other things that we like.”

Freddy, a grade 9 student who always strives for good grades proudly relate his participation in his science class:

One day in my chemistry class, our teacher gave us an extra assignment about salts, and promised a good grade for the student who was able to complete it and explain to the class. Then, I did it and earned the grade. I like being active in class...well, as much as I can, so that I am ready at any time...

Mr. Molina explains that he strives to have his students, “learn enough about something, rather than going over many things without assimilating them.” He also remarks that in class his students really respect him. “They did not have any problem with me, probably because I was a little harsh on them; I kept an eye on them.” Nevertheless, students are equally appreciative of their school and teachers. Ana, for instance, a grade 8 student suggests that her school is wonderful, even though it is not spacious. “To me, everything is fine with it, except that they should remodel it and make it a little bigger.” Ana admits that her participation in class is always based on what her teacher tells her/them to do. “My teacher comes in and sometimes asks me to read the book aloud, or even take attendance.”
In line with his classmate, is Paulo, who describes Mr. Molina as a teacher that always strives to make the class appealing for his students. He also notes that “Mr. Molina knows a lot; he never has been stumped by any question. One could ask anything and he would respond right away,” he explains. Nonetheless, like his fellow science teachers, and from the deficit model perspective (McKinley 2005), Mr. Molina has determined that the poor involvement of his pupils has made his job a difficult task.

It is just incredible mental laziness on their part; they [students] just think of partying, goofing around, and you know, no matter how hard one tries, they do not seem to cooperate. In chemistry, my pupils were really interested, especially the 10th graders. I divided them into seven groups. They all did nice and their projects worked out. But on the contrary, with the senior students, they were so uninterested this year, I set up five groups and only one of them was able to finish the project.

Now, in his new role as a school administrator his primary concern is the national tests: “we really need to improve much more because a school with good scores on the standardised tests is a good school,” he affirms.

**The Catholic-private School**

Science classes at the Catholic school simulate to a great extent the happenings in the military school. The academic load includes three 1-h class periods that take place every other day. Joaquin, a grade 8 student at this school, relates a typical biology class as follows: step 1, she [teacher] would come and tell us what the class is going to be about, and then, step 2, we would start socialising [revising] the homework or working on a set of questions. If we are going over a new topic, the teacher then would ask us to search for information about the contents, besides the information she has given us in class. Step 3, she would also explain the topic on the chalkboard to tell us what to put in the notebooks and then would ask us questions. Before the class is over, step 4, she would assign the homework or tell us to review the information in the notebooks for the next class. Finally, step 5, we [students] take a written test. In the event of failing a test, students then would have to return to school in the afternoon and take an extra class. In these ‘remedial’ classes students are once again evaluated and determined, on the basis of a written assignment, if they pass or not that specific set of contents.

For Joaquin, an ideal biology class should include more explanations from the teacher so that, “we can get more into the topics we are going over and thus more motivated to work on the sets of questions.” Nevertheless, he interrupts to make it clear that science will not be involved in his future career:

I am not going to need to know about biology in my career. I want to be a lawyer. I like it [law] since one of my relatives took a class in that field, but now I like it even more.

**Dual Behaviours in Inter-border Transitions**

There were notable languages differences between the two groups [urban and provincial]. For instance, the conversations were generally more cohesive with students from the urban schools. Although, not a linguistic analysis by any measure, it is interesting to note, for instance, that the average length of total responses obtained from the urban students was
around 1,330 transcribed words versus 937 over a 35-min conversation as produced by their provincial counterparts. This measure will be more meaningful if we could assume that all students were average in terms of verbal skills. Still, verbal abilities and provincial versus urban communicative styles may once again reflect within-whole culture differences. The provincial students, as a whole, seemed more reserved and less likely to present conflictive responses. Although not from a scientific perspective, provincial students seemed most concerned about environmental issues and their personal experiences with nature during interviews (see Fig. 1). It could be suggested that the exhibition of this behaviour are in connection to the same social-cultural quality of learning. In that sense, these students [provincial] may feel in conflict with the elements of learning being portrayed by school science which may affect their acceptance of science contents (Gitari 2005). Equally important is the fact that within the extended responses given by urban students with seemingly more detailed and elaborated explanations. Still, and from a science-related angle, they produced lengthy reactions when addressing aspects related to the quality and preservation of the environment. In some cases, students employed scientific, social, cultural and environmental elements in preparing their responses which contributed to the difference in the quantification of their perceptions in comparison with the other group [provincial] (see Fig. 1).

A reason for this type of characterisation could be found in the same structure of the family, school and also social setting. It could be said that, at least in the urban schools, the incidence of the dominant world [subculture of school science] projects the view of education as a market value that although inculcating a foreign perspective, is well blended

![Percent of Proportional and Urban Students in Each Category](image)

**Fig. 1** Questionnaires summary by category \((n_p=96, n_u=154, N=250)\). Categories: 1. Student expressed interest in a science-related career; 2. Student commented positively about science classes; 3. Student commented negatively about science classes; 4. Student commented on how nature is knowable; 5. Student commented on aesthetic aspects of nature; 6. Student commented on religion and religious aspects of nature; 7. Student expressed his/her concern with the quality of the environment; 8. Student commented on personal experiences with nature.
with the perspectives students have about the natural world. On one side, the school life is approached as a support for the goals and expectations held by students and their families, and on the other one, the life outside school re-takes a totally different role functioning under other sets of actions. For instance, as a member of a upper-middle class group, a student will agree to participate in the foreign world of school science because of the immediacy of the upcoming dividends, letting the school world act upon him/her in preparation for the next segment of his/her life, or vice versa enjoying at home the benefits of a science-free perspective of the world which makes things work the way they have been dictated by their own ways of knowing.

### About Teachers and What Matters to Them

In the classroom, what matters to Mr. Rodríguez (the provincial science teacher) is to make sure that his students feel comfortably getting through the content, which is supported by a healthy relationship he strives for with his students. These tacit teacher–student treaties guarantee that for instance, the student will be aided by the teacher as soon as he/she finds a difficulty whilst solving an in-class assignment. “I think that my students know that they can ask me all the questions they have if they do not understand; I consider myself good at communicating with them.” His students on their part are also aware of the agreement. Oscar, a grade 9 student supports his teacher’s claim. “He [Mr. Rodríguez] explains the themes over and over again so that we understand what we are talking about, and if we have questions, he will help us.”

These types of negotiations and context dictate the meaning of science and school science that is constructed in the classrooms. In this school settings, the ideal interaction of having teacher and students engage in a discourse in which “talking science” (Bleicher et al. 2003, p. 321) and thinking scientifically is done in a constructive manner (e.g., students pose questions, dispute novel ideas or bring in new perspectives) does not occur, instead talking about science in which the teacher holds on to the conversational floor is the persistent behaviour (Bleicher et al. 2003). The science classroom environments (urban and provincial) being described in this study depicts rather a community learning a single discourse, the one imposed on and performed by the teacher which creates a misleading learning experience.

Beliefs, such as: educating knowledgeable students in a subject matter to be able to succeed on standardised tests with gains for everyone as a synonym of excellence in education; goals such as getting through a set of contents in a timely fashion and training students to be able to use that knowledge on a pencil-and-paper examination can be predictable of the type of knowledge that is constructed in these settings (Tobin and McRobbie 1996). A good example of this analysis can be outlined by looking at the actions driving the educational practices in these schools. Mr. Molina, for example believes that “a school with good scores on the standardised test is a good school.” Mr. Rodríguez, at the provincial school laments not having accomplished his goal of covering the contents he has planned for the school year. Therefore, pouring knowledge into the student’s head with the rigor of the discipline has made schools to implant, and students to assume roles that justify the so-called re-organisation of the school curriculum. Mr. Molina, for instance claims that:

For this year, we signed a contract with PC Group, Inc. We are going to consult with them, so we are hoping to increase our scores even more. They are the best in the country [training students on how to approach standardised tests]. Thank God we have
reached a good agreement with this organisation, plus Mr. Blanco, the owner of this company, is one of my very best friends, so it worked out really well.

It is particularly important to note that features of cultural difference may force the student to unwittingly adjust to unfamiliar contexts. This fact, as mentioned before, oftentimes goes undetected by parents, educators and school administrators. An excerpt from a conversation with Paulo, a grade 8 student, reflects the differentiated vision that students have about their worlds of school and home. Paulo feels doubtful about the possibility of taking his home-based investigations to school and sharing them with his peers and teachers: “It depends, in my school this would not work, there are mediocre students who would laugh at me...they just do not know, I would also have to know the teacher well.”

Despite feeling insecure about science in the classroom, Toni, Wilson and Elisa revealed an interest in scientific activities at home. Toni, for instance, proudly comments on home experiments he has adapted from textbooks. Wilson reads about astronomy and physics at home and in the hall during morning breaks at school, yet never in the classroom. He vows with confidence: “I am a good student, but obviously with the typical difficulties that anyone has.” He also feels confident he would be able to conduct his own home-experiments. As for Elisa, her home-experiment would investigate ants as living creatures:

First, I would get information on how they live, how they survive over the winter, and how they communicate. I would also be interested in learning how they search for food, and how they recognise each other.

At first glance, the cases seem to correspond with different students, however and due to the norms established in their school worlds, they have been forced to adopt dissimilar attitudes whilst in the school settings. Evidently, they will not reveal their dissatisfaction, because as already mentioned, there are tacit agreements governing social interactions in the school context. These students prefer pursuing ‘Personal-Curiosity-Science’ and ‘Enticed-to-Know Science’ type endeavors in which the motivation comes from sources such as TV shows, books, magazines and friends. It can be argued that their reports also provide insights about undetected circumstances affecting their connections with school and school science contexts, although such sentiments may go hidden for sake of acceptability within the community.

Discussion and Conclusions

The findings reported in this study highlight issues of inequality in the Colombian education system which replicates the state of education in the rest of the Latin American region. These concerns are well known in the Colombian society and originate from outside the classrooms, with or without direct responsibility of educators. According to the Antonio Restrepo Barco Foundation (FARB 2003), an organisation created in 1998 by the private sector to evaluate the quality of education in Colombia, there are tremendous inconsistencies between what is administered in urban and rural/provincial school settings. It was found, for instance, that among nine indicators of educational quality, efficiency measures reflect the poorest performance. In connection with this issue, it is observed that in Colombia, a fifth of all students drop out of school because they do not like it and because they feel forced to find a job. Colombia’s National Department of Statistics (DANE, from its Spanish acronym) reports that 14% of school-aged youth are not in the...
education system. The main reasons cited for non-attendance include the economic difficulties faced by the parents, and reports of student dissatisfaction which is highest among 15 to 17-year-old secondary students (DANE 2001). In reference to economic barriers, a Colombian family’s access to quality in educational services is governed by their socio-economic status as in other Latin American countries (Abdalá 2002). According to the Commission for Education in Latin America (CEPAL, from its Spanish acronym), this differential gap in quality of education widens as students begin secondary education, around the age of 12. Students change schools at this point and follow a more determined path to who they will become as working citizens.

Overall, a huge breach exists between the education offered in urban and rural schools, and also between public and private schools. This disparity has been steadily increasing. In this regard, private schools outnumber their counterparts in the number of students finishing secondary education. Particularly in science, these schools, which for the most part are located in urban centers, are the ones that normally rank first on national standardised examinations. Consequently, students and families affiliated with prestigious private-urban schools enjoy the possibilities of upward mobility in the Colombian society. According to interviews with administrators and teachers of these schools, measures are taken to maintain the status and prestige they have long enjoyed. For instance, Mr. López, a school administrator at the Catholic-private-urban school, explained the strategies of prioritising content areas for the national examinations, a key justification for higher tuition costs at his school. He harshly described terminating teachers whose students did not perform acceptably:

In grades 8th and 9th, the teacher is gone. She was more aligned with working in the classroom setting; she did not like working outdoors, perhaps because she is a woman and her nails could break. In the case of 11th grade, that teacher is not with us anymore. He was a very kind and bright person, but unfortunately his speech was just speaking. He did not have good communication skills; he could not reach the student...I let him know, but he did not make any effort to improve his teaching, and here are the resulting scores from the standardised test.

Although the provincial Catholic school is equally concerned about the national examination and follows a national curriculum, science teachers like Mr. Rodríguez find themselves at a disadvantage position when unable to update textbooks that have been in use for over 15 years or purchase laboratory materials. Although Mr. Rodríguez has been in his job for 10 years, he still hopes to improve his teaching practices.

"The problem is putting the theory into practice. We have too much theory, but too little practice. I try to do all the lab experiences that come in the textbook...but creating new activities is something that one would not do, it would be like improvising..."

The reasons for these incongruities, according to the (FARB 2003), are the socio-economic aspects affecting the Colombian community as a whole. It has been pointed out, for instance, that the scarcity of resources, the climate of violence, poverty, and teaching methodologies, waste of time in school, deficiencies in teacher preparation, and the absence of adult support for the students are the major agents of inconsistency (FARB 2003).

Furthermore, not all states in Colombia were created equally. For example, some states were historically called national territories, meaning with the lowest levels of governmental presence (Molano 1987). Many of these areas, despite now being official states, remain ignored in health, education and corporate investment. This is the case of states such as Amazonas, Putumayo, Caquetá, and Meta, where drugs, weapons, terrorism and kidnappings are most likely (FARB 2003). Thus, schools across the country function under differential treatment by the national government which translates into an irregular
allocation of human and physical resources (Tooley 1999). As cited in studies about the quality of the education in Colombia (FARB 2003), a very low proportion of rural and provincial students, who for the most part are found in mid-low SES, continue on to the tertiary education level.

Additionally, other socio-cultural features come into play in correspondence with the nature of each setting. “Because practices are created within specific fields they can be thought of as belonging to the field in which they are produced (e.g., science classroom, streets, homes)” (Tobin 2005, p. 579). All family, school, and church are in tune with the values and expectations professed in their religious beliefs. Home and church institutionalise a set of principles, and schools on their part function as multipliers of those aspirations. There in school, programs, schedules, demands, and even curriculum contemplate the agency of that way of being in the world. Within the school environment, all the members of the community have learnt to adequately harmonise with the everyday dynamics of practicing, professing, and following local or internal affairs. Furthermore, the same religious orientation is organised in such a way that no perceivable discrepancies are produced as national or universal discourses (i.e., Euro-centric view of the natural world) are under operation.

In both educational settings (Provincial and urban), not only cultural differences can be held responsible for the attitudes shown by the students. These attitudes are oddly interpreted by teachers, for instance, as ‘the culture of minimal effort’ or simply as ‘a mental laziness.’ There are other factors at play that produce socio-cultural differences. These so-called differences are better characterised as mediators in the border transitions made by the students. A list of those possible factors include: socio-cultural borders, socioeconomic borders, psycho-social borders, linguistic borders, and structural borders (Phelan et al. 1997).

Socio-cultural components of school science in these schools [provincial and urban] create an exclusively dictatorial image of the teacher. From this perspective, this type of border relates to aspects such as: communication, relationship, and cognitive styles that unwittingly introduce unilateral interactions. Sentiments such as: “Mr. Molina tells us which notes to write down (Paulo, a grade 8 student at the Military school),” or “Our teacher told us that the class was misbehaving and that she preferred to have us in the classroom (Joaquin, a grade 9 student at the Catholic urban school),” are examples of these types of interactions. The perception that students in the provincial school have of their science teaching and learning experiences speak to this suggestion. This relationship is evidenced in a setting where the organisation of the class solely displays teacher-centered activities, apparently as friendly interactions, but limited to finding right answers to questions created and asked by the teacher, and learning about nature through the teacher’s speeches that emphasise authoritative knowledge as the ultimate source for learning. This dictatorship model is too cyclic and problematic for truly meaningful learning to take place.

Another characterisation, emanating from the socioeconomic conditions may reveal one more limitation to giving students a dynamic role in the school world of science. The provincial science teacher blamed economic constraints for enticing his students to plan a career before completing their secondary education, in occupations very distant from science fields. Internally, financial features also change the quality of the work of the teacher who has to deal with managerial issues. The occurrence of these types of limitations is up to a point, suggestive of disparities that may preclude the students in this school community from seeing school science as a relevant endeavor in their lives. Although provincial students may communicate their interest in entering science-related careers (see Fig. 1), a different reality is likely to force them into unstable professions after their secondary education.
Another form of the imperceptible disturbances inside the classroom atmosphere originates in teacher–student interactions. Psychosocial borders are built on the emotional demands generated as the social structure of the classroom is developed. Students, for instance, have assumed and tacitly agreed to behave as passive listeners of the teacher speeches. As reported by some students in this school community, his/her participation in the science classroom is merely limited to process fragmented pieces of knowledge. This sentiment comes from the unspoken messages telling them to be simply receivers and reporters of factual information. It is then predictable that characteristics such as shyness, apprehension, insecurity, fear and indifference are reinforced, as undemocratic classroom settings shape the school world in this provincial community.

It could be suggested that in this kind of educational scenario, the school and classroom function in favor of a select minority of students who, screened by the system, are the ones also chosen to excel over the disempowered students who are relegated to simply go through the motions. “There are some students who show interest in the class. Others are just there,” commented a high achieving student who enjoys a prestigious image among his peers and teachers. “They [students] just do not like it [chemistry class], they are uninterested or just do not want to learn,” reported yet another student who struggles to understand her teacher’s speeches. There are also the voices of those who do not receive equal treatment in their classrooms. “Sometimes people try to bring me down, but I just feel that, with my skills, I can be creative and all of that...” reported José, a grade 8 student at the urban-military school.

Anthropologists who have studied the culture of this part of the country [mid northeastern region] contend that the child-rearing practices of this region impose a harsh environment for children (Ardila1986). Literature on diversity presents Hispanic children as more silent participants due to family structures that prepare children to obediently fulfill traditionally authoritative and conforming educational norms (Rodríguez and Olswang2003).

Linguistic features of the students interviewed were also significant, especially in the provincial school community. The length and quality of their speeches were limited as compared with their urban counterparts. It has been argued (Phelan et al. 1997) that linguistic borders take place when inter-worlds (i.e., home/school, peer/home) communications are regarded differently (i.e., acceptable or unacceptable) in each of these contexts. In this study, there is no conclusive evidence to account for the language differences between the two groups. As suggested before, it may be that linguistic disproportions – lack of high content words and extended responses to the language elicitation task – are due to varied amounts of exposure, through the media and social circles, to the Westernised way of looking at the world. It could even be suggested that the same diversity of the social context enables students in urban centers to act more freely in social and cultural environments, including the context of a semi-structured interview with an adult examiner. Each community and even student must be addressed creatively by the school and teachers who are responsible for lessening the cultural borders of the classroom. For more traditional families and in collective communities, interactions are to be harmonious; questioning and conflict are avoided, whilst importance is placed instead on politeness and respect (Hammer et al. 2004). Oscar, a grade 9 student at the Catholic provincial school, suggested that the event he remembers most from school was the day he and his classmates were punished for playing soccer in a hallway and having hit a teacher with the ball.

From interviews with students, it was observed that those from the Military school were concerned with the qualities that should exist in their school, and that in their views, would bring the school great improvements. Some of them even went beyond merely physical qualities of their school that should be tackled, they pointed out their concern with the
improvement of the curriculum. They mentioned for instance, the need to be, “taught more sophisticated things in their science classes.” Others pointed to the fact that, in the absence of competitive levels of academic demands, they opted for achieving their own academic interests at home or with friends, or reading about specific science contents or even learning from TV shows (i.e., Paleolithic World, Mega-Constructions). This research supports the use of a Student’s Multiple World Model by Phelan et al. (1997) as an illustrative tool for discussing the transitions students experience in daily interactions with their worlds of family, school, and peers.

It is particularly important to note that features of cultural differences may force students to inadvertently adjust to unfamiliar contexts. (i.e., approaching the natural world in school from the prevailing view of Western science) whereas in familiar contexts those same aspects are approached differently (i.e., at home looking at reality from a science-free/common sense stance). These issues are mostly ignored in pre-service and in-service teacher development programs throughout Colombia. Teaching teachers to appreciate and incorporate individual and cultural characteristics would help bridge the border crossing gaps that separate Western science from students (urban and rural) from LDC. This perspective and need to address diversity of thought in science education also gains relevance in developed nations, especially in those with ever-changing demographics and influences of immigrant groups.

As for the Catholic-urban private school, students reported higher levels of confidence than their both urban and provincial counterparts, in the education guaranteed by their school. For them (students at the Catholic-urban school), scoring high on standardised tests and participating of the culture of prestige inherited by their institution is the vehicle that makes their future career goals attainable. “I am not going to need to know about biology in my career. I want to be a lawyer.” relates Joaquin a member of the urban-private Catholic school. One of his classmates, Marco, has a different but significant view, “What happens is that I would like to go to medical school, and so I need to do well on this subject [biology].” In the case of the Catholic-provincial school, some students feel their future educational goals are diminished by what could be described as a “double breach” they have to traverse to their next destination in life (e.g., a beautician, a soldier). First, it is well documented that rural and provincial schools in Colombia, remain relegated to subsist with a lack of resources and low quality education services (FARB 2003; Molano 1987; Tooley 1999). Second, for some high school graduates, making the leap from the village to the complexity and challenging context of the metropolitan centers adds another hurdle in the realisation of their aspirations. As reported by one student, “One cannot sleep in the laurels. If you are told that something is useful, you should go for it.” And when the time comes to embark on her/his life career, the student must make practical and economical decisions. Of course, their decisions are not usually guided by academic interests, but forced by the available opportunities, leaving most of them unprepared to fit into modern society (Puryear and Olivos 2003).

Worldwide, science education researchers (Aikenhead 1996; Coben 1997; Ogawa and Omoifo 2002) recognise that students’ views and beliefs are significant and predictable of the type of science learning achieved in schools. For the students in this study, their transitions to and from the world of school science imply a variety of adjustments and regulations in their epistemological frameworks that, up to a point, involve emotional expenses. Medvitz (1996) asserts that the type of science typically learnt in school is learnt as science in school, not as the science that students may find in their everyday contexts. Unfortunately, after repeated concerted calls (Atwater 1996; Shapiro 1994; Taylor 1994; Yager 1988) for adopting culturally sensitive education in science, the current circumstances
still remain to be driven by an objectivist view of knowledge. Routinely, science classroom activities, such as the ones reported in this study, consist of mastering the solution, through algorithmic procedures, of a set of questions. Costa (1997) contends: “Teaching students to solve problems in chemistry is not equivalent to teaching them about the nature of matter” (p. 658). If not chemistry, biology classes also impose the habit of getting the right answer, certified by the corrections made by the teacher. Worldwide, science education researchers (Aikenhead 1996; Cobern et al. 1999; Ogawa and Omoifo 2002) recognise that students’ views and beliefs are significant and predictable concerning the type of science learning (i.e., teacher-centered) achieved in schools. For the students in this study, their transitions to and from the world of school science imply a variety of adjustments and regulations (i.e., performing scientific experiments outside school scenarios, alluding to media sources as learning motivators). Likewise, these scientific quests never will be shared in the social context of the classroom, probably because it would disrupt the already score-oriented agenda. Even within Colombia, curriculum and teaching must be adjusted accordingly to be culturally sensitive and meaningful for any student, whether she/he is part of the majority regional culture or is a student who stands alone with a particularly unique background and history. Tharp (1994) proposed several principals to simultaneously promote achievement cross-culturally: learning should be contextualised; teachers and peers should use joint productive activities; and instructional conversations (ICs) should allow dialogue between teachers and learners as discussion-based lessons geared to a holistic view of the science classroom. From the anthropological approach used in this study, it is clear that the voice of the student is central in the construction an education setting that equally serves both the student’s own views about the world and the ones practiced and promulgated in the school classroom.

Weinstein (1998) recognises that in classrooms some moments of the class are oriented towards finding out the links between the delivered knowledge and the life of the student, out there in their familiar environments, but he advises that the reverse procedure should also take place. This is a fundamental premise expressed in the cultural border crossing model. Science educators should be aware of teaching science as an endeavor that involves cognitive, social and personal issues. School communities such as the ones included in this study could certainly accomplish memorable goals that would start with a re-organisation of the existing curriculum making subjects such as philosophy, religion, ethics – which are compulsory – and science intermingle in the treatment of the science programs. This association would surely bring a new perspective in having students understand the nature of science and the perceptions and beliefs they have about science.

Internationally, a good number of approaches have already been suggested by researchers (Aikenhead 1996; Atwater 1996; Jegede 1995; Pomeroy 1994) in order to provide school communities and science educators with some insights that may help reconsider a community of learners from a conceptual eco-cultural paradigm. All of these proposed approaches address the role of the teacher in varying terms. It has been for instance referred to the science educator as a ‘culture broker,’ a ‘tour-guide,’ a ‘travel agent.’ The term given to the role of the teacher is not what matters, but the acknowledgement of cultural differences in the classroom that provides the needed attention to each student in coping with his/her strengths and weaknesses as they feel integrated into the cross-cultural scenario of the classroom.

This study suggests further analysis of cultural and language-based differences. It is difficult to assume underlying concepts and world-views when verbal ability and skill has not been controlled. It is recommended that the next step is to correlate linguistic styles and narrative analysis with the science student categorizations. This type of information would
allow the researcher to perform the study with other groups, language-based again, and compare cross-linguistically between Western and the Colombian, non-Western, respondents.

In general, the science education community lacks qualitative consideration of different ethnic groups and a variety of the culture-specific problems that occur when Western curricula are used outside of their scope and normative populations. Teachers may better serve these communities by fostering science learning through the ecological views of their students. Improved education of non-Western groups could promise more scientifically-oriented generations from across the globe.

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