

Spring 5-1-2009

# Ethnomathematics in the Dominican Republic: A Mathematics Education Approach to Knowledge and Emancipation

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## Recommended Citation

Pablo-Hoshino, Sofia, "Ethnomathematics in the Dominican Republic: A Mathematics Education Approach to Knowledge and Emancipation" (2009). *Syracuse University Honors Program Capstone Projects*. Paper 464.

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## Introduction

My interests have always touched on broad range of topics, and that is why I am so interested in studying ethnomathematics in the Dominican Republic. I am a current mathematics major, but have always had an interest in traveling and understanding other cultures.

During the planning stages of my Capstone Project, I was taking a few classes that helped me shape my idea for my topic. One was an English class taught by Professor Greg Thomas where we focused on the life and myths surrounding Malcolm X. However, we focused not just only Malcolm X's national and international politics, but we branched out and learned about the rights movement as a whole, the Bolivarian revolution in Venezuela, and the African Diaspora.

The other class that affected my Capstone proposal was the Creativity in Entrepreneurship, taught by Minet Schindurette. In this course we looked at entrepreneurship from many different perspectives. The one perspective that I was most interested in was social entrepreneurship. We discussed the many businesses and entrepreneurial ventures that are established for the greater good of the people.

The interaction between these two classes, along with my mathematics classes, got me thinking about the many ways that these issues interact on a daily basis—mathematics and social justice. Earlier in the semester, I had a professor tell me that mathematics was not political, and wondered if that was true. We have come to accept mathematics as universal, but is that truly so?

These are the questions that started me off on my research. I learned of the idea of ethnomathematics from Professor Joanna Masingila. I learned that ethnomathematics has many definitions; depending on the perspective that one is coming from. If one is to simply Wikipedia the concept, the response is that “Ethnomathematics is the study of the relationship between mathematics and culture. It refers to a broad cluster of ideas ranging from distinct numerical and mathematical systems to multicultural mathematics education. The goal of ethnomathematics is to contribute both to the understanding of culture and the understanding of mathematics, but mainly to appreciating the connections between the two.” I was interested in whether mathematics was taught with a level of cultural, historical and political understanding of the country, and more importantly, the students.

I set out to understand a more global mathematics. I wanted to know how other cultures were able to teach their students and what they found to be most useful in the teaching of mathematics. I had not fully developed my proposal, but knew that I was onto something of interest. I knew about the UN Millennium Development goals and that goal number two was to reach a level of universal primary education for all students. Although I believe that this is an important task to be accomplished, I wondered how we would know when this level of literacy had been accomplished. I wondered what the standard is for evaluating the education being provided and who is setting this standard.

After my continued research I learned about the idea of transplanting curriculum. Essentially, Third World countries were receiving mathematics curricula from First World countries and implementing such curricula. This of often meant that the material was not tailored to the students or their environment, making it difficult for them to comprehend. Paulus Gerdes explains in his article, *On Culture, Geometrical Thinking and Mathematics Education*, how in many countries in Africa, low levels of mathematical attainment can be attributed to curriculum transplantation. He explains that “with the transplantation of curricula their *perspective* was also copied...Maths anxiety is widespread; especially for sons and daughters of peasants and laborers, math enjoys little popularity” (1988, p. 137). I hypothesized that this issue must be occurring in other parts of the world, especially the developing nations, such as the Dominican Republic.

My interest in the Dominican Republic came after a trip to visit a friend who was studying at Pontificia Universidad Madre y Maestra in Santiago, Dominican Republic. She was working with women business owners and I had the privilege to meet these dedicated, motivated, independent women. Their kindness and open hearts left me wondering about the many different facets of Dominican life and culture. As a mathematics major, I wondered what their mathematics education system was like. I decided that I would learn more about whether ethnomathematics was being taken into consideration in the Dominican Republic.

In order to understand the current state of the mathematics education program, I think it is necessary to understand the national education system and the politics that lie within it. Escuela Básica (basic schooling) is from first grade to eighth grade and Bachillerato (high school diploma) is from eighth grade to twelfth grade. UNESCO estimates that only 40.2% of high school aged students are actually attending high school. They explain that financial hardships are to blame. In the large cities, there are various public schools that students can attend; however, most elite families send their students to either private schools or religious. In a research paper written by Jimenez, Lockheed, Luna, and Paqueo entitled, "School Effects and Costs for Private and Public Schools in the Dominican Republic" they concluded that, "students in eighth grade mathematics achieve more in both [elite and non-elite] private school than they do in public schools, and achieve more in elite than in non-elite schools. Differences in teachers' backgrounds and teaching practices account for some of this difference in achievement, but differences in the students' peer background characteristics are substantially more important" (1988, p. 393). Unfortunately, in many remote areas there are neither public nor private institutions for students to attend school. In terms of curriculum, there is a national curriculum that is set forth by the Secretary of Education.

Although my intentions were to examine the implementation of ethnomathematics in the Dominican Republic, I was only able to accomplish a certain amount. I interviewed over 30 mathematics teachers, mathematics professors, and mathematics education professors; however, I know that this is

a small number in comparison to this group within the whole country. I also realize that certain ideas might have been lost in the translation from Spanish to English or vice versa. I in no way intend for this piece to be taken as a complete representation for the mathematics education system in the Dominican Republic, but instead a opening for discussion about the way that mathematics is taught at the intermediate level around the world.

## Literature Review

### Where Does Ethnomathematics Come From?

Mathematics has long been considered one of the only culture-free subjects taught in schools. People revel in the “universality” of mathematics and manipulate this mainstream concept in ways that inadvertently, although sometimes purposely, marginalize certain peoples or concepts of mathematics. Although the laws of mathematics are generally accepted as “universal” in their implementation and comprehension, their applications to daily life differ considerably around the world. It is this difference that led to the introduction of ethnomathematics.

The term was coined by the Brazilian mathematician Ubiratan D’Ambrosio in 1977. D’Ambrosio is a professor at Universidade Estadual de Campinas/UNICAMP in Brazil. D’Ambrosio stated that “the term *ethnomathematics* is used to express the relationship between culture and mathematics...the term *ethno* describes ‘all of the ingredients that make up the cultural identity of a group: language, codes, values, jargon, beliefs, food and dress, habits, and physical traits.’ *Mathematics* expresses the ‘broad view of mathematics which includes ciphering, arithmetic, classifying, ordering, inferring, and modeling” (D’Ambrosio, 2001, p. 308). This definition recognizes the links between local culture and mathematics and gives value to the local community regardless of region, class, or race. D’Ambrosio also noted that “ethnomathematics is thus associated with the pursuit of PEACE and of a civilization free of truculence, arrogance, intolerance, discrimination,

inequity, bigotry, and hatred” (D’Ambrosio, 2002, p. 9). In this statement, D’Ambrosio offers ethnomathematics as a form of social justice and political reconceptualization. He proposes the concept from an anthropological standpoint that indirectly champions the utilization of local culture in mathematics over the “westernized,” culture-free mathematical imperialism that was previously embraced by most Westerners.

After D’Ambrosio’s introduction to the concept of ethnomathematics, other academics began researching the new concept. The International Study Group on Ethnomathematics was founded in 1985 by mathematics educators Gloria Gilmer, Ubiratan D’Ambrosio, Gil Cuevas, and Rick Scott. A definition printed in their newsletter states that “Ethnomathematics lies at the confluence of mathematics and cultural anthropology. At one level, it is what might be called ‘math in the environment’ or ‘math in the community.’ At another related level, Ethnomathematics is the particular (and perhaps peculiar) way that specific cultural groups go about the tasks of classifying, ordering, counting and measuring” (Scott, 1985, p. 2). This definition respects the way that mathematics is used in both the environment, as well as the community. It also weaves in the concept that mathematics is related to cultural anthropology and can be affected by and defined differently in specific cultural groups.

Other definitions more specific to certain regions, indigenous peoples, or languages have emerged from around the world. For example, Ron Eglash, current associate professor in the Department of Science and Technology



studies at Rensselaer Polytechnic Institute wrote that, “ethnomathematics is typically defined as the study of mathematical concepts in small-scale or indigenous cultures” (Eglash, 1997, p. 79). This definition links not only the concept of local culture, but addresses indigenous culture. Throughout time, there has been a gradual sterilization of the indigenous and movement in the direction of globalization and unification of culture. Eglash’s definition refocuses attention on the local and indigenous people and their use of mathematics.

### **Example of Ethnomathematics in the Curriculum**

Eduardo Sebastiani Ferreira, a Brazilian professor of mathematics, worked with 12 Brazilian tribes in their learning of mathematics. At the time of the study, 1988, there were 220,000 natives spread throughout 143 ethnic groups. The tribes had their own form of educating their students and paid particular attention to the ways in which education socializes the new generation with an understanding of their own community. This is in line with what D’Ambrosio has written that, “an important component of mathematics education today should be to reaffirm, and in some instances restore, the cultural dignity of children” (2001, p. 308) It was also important to the communities that students learn to be an element of their community with their own personality.

However, due to contact with “white communities” there was a need for more formal education systems in order to communicate with the National Foundation for Indigenous Support, understand maps and graphic

presentations have fair trade with peoples outside the tribe, and sell their goods at a reasonable price. These were the reasons that the Tapirapes tribe, along with other tribes, requested to have a “white school.” Therefore, the tribe felt pressure to have a more Western education system in order to be able to interact with those outside of the tribe.

Although it makes sense that this tribe wanted to increase their interactions with the outside world, that did not necessarily mean that they needed to bring in Western education. Ferreira believed that they needed “a school where their culture is respected, where there is no dominant culture and where they could really use the knowledge to the tribe’s advantage” (Ferreira, 1988, p. 546). Therefore, the proposal was to implement a curriculum that would support the tribe in accomplishing the tasks at hand, while continuing to be conscious of local culture that Ferreira was attempting to maintain and support.

In order to implement such a curriculum, ethnographic research was conducted to better understand the mathematical knowledge present in local culture such as in building a house, trading, fishing, and children’s games. It was important, as well, to understand that in such tribes there are oral expressions only for a few numbers and that time is considered to be spiral instead of the Western construct of time as linear. Time in these tribes is divided into four periods: great rains, planting, drought and harvest. Therefore language, time and space are used in specific ways in these tribes.

The curriculum that was used during Ferreira's research attempted to bring the socio-cultural reality together with the students and their participation in village life. In his writing he offers a few examples of how local culture gets woven into the mathematics curriculum. For example, when a house is being built on a rectangular base, a vine is used to measure the diagonals. When rectangles are introduced in the classroom, students come with an understanding that the diagonals are of equal length since this concept is widely used throughout the community. Also, there is an understanding of parallelism and perpendicularism since these ideas are used in body painting and handicraft. Ferreira is very clear that he wants to "introduce institutional mathematics, without running the risk of destroying [students'] knowledge, without it being a dominant science, and finally without making the student feel that this new knowledge is something detached from his everyday life" (1988, p. 549). In this statement, it is clear that there are certain aspects of tribal life that Ferreira felt would be excluded or misunderstood if the "white schools" were to be implemented in this area. Although Ferreira does not address in detail the success of this non-Westernized system, clearly he places importance on the maintenance of local culture and preparing students who are attune to tribal values and beliefs.

### **Mathematics Outside of the Classroom**

It is widely accepted that students receive the bulk of their mathematics education while attending school. However, considering the importance of mathematics to all other parts of life, it only makes sense that

students are experiencing mathematical phenomena prior to and concurrent with their formal academic sessions. Therefore, during students' time in the classroom, they must relearn many of the concepts that they have already grasped. The problem with this is that instead of being able to add a more formal explanation for their experiences to their previous knowledge, their out-of-school experiences are often overlooked: "The informal, sensible methods children have learned outside of the school are ignored or discouraged and little oral arithmetic or substantive discussion is related to the meaning of the formal procedures that are taught" (Lester, 1989, p. 33). Therefore, instead of utilizing students' previous knowledge and exploratory senses, students are taught new procedures and methods for school learning purposes.

Although, there is value in understanding mainstream mathematics, utilizing students' prior knowledge within the curriculum could make for a smoother transition into the formal mathematics classroom: "Research suggests that the focus in school mathematics on formal manipulation of symbols discourages students from bringing their developed intuitions to bear on school learning task. Thus, it is not surprising that students spend very little time using their intuition or making sense of what they do in school mathematics" (Lester, 1989, p. 34). As most mathematics educators know, when teachers can engage students with the material in ways that are relevant to their daily lives, the students learn the material better and are able to utilize it outside of the formal classroom setting.

As stated previously, students enter the formal mathematics setting having already done some exploratory learning on their own. As Geoffrey Saxe explains, “mathematics learning is not limited to acquisition of the formal algorithmic procedures passed down by mathematicians to individuals via school. Mathematics learning occurs as well during participation in cultural practices as children and adults attempt to accomplish pragmatic goals” (1988, pp. 14-15). In other words, mathematics is an integral part of our daily lives and therefore people learn many concepts outside of the school environment.

Saxe himself did research on child candy sellers in northeastern Brazil. Saxe observed a group of candy sellers ranging in age from five to 15 years as they went about their candy selling business. Saxe explains that there is a four stage process in candy selling: purchase from wholesale stores, price the candy for sale in the streets to ensure profits, sell the candy, and consider market conditions for the purchase of a new box of candy. Saxe noted that the sellers had to be aware of many different mathematical issues in order to be successful. For example, they were aware of inflation rates, how to make on-the-spot computations for giving people deals (such as 3 bars for Cr\$1000), and the prices set by their competitors.

Saxe also completed a comparison study of 23 children who were 10-12 years old who had minimal schooling, a group of 20 urban children from the same commercial environment and a group of 17 rural children whose exposure to commercial transactions was limited. Since all children had

limited access to education, Saxe hypothesized that the biggest difference would be in their performance linked to problems related to frequent commercial transactions.

All students struggled with the formal mathematics questions and almost all performed very well on the alternative representation tasks (bill identification and currency comparison). However, when it came to bill arithmetic tasks and ratio comparison, problems linked to the selling practice, the sellers more frequently provided correct solutions. Saxe observed that very few of the children used paper and pencil methods and correct solutions from the group of sellers were often accompanied by explanations that related to their selling practices.

Saxe also looked at the performances of four groups of sellers based on their school experiences. The groups were made up of sellers who were 12-15 years of age and had never attended school, reached 2<sup>nd</sup> grade, reached 3<sup>rd</sup> or 4<sup>th</sup> grade, or reached 5<sup>th</sup> to 7<sup>th</sup> grade. From this research, Saxe found that sellers with higher levels of schooling achieved higher performance on the formal mathematics questions and that this same group also utilized a more formal method of computations. However, on both currency arithmetic and ratio comparison there were no statistical differences in performance.

Therefore, although those who had more formal schooling did well on the formal portion of the research and used their formal schooling skills, they did no better than their less-educated counterparts on the material that is most closely linked to candy selling.

Other researchers conducted a similar study found with similar results. Analucia Schliemann carried out a study in Recife, Brazil on a group of carpenters and another group of carpentry apprentices with varying levels of education. The group of carpenters consisted of 12 professional carpenters with zero to five years of formal schooling. The other group was made up of 18 adolescents from poor backgrounds who were carpentry apprentices, age 13 to 18 years, who were enrolled in a three year carpentry school. The apprentices attended formal schooling and had at least four years of school instruction in mathematics prior to their enrollment in the carpentry school. Schliemann wanted to see the way that the professionals and the apprentices would deal with the issue of supplying enough wood for five beds, where all groups were given dimensions, a picture, a paper and a pencil (Schliemann, 1984).

The results were interesting. Many of the first-year apprentices preferred to use addition when it seemed that multiplication could have been applied. It is also interesting to look at the way that the different levels of experience changed their approaches. For example, 70% of second-year and third-year apprentices and 90% of percent of professionals used multiplication. Also, first-year apprentices would only consider the length of the parts, the second-year and third-year apprentices considered length and width, and in most cases length, width, and thickness. As for the professionals, they always looked at things in terms of three dimensions.

Observations from research made for interesting results. She noticed that apprentices looked at the task like a school assignment and did not look at the actual suitability of their answers. The professionals, on the other hand, took it as a more practical assignment and sought a solution that seemed feasible to them: “That difference between a school approach and a practical approach, as noted by Lave, seems to change the nature of the problem” (Schliemann, 1984, p. 93). Considering their results, both groups did very well on the problem and very few mistakes were made.

Although the apprentices had been taught the formal school methods to solve such a problem involving area and volume, they struggled to utilize such methods and instead resorted to the methods taught at the carpentry school. As Schliemann points out, “it seems then that problem solving at school has to be taught differently if it is to have any use out of school” (1984, p. 93). However, one must recognize the apprentices were challenged by the problem even as carpentry students, therefore the responsibility does not only lie within the confines of the formal schooling system. Although there are many variables in these studies, it is important to recognize that students come to formal educational setting with a wealth of mathematical knowledge that they attempt to integrate into their school mathematics learning. Sometimes this experience is valued, but more often, it is disregarded and new, more formal methods are meant to replace the existing knowledge. Often times these new methods prove difficult for students to utilize in ways that are applicable to their daily lives. The goal of ethnomathematics is that these out-



of-school experiences will be valued and used as a foundation for further learning instead of being overlooked.

### **Mathematics as an Emancipator**

As one can see from the previous discussion, mathematics can be used within the curriculum to maintain indigenous culture. It is also used by students on a regular basis, prior to the formal mathematics taught in the classroom. These are good examples of the way that mathematics should be used to build on the prior knowledge that students have, whether that be from their own culture or from other experiences. However, mathematics can also be used to “undo” or emancipate one from imperialist thought.

D’Ambrosio writes that, “...mathematics has been used as a barrier to social access, reinforcing the power structure which prevails in the societies (of the Third World). No other subject in school serves so well this purpose of reinforcement of power structure as does mathematics. And the main tool for this negative aspect of mathematics education is evaluation” (1983, p. 363). D’Ambrosio recognizes the way that mathematics can reinforce the power structure that educational imperialism implanted throughout developing countries and on indigenous groups.

Former President of Mozambique, Samora Machel, has highlighted the need for a cultural rebirth in Mozambique. “In this cultural rebirth, in this combat of racial and colonial prejudice, a cultural-mathematical-reaffirmation plays a part: it is necessary to encourage an understanding that our peoples have been capable of developing mathematics in the past, and therefore –

regaining cultural confidence – will be able to assimilate and develop the mathematics we need; mathematics does not come from outside our African, Asian and American-Indian cultures” (Gerdes, 1988 p. 140). These are strong words that come from a national leader. It is important that those in power are recognizing that Westernized thought and mathematics have a huge effect on peoples’ national psyche.

It is not widely understood that mathematics, history, culture and language are all linked and how repression of one, results in the repression or rejection of one or many of the rest: “We may conclude that the incorporation of mathematical traditions into the curriculum will contribute not only to the elimination of individual and social psychological blockade but also of the related cultural blockade” (Gerdes, 1988, p.140). Gerdes references the psychological blockade that students encounter early in their mathematical careers. He explains that this psychological blockade begins when an individual who manages perfectly well numbers, operations, geometric forms and notions encounters new and more formal approaches: “What happens in school is that ‘the former, let us say, spontaneous, abilities (are) downgraded, repressed, and forgotten while the learned ones (are not being) assimilated, either as a consequence of a learning blockage, or of an early dropout’” (1988, p. 138). Therefore, students’ prior knowledge is not recognized and built upon, but gets pushed aside or repressed by school-taught mathematics.

Although deconstructing the psychological blockade, there is also a need to deconstruct the cultural blockade that persists throughout many third

world countries. As former President of Mozambique, Samora Machel explains, “Colonial education appears in this context as a process of denying the national character, alienating the Mozambican from his country and his origin and, in exacerbating his dependence on abroad, forcing him to be ashamed of his people and his culture” (Gerdes, 1988, p.139). However distant colonization is to the countries that were once colonized, the effects are still being seen today. Although mathematics is only one thread of change, it is an important one. As D’Ambrosio puts it, “ethnomathematics is associated with the pursuit of PEACE and of a civilization free of truculence, arrogance, intolerance, discrimination, inequity, bigotry, and hatred” (D’Ambrosio, 2002, p. 9). Looking at ethnomathematics from this perspective positions the concept as one of the keys to social justice and social consciousness. It is this consciousness that is required of teachers when implementing their mathematics curriculum.

### **Research Specific to the Dominican Republic**

There have been various projects that have looked at the education system within the Dominican Republic. Eduardo Luna and Sarah Gonzalez have played integral roles in the dissemination of this information. In an article published in 1995 entitled, *Improving the Teaching and Learning of Mathematics in the Dominican Republic*, Luna, Gonzalez and Wolfe pointed out some of the areas for improvement in the education system. Some of their concerns included:

1. Few students owned textbooks and teachers spent much of classroom time copying lessons and exercises on the chalkboard for students to copy.
2. The majority of teachers at the grade 8 level had almost no formal training in mathematics or pedagogy
3. Schools were ill equipped, with poorly lit classrooms and inadequate chalkboard area. (1995, p.68)

The result of this research was the development of a new program for teaching mathematics. One change was conceived in the curriculum materials. The suggested review was modeled on the Missouri Mathematics Project, which follows the following principles: (1) Instructional activity is initiated and reviewed in a context of meaning; (2) Students are prepared for each lesson stage to enhance involvement and to minimize errors; (3) the principles of distributed and successful practice are built into the program; and (4) active teaching is demanded, especially in the developmental portion of the lesson (Luna & Gonzalez, 1995). Another aspect of the program was to provide teachers with in-service training. One group received three days of training, while another group received three weeks of training. The results showed that students in both of the groups showed substantial growth in achievement in their mathematical performance. This appears to imply that simply improving training systems can make mathematics a more tangible subject.

Although the concept of ethnomathematics is fairly new, educators are realizing more and more the changing face of their student populations. They

are realizing that in order to make the material even more applicable, they need to find ways to incorporate their students' experiences into the curriculum. As Lawrence Shirley states, "It has now been recognized that culture can determine the student's feeling toward participation in class discussion, initiating questions, acceptance of authority, memorization of facts, seeking innovative ways of understanding, and many other aspects of classroom education" (2001, p. 86). Therefore, in order for students to get the most out of their classroom experience it will be crucial that teachers take the steps necessary to implement more ethnomathematics into their classrooms so that students see that mathematics is a part of their culture, history, ancestors, and that they can make contributions to the mathematical world regardless of where they come from.

As one can see, ethnomathematics can be directly utilized in the mathematics curriculum, can be found in the daily lives of people, and can be used in social justice efforts. As most of these articles and researchers suggest, it is important for teachers to be aware of their students' prior mathematical knowledge when creating lesson plans. This, therefore, needs to be taken back to the level of the teachers as well as the teacher preparation programs. As Alan Bishop states, "[teachers] need to know about the values inherent in the subject they are responsible for, they need to know about the cultural history of their subject, they need to reflect on their relationship with those values, and they need to be aware of how their teaching contributes not just to the mathematical development of their pupils, but also to the development of

mathematics in their culture” (Bishop, 1988, p. 190). I believe this quote truly embodies what ethnomathematics is all about. It is really about understanding the students, their history, culture, language, and experiences and doing all one can to make the material relevant to all aspects of their lives and emancipating them from imperialist thought that is all too often integrated into educational curriculum.

## Methods

The goal of my research was to find out whether or to what extent mathematics teachers are using ethnomathematics in their classrooms in the Dominican Republic. I focused on the methods used to teach their lessons, the examples that they used in class, and the relevancy of the material to their students' lives.

My research data were collected in various ways. A large part of the work was done through one-on-one interviews with middle school mathematics teachers, mathematics education professors, mathematics professors, and students. Due to the difficulty in contacting professors and teachers prior to my arrival in the Dominican Republic, I made many of my contacts along the way. I interviewed any mathematics teacher who was willing. I started in the Santiago area, the second largest city in the nation, where I interviewed middle school mathematics teachers at a local private school as well as a Catholic school. I then went to the Moca area (about 20 minutes from Santiago). From there, I went to the Universidad Autonoma de Santo Domingo (UASD) in Santiago where I interviewed two mathematics education professors and a Ph.D. physics candidate who taught in the Santiago school district. I then traveled to Santo Domingo, where I interviewed an Afro-Dominican poet and activist who gave me more details regarding the culture and history of the Dominican Republic. I interviewed three teachers at St. George, a private Catholic school. I then went to a small, public school called Café con Leche. I was also able to interview mathematics professors at

both Pontificad Universidad Madre y Maestra (PUCMM) and Universidad de Santo Domingo (UASD) in Santo Domingo.

I analyzed the interviews by both listening to all interviews and transcribing the most relevant information. While I listened to the interviews, I took notes on the main ideas that were being expressed. After listening to all interviews, taking notes, and transcribing certain quotes, I compiled a list of themes that were present throughout the interviews. In order for me to consider an idea a theme, I decided that I would have to hear about it in at least five interviews.

After completing 32 interviews, I traveled to Cabarete on the northern coast of the Dominican Republic. I spent one and a half months volunteering as a counselor in the Dominican Republic Education and Mentoring (DREAM) Project. I helped out in different classrooms, and also had the chance to work with the mathematics teachers. There were three mathematics teachers. One was from the United States and the other two were from the Dominican Republic. It was at this time when I was able to observe the interaction that students had with the mathematics materials they were given. The teachers had various projects for the students going on throughout the short summer program, such as creating the floor plans for a house using graph paper, and then attempting to construct the house out of popsicle sticks.

An issue that I faced along the way was having to change my research questions to better fit what I was observing. I came into the situation assuming that the curriculum was transplanted from the U.S. and that there were issues



in the way that culture and history were being addressed in the mathematics classroom. Although some researchers claim that this is true, I realized that I was on the ground floor with teachers and students who implement the curriculum and interact with the material to the best of their abilities.

Therefore, the people that I was working with were not focused on whether the curriculum had been transplanted from another nation, but were instead more focused on the way that it is used in the classroom. I believe that if one is to research specifically the transplantation of curriculum, it would be more important to look at national politics and the national educational policy. In other words, such research would need to be at a different level.

I decided it was important to look whether there were any differences in the issues that students and teachers were facing in Santiago and Santo Domingo, both urban areas. However, I think it may have been more interesting to compare an urban city with a more rural area. The income levels differ greatly based on proximity to a larger city.

Although I feel confident in the number of teachers I was able to interview, were I to do the research again I would alter my methods. First of all, I would try to have more balance between the number of public school teachers and private school teachers. I found, as other researchers have found, that there is a huge disparity between the resources in public schools in comparison to private schools. There is also a different student population in the two types of schools considering that students must pay tuition at all private and Catholic schools. I believe it would have been interesting to look

at the way that ethnomathematics was approached in public schools in contrast to private schools.

Another change that I would have made is interviewing more mathematics education professors. I was only able to interview two mathematics education professors. After seeing the results of the interviews with the mathematics teachers, it would have been interesting to look at the way that the mathematics education professors responded. Had I had the opportunity to interview more mathematics education professors, I would ask if they feel they are preparing their students to be mathematics teachers and addressing some of the many issues that the Dominican Education system faces.

## Results

### **Are Teachers Prepared to Teach Using Ethnomathematics?**

After listening to the interviews and transcribing certain sections, a few themes emerged often enough that I feel confident making several generalizations about the way that ethnomathematics is viewed and implemented in the Dominican Republic. The themes that I heard were a lack of mathematics teacher preparation prior to teaching, an attempt to link certain cultural experiences of the students with the mathematics material, and a general inclination to leave Dominican history, and specifically the African ancestry of the people, out of the mathematics curriculum.

The first of these themes seemed to have the most relevance to the middle school mathematics teachers that I interviewed, as well as the mathematics professors. The majority of mathematics teachers highlighted that some of their counterparts are unprepared to teach at the level that they are teaching at. Some times this had to do with their lack of preparation as teachers, however, most teachers blamed this issue on the education system. They noted that teachers are often hired for one position and then at the last minute are asked to teach something that they did not study beyond high school.

A similar issue that the middle school teachers explained was students' attitude towards mathematics coming out of elementary school. They explained that there are a some teachers at the elementary level, who must teach all subjects, but either do not like or are not fully competent in

mathematics. Therefore, they pass on to their students their dislike or lack of confidence in mathematics. This leaves students entering middle school with a mathematical deficiency and math phobia that might be attributed to their elementary school teachers.

I met a teacher who was teaching at a private school in Santo Domingo who was in the process of writing a book about the math phobia that he observes in students. He continued the discussion of this issue as he spoke about the general math phobia present throughout the Dominican Republic. The teacher explains, “mathematics has been a problem for students. Under my research I see that it’s not mathematics, it is the idea that they have about math. They have a predisposition and come conditioned to dislike math....generally there is a systematic problem. The students don’t come in with a good mathematical foundation. They have gaps in their education and are unable to move forward with their mathematical understanding” (Interview, June 15, 2008). A majority of the teachers echoed this sentiment.

Another effect of this math phobia and deficiency in mathematics literacy is that this leaves many students unprepared to move on to higher levels of mathematics. About 80% of the mathematics professors that I interviewed from both public and private universities said that the majority of their students are entering their college careers without a proficient understanding of some of the most basic mathematical concepts. There is, however, always a group of students who enjoy mathematics, are excelling, and plan on continuing on to be engineers or physicists, but these are less

common. As one mathematics education professor explains, “Obviously the students aren’t prepared when they come to college. About 20% come prepared for college. The factors are many in the reason why they don’t come prepared. In high school, they don’t give them all the needs they have for a professional or academic career. This is the national system that I’m talking about” (Interview, June 17, 2008). Therefore, the lack of preparation stems from elementary school and only gets worse as the years go on. Then, students reach the university level and continue in their struggles with the material.

### **Is Ethnomathematics Part of the Curriculum?**

One of the questions that I was most eager to hear about was the way that teachers are making material relevant to the issues and experiences of their students. As stated in the literature review, the implementation of ethnomathematical concepts require that teachers take into consideration the culture, history, and experiences of their students in order to make the material most relevant.

To a certain extent, I found that teachers are making the attempt to accomplish this goal. About 75% of the teachers used the example of the “colmados.” Colmados are small corner stores that have sweets, drinks, and packaged food and often sell household foods such as plantains, butter, salt, avocados, and yucca. Colmados usually run about one every few blocks in larger cities such as Santiago and Santo Domingo. Children tend to run errands for their parents to the closest colmado. The teachers explained to me how they integrate this example into their teaching methods. For example, as

one teacher explains, “when the students go to the colmado, they buy five pounds of rice and get charged 85 pesos. I ask them, ‘How much did you get charged for each pound of rice?’ Immediately they do their calculations and use the system that they know to get the problem done. After you put the equation up, they realize they solved the problem without seeing the algebraic expression. Then I ask, ‘What did you do to get it?’ and they explain it. They use their knowledge to get the right answer, and then I show them equation that they represented” (Interview, June 10, 2008). This is an example that almost all teachers said they utilized in their classrooms.

There were other examples that teachers explained that they used in their classrooms. For example, one public school mathematics teacher told me that he had students measure the size of their classroom because he explained that it was a resource that they have right in the school that students are familiar with. He also stated that the students could measure the Catholic Church a few blocks away to get a better understanding of how mathematics can be used in various ways. A Catholic school mathematics teacher explained that she uses examples like the Eiffel Tower or a bridge in Chicago when discussing measurements. She recognized that these were pieces that most students had not seen in person, but wanted to open their minds to other parts of the world.

One difference that I noticed between the private schools and public schools was the types of examples that were used. In the public schools the teachers talked about the colmado example as well as cooking recipes that

their parents use. In the private schools, there were examples such as the amount of tip that you leave at a restaurant or the amount of taxes one's family pays. Although I do not believe that I can make generalizations about these differences based on the few interviews that I did, I thought that this difference in examples reflects the experiences of the student population that each type of school is dealing with.

### **Is Ethnomathematics Being Used as an Emancipator?**

When I first decided that I wanted to study such material, I met with a local professor who is well versed in the issues affecting the Dominican Republic. When I told him that ethnomathematics was about including the history and increasing the pride in their roots, his response was that he did not feel that the students know their history or roots. We went on to discuss the anti-black and anti-Haitian sentiment that is commonly accepted throughout the Dominican Republic. Although I did research on race relations within the Dominican Republic, I still thought that there might be teachers working against such a system.

In considering ethnomathematics as a form of emancipation or cultural affirmation, I did not see it used to such an extent in the group of teachers and professors that I interviewed. I asked whether they used information about the indigenous Taino group, Africans originally brought as slaves, or Europeans. About half of the interviewees, although claiming that mathematics has to do with every aspect of our lives, explained that mathematics does not relate well to history. About half of this group concluded that history was discussed in a

different class within the middle school and therefore they were not responsible for such material.

About 25% of those interviewed explained that they tried to integrate the Tainos into their curriculum. For example, one teacher explained how she had an assignment where there were “drawings of Indians [Tainos] to show what fraction it represented from the whole and change it into decimals or percents...There were Indians and Spanish” (Interview, June 16, 2008). Other teachers gave examples relating to the relevant dates within the known history of the Dominican Republic. For example, the teachers would ask questions such as, “What date did Christopher Columbus arrive? How many Tainos were present? How did that number decrease as the years passed?”

I tried to ask follow-up questions affirming their integration of Taino culture and at the same time being critical of the fact that their response lacked information regarding people of African descent. These follow-up questions, in my opinion, were often overlooked. I received answers such as, “We like to give a general concept of history” or “We meet in departmental groups and plan cross-curricular events in order to celebrate history. We have a whole international week where we celebrate the many different cultures and nationalities present at our school” (Interview, June 16, 2008). I had long discussions with people about whether there is still anti-black sentiment throughout the country and was often told that discrimination and racism do not exist anymore.



Another professor whom I met in the Dominican Republic, who researches the roots of the Dominican Republic, painted a similar picture for me. He stated that, “The Caribbean wants to be a part of the American culture. They won’t use anything about the African culture. They won’t use examples of the rhythm of the drums. They will use examples that you understand even as a North American. They will talk about the Arab roots of math. They won’t talk about Africans. Its not part of dominant culture. The culture of the dominants is in line with North American... I doubt that there are professors at the university talking about Africans... If you use the actual history of math, the students would have a more complete understanding of themselves. However, it would be very difficult” (Interview, June 14, 2008). As this professor states, there seems to be a lack of representation of the actual history and racial make up of the Dominican Republic.

From a Western perspective, it seems that there is a rejection of the African ancestry that is a part of the foundation of the Dominican Republic. One of my initial goals was to see if teachers were using the mathematics curriculum and implementation of ethnomathematical concepts in order to increase students’ pride in their African roots and history of their country. I also wanted to see if it could mitigate the anti-African/anti-black sentiment present. I quickly learned that there is a very little recognition of this sentiment from the perspectives of the teachers. Obviously, if the teachers are not recognizing such issues, it is not something that they are addressing in their classrooms.

I was hoping to see these ethnomathematical concepts being used, as D'Ambrosio emphasizes, as an emancipator. As an educator myself, I believe that, just as Ferreira explains in his research of the Brazilian tribes, the classroom is a place where students learn many of their values and beliefs. It is a place where positive values can be imbedded in the students and negative values can be extended instead of exterminated. The fact that Tainos are the main source of historical relevancy for the students makes me believe that teachers are letting the rejection of the issues at hand persist. However, given such a strong anti-black national sentiment is it the teachers who are at fault or is it the whole system? I do not believe that there is an answer that all will be satisfied with, but I think it is important to recognize this issue.

An observation that I made in the few classrooms I visited was that there continues to be reliance on rote learning. I saw, and heard from teachers I interviewed, that many teachers who are unprepared for class or uncomfortable with the material have students copy problems or whole pages out of books. This was a similar issue that Luna, Gonzalez, and Wolfe found in their study of Dominican mathematics teachers in 1995. This method is a huge contradiction to the use of ethnomathematics. The students are unable to interact with the material or view it as relevant material to their lives.

## Discussion

In the results, I discussed that a majority of teachers feel that mathematics teachers are unprepared to be in the mathematics classroom. I can best relate this situation to that of the United States where there is currently a shortage of mathematics and science teachers, meaning that there are positions that are being filled by unprepared teachers. Although this is an issue that takes time to change, I see that the first step is to provide more training for teachers and more professional development opportunities. As Luna, Gonzalez, and Wolfe (1995) found in their study of the Dominican Republic, even a three-day training session can change the style and techniques used in mathematics instruction. During my time in the Dominican Republic I was also able to meet Sarah Gonzalez de Lora, Vice-rector at Pontificia Universidad Madre y Maestra (PUCMM) who is working with USAID and many of the local mathematics teachers. She invited me to the graduation of a group of local teachers who had completed a longer training program. The teachers displayed student work and had short demonstrations on some of their new instructional techniques. I felt that these new techniques were bringing in more of a cultural piece to the mathematics classroom as well as engaged students actively in doing mathematics. I see that in this project there is an understanding that some changes are needed and that ethnomathematics seems to be on the up and coming.

I originally began this research wondering about the ways in which the Western world was affecting the developing world. I wanted to look at the

ways that curricula were being used and whether there was a direct transplantation of curricula, as some researchers claimed, or if the curricula were being modified to fit the needs of the students. For example, as explained in the introduction to this project, Paulus Gerdes (1988) states that, “In the case of mathematics education, this tendency has been reinforced by a hasty *curriculum transplantation* from the highly industrialized capitalist nations to Third World countries. With the transplantation of curricula their *perspective* was also copied...Mathematics education is therefore structured in the interests of the social elite” (p. 137). After completing my data collection and analysis, I realized that the way that the Western world affects the Dominican Republic, past and present, has affected the students and education system more than even Gerdes’ point suggests.

The history of the Dominican Republic has a great deal to do with the current state of the nation. The history can not be explained in great detail here; however it is important to recognize the historical context about which we are speaking. Silvio Torres-Saillant, author of *Introduction to Dominican Blackness* (1999), helps identify some of the main historical benchmarks that have shaped the Dominican psyche in terms of blackness.

As history books explain, Christopher Columbus set sail in 1492 and reached Hispaniola. When the settlers arrived, the aboriginal Taino population inhabited the island. In 1492 it was reported that there were 400,000 Taino, by 1508 there were 60,000 and by 1519 there were only 3,000. In 1501, King Ferdinand and Queen Isabella appointed Fray Nicolás de Ovando as governor

of Santo Domingo and authorized him to bring “black slaves” to the colony. This is where the large presence of people of African descent in the Dominican Republic began. It was around 1516 that the sugar industry began to boom in the Dominican Republic through the work of entrepreneur Gonzalo de Velloso. It was at this time that the institution of slavery was most directly linked to race. “Velloso’s success, then, in equating sugar with blackness, inaugurated the racialization of slavery” (Torres-Saillant, 1999, p. 6). With the slave population outnumbering white settlers and the continual increase in slaves, mulattoes and Blacks became much more prevalent.

Another influential period in Dominican History was the Haitian Revolution. During this time the black population increased when in 1801 Toussaint L’ouverture, who was once a slave himself, led the troops to take control of the Spanish territory for France. He unified the two countries, abolished slavery, and created a short-lived span of peace on the island. During this time it is said that Dominicans were satisfied with Toussaint, but with troops coming from France, Toussaint had to strengthen defenses on the Eastern half of the island, and therefore left the western side vulnerable. His rule over the united island was over.

Later, in 1822 Jean-Pierre Boyer and 12,000 Haitian soldiers took over Santo Domingo and once again unified the island under one government. Once again, slavery was abolished and there were good relations between Haitians and Dominicans. From 1824 to 1825 Boyer invited over 6,000 free African Americans from the United States to come to the island, which

increased the black population. This leadership lasted for 22 years and was then disbanded.

The formal celebration of Dominican Independence day is February 27, 1844. This is the date that the leaders of Eastern Hispaniola declared freedom from the Republic of Haiti. This ended the 22 year unification of the island. With the split came tensions and clashes between the governments, as well as the people. This tension was misrepresented in so many ways such as, “the inhabitants of the small Caribbean republic ‘with very few exceptions’ were white and cited racial hostility, that is ‘refusal of the white Dominican to be governed by the black Haitian,’ as the cause of the partition of Hispaniola into two countries’” (Torres-Saillant, 1999, p. 4). The scenario was being misrepresented by those sent from places such as the United States to “assess whether the country was ripe for annexation” (Torres-Saillant, 1999, p. 4).

In 1916 the United States occupied the Dominican Republic and occupied Haiti in 1915. The United States military preferred to bring Haitian citizens to the Dominican Republic to work on the sugar plantations and in 1916 the first large fleet of Haitian *braceros*, sugar cane cutters, arrived in the Dominican Republic. By 1920 there were a recorded 28,258 Haitians and by 1935 there were 52,657. Throughout the years, the trend and image has maintained that majority of Haitians work on the sugar plantations. In 1983, Dominican historian Frank Moya Pons conducted research with the State Sugar Board and declared that the living and working conditions of the

Haitian *braceros* fit the technical definition of slavery. Although conditions today are improving, there is still much room for improvement.

Another turn in Dominican history came when on May 15, 1930 when Rafael Trujillo, an American-backed military man, became president after sham elections. Trujillo was known for many things, such as renaming the capital city, Trujillo city, renaming the largest peak in the Caribbean Trujillo Peak, or ordering the murder of the infamous Mirabal sisters. However, his reign was not just a physical one; he also had a certain degree of mental power over the people. In 1937 he ordered the killing of thousands of Haitians living on the borders of the Dominican Republic. The standard was that if one could not pronounce parsley correctly, a common challenge for people of Haitian descent, then that person would be killed. Finally, after a week of bloodshed, Trujillo ended the Parsley Massacre. The death toll is unknown, ranging from 12,136 reported by Haitian historian Jean Price-Mars to 35,000 reported by Dominican historian Bernardo Vega. While the exact numbers of this dreadful event are unknown, it is the lasting memory of it that is still present in Dominican culture. The Parsley Massacre illustrates the Dominican rejection of Haitians, particularly those living in the Dominican Republic.

The relationship with Haiti has had a profound effect on Dominican society. The many intricacies of this relationship make it hard to create a blanket statement that represents the many twists and turns; from the unification of the island under Haitian rule, to the legal and illegal Haitian *braceros*, and the brutal dictator Trujillo. Therefore, the anti-Haitian sentiment

is not one that can be over generalized; however, there are undertones throughout Dominican culture. In my experience in the Dominican Republic, some Dominicans will call another Dominican a Haitian if they want to insult them. I also heard parents tell their kids to stop doing something because a “Haitian would come to eat them if they didn’t stop.” I believe that the dynamics of this relationship have increased the distance between Dominicans and full acceptance of their African ancestry.

Although this is a history full of racially intense situations, there are images of both black, white, Creole, and mulatto Dominicans who are strong figures in the history of the country. For example, General Luperón, a black Dominican, fought against the Spanish in the war of restoration, while white Creole Juan Pable Duarte is considered one of the founding fathers of the nation. Throughout history, there have been black, Creole, mulatto, and white presidents and leaders of the country.

It is also hasty to assume that there is a complete black-white divide. “Scholars face the challenge of shedding light on the sociocultural dynamic at work in the peaceful coexistence of the Dominican population’s self-awareness as a people of African descent and the Negrophobia contained in prevalent definitions of Dominicanness” (Torres-Saillant, 1999, p. 25). The constructs of race that have been created in the United States do not transfer over to the Dominican Republic. There are a plethora of endearing terms used for the different skin colors that are present throughout the Dominican Republic, which contrasts to the few categorizations prevalent in the United



States. As Torres-Saillant purports, it is this flexible race system that has given Dominicans the freedom to identify themselves more closely with Dominican culture than with any dichotomous race system. Therefore, “Dominicans have little familiarity with a discourse of black affirmation” (Torres-Saillant, 1999, p. 27). So the question becomes, is there a need for more black affirmations in Dominican culture or is it only my American perspective that makes me believe these affirmations are important?

I can respect the many endearing terms that are used for the many different shades of the Dominican people and see how starkly this differs from the racial categories that I am familiar with. I can appreciate that people of all different shapes and shades explained to me during my stay in the Dominican Republic that race was not a big issue. However, in looking at the historical context of the country, and comparing it to the representations in text books and classrooms, I can not help but feel that there is a missing piece. I heard all too often about the acceptance and celebration of the Taino and Spanish ancestry of the people, and similarly often felt that the African ancestry was not being celebrated. I can not say that I believe that there is not a recognition of the African ancestry, as other researchers might claim; however, there is a difference between recognizing something and actually celebrating it.

My analysis of this information has brought me to believe that education might be one of the many avenues to counteract this issue, most specifically in the mathematics classroom. It seems that teachers are already integrating some history of the Dominican Republic into the curriculum and I

feel that a more complete history of the island is necessary. Eduardo Luna, retired professor from Barry University partnered with the Department of Education in creating new, and more historically correct, textbooks for elementary school students. I realize that teachers, regardless of race, nationality, or social class, have one of the most important and impactful positions. They have to deal with students, parents, the surrounding neighborhood, their budgets, and a plethora of external variables. I believe that having the expectation that all teachers find material that relates directly to their students and the history on top of the aforementioned distractions may be difficult. I do not claim that this process is one that will be easy, but might instead have a ripple effect in changing some of the difficulties within the classroom and society as a whole.

The various issues that I have shed light on, as well as the suggestions that I have put forth are in no way meant to judge the current system, but to instead bring up issues that might be overlooked in the bigger picture. I truly believe that ethnomathematics can be used as an emancipator. I also recognize that education and consciousness are emancipators in and of themselves. I hope that we can begin to use education as a tool, as D'Ambrosio suggests, for social justice and peace, whether it is in the mathematics classroom or elsewhere.

## Summary

My research began in the fall of 2007. Half of my course load at the time was focused around social issues and the roots of these social issues and the other half was made up of mathematics courses. I wondered what the interaction was between mathematics and humanities. After having the opportunity to travel to the Dominican Republic in the fall of 2007, I was intrigued about the ways that mathematics and Dominican culture interacted.

I then learned about the concept of ethnomathematics. Ubiratan D'Ambrosio, professor at Universidade Estadual de Campinas/UNICAMP in Brazil, was the founder of this concept. He emphasizes that, "the term *ethnomathematics* is used to express the relationship between culture and mathematics...the term *ethno* describes 'all of the ingredients that make up the cultural identity of a group: language, codes, values, jargon, beliefs, food and dress, habits, and physical traits.' *Mathematics* expresses the 'broad view of mathematics which includes ciphering, arithmetic, classifying, ordering, inferring, and modeling'" (D'Ambrosio, 2001, p. 308). Therefore, there is a value given to the cultural experiences of those interfacing with the mathematics material.

I did preliminary research and found there were cases where mathematics curricula were transplanted from developed countries into developing countries and implemented without concern for the differences in culture, history, and attitude of the students receiving the information. Given this information, I wondered whether Dominican culture and history were

taken into consideration in the mathematics curriculum in the Dominican Republic. Therefore, I began my research expecting to find information regarding the transplantation of mathematics curricula.

During the summer of 2008, I was given the opportunity by the Renée Crown Honors Program at Syracuse University to travel to the Dominican Republic to conduct qualitative research. I conducted 32 interviews with various professionals. These professionals consisted of middle school mathematics teachers, mathematics professors, and mathematics education professors. These professionals were from public and private middle schools and universities. The two cities that I focused on were Santiago and Santo Domingo. Santo Domingo is the capital city and Santiago is the second largest city in the country, and both are considered very urban.

While conducting such interviews, I realized that my research question regarding the transplantation of curricula was not something that any of the aforementioned professionals were aware of. I then decided to focus on the level of ethnomathematics used in the mathematics classrooms as well as the means of utilizing this concept. My interview questions looked at whether teachers were using the culture, history, and experiences of their students in the mathematics curriculum.

I was able to read about the research conducted by others where ethnomathematics played various roles in the lives of the students; ethnomathematics in the curriculum, mathematics outside the classroom, and ethnomathematics as an emancipator.

For example, Eduardo Sebastiani Ferreira, a Brazilian professor of mathematics, worked with 12 Brazilian tribes in their learning of mathematics. These tribes had schools that were taught with much of the values of the tribes infused in the curriculum. As trade and interaction with persons outside the tribe increased, the elders felt the pressure to open a more mainstream school to increase communication with those outside the tribe. Ferreira, a proponent of ethnomathematics found it important that the tribe had “a school where their culture is respected, where there is no dominant culture and where they could really use the knowledge to the tribe’s advantage” (Ferreira, 1988, p. 546). For this reason, Ferreira suggested implementing a curriculum where the mathematical experiences of the students were respected. For example, many students were familiar with mathematical concepts through their families and cultural experiences such as body art and handcrafts. Ferreira encouraged that school mathematics build on the mathematical foundation already found in the students. Although it was not stated what the results of this study were, it is a very clear implementation of ethnomathematics in the curriculum.

Ethnomathematics is also defined outside the classroom. For example, there are various studies about the mathematical concepts used by student-aged children. Geoffrey Saxe conducted research in the northern part of Brazil with a group of candy sellers ranging from five to 15 years of age. Some of these children had attended school, and were receiving the formal computational methods taught at school, while others had no formal schooling

experiences. He explains the intricacies of the candy selling process; from the buying of candy at bulk prices, to the selling of candy using various discounted or full pricing schemes. In terms of formal equations, such as those one might find in a mathematics classroom, those children who attended school performed significantly better than their counterparts. However, given equations based on currency and ratios, both groups performed equally well (Saxe, 1988). The point of this research was to show that it is important that mathematics teachers recognize the mathematical concepts that students have already mastered and attempt to build off of this foundation instead of devaluing their methods.

The third definition of ethnomathematics looks at the way that mathematics can be used as an emancipator. As D'Ambrosio explains, "...mathematics has been used as a barrier to social access, reinforcing the power structure which prevails in the societies (of the Third World). No other subject in school serves so well this purpose of reinforcement of power structure as does mathematics" (1983, p. 363). Therefore, mathematics education has the power to continue providing the unjust power structure that D'Ambrosio criticizes, or it can be used to deconstruct the power structure. As D'Ambrosio puts it, "ethnomathematics is associated with the pursuit of PEACE and of a civilization free of truculence, arrogance, intolerance, discrimination, inequity, bigotry, and hatred" (D'Ambrosio, 2002, p. 9). Looking at ethnomathematics from this perspective positions the concept as one of the keys to social justice and social consciousness. It is this

consciousness that is required of teachers when implementing their mathematics curriculum.

After analyzing the data from the 32 interviews, as well as volunteering at the Dominican Republic Education and Mentoring (DREAM) Project in their mathematics classroom during summer camp, I was able to recognize some themes. The first theme is that there are various mathematics teachers who are unprepared to teach, the second theme is that most mathematics teachers tried to utilize some aspect of Dominican culture in their classrooms, and the third theme is that although teachers use Dominican history in their curricula, the African ancestry of the country is often not represented.

In terms of the lack of teacher preparation, it was explained to me that, on a national level, there is a need for teachers. Often, teachers believe they are teaching one subject and have to teach mathematics because there is no mathematics teacher. Another issue is that teachers who teach at the elementary school level have to teach every subject and sometimes do not completely understand or have a dislike of the material and therefore pass on these experiences to their students. This is not an issue that can be fixed overnight. I believe that having more in-service trainings and professional development opportunities would help mitigate the effects of this problem and begin to turn things around.

On the other hand, it was great to hear that teachers were attempting to take their students' experiences into consideration. Teachers often explained

that they used examples involving the “colmado,” the local corner stores. Students often run errands for their families at the colmados and so it is an experience that can be generalized for all students. They talk about creating word problems involving a certain item and having students calculate the amount of change they are due or the specific price of the item. This was the most common example, but other examples included measuring the size of the classroom or measuring a local monument.

The most troubling theme that I saw arise was the use of history in the mathematics classrooms. Some teachers explained to me that they used indigenous Taino people or Spaniards in their word problems. However, when asked whether they integrated people of African ancestry into their lessons, they explained either that they wanted to give a general history of the country, or that they were not responsible for using history in the mathematics curriculum.

Researchers have found that there is an anti-black and anti-Haitian sentiment throughout the country. Many claim that this has to do with the history of the Dominican Republic. For example, the various government changes during the early days of the island, the legal and illegal immigration of Haitians to the Dominican Republic, and the infamous Parsley Massacre where Dictator Rafael Trujillo ordered the killing of Haitians along the border of the Dominican Republic. Regardless of where this anti-black or anti-Haitian sentiment comes from it is still important that people of African



descent be represented in the mathematics classroom, just as Tainos and Spaniards are represented.

Although many consider mathematics to be one of the only “culture-free” subjects, it is important to understand the way that culture, history, and experience factor into every subject. Most importantly, education and mathematics education play such a crucial role in shaping and molding the future generation. I truly believe that the implementation of ethnomathematics in the mathematics classrooms in the Dominican Republic could change the ways that students interact with mathematics as well as increase the pride they have in their African, Taino and Spanish roots.

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