Ethnobotanical Research Skills for Students of Underrepresented Minorities in STEM Disciplines

Flor Henderson, Ina Vandebroek, Michael J. Balick and Edward J. Kennelly

Education

Abstract

We developed a collaborative educational strategy to actively engage students from underrepresented minorities in Science, Technology, Engineering and Mathematics (STEM) in the study of ethnobotanical knowledge and practices of Dominicans in New York City and the Dominican Republic. Three Dominican students from Hostos Community College in New York City were taught basic botany in preparation for their training as research assistants in an ongoing Dominican ethnomedicine project at The New York Botanical Garden. The aim of this internship was to teach appropriate research skills while raising awareness and promoting cultural appreciation of Dominican and Latino health traditions. Students were selected based on their academic achievements and potential, their interest in learning more about Dominican culture and traditions, and their bilingual (English-Spanish) skills. At the end of the six month internship period the students were competent in basic botanical identification techniques, plant collection methodology, ethnobotanical interviewing, as well as research data management, and expressed increased awareness of the richness of Dominican medicinal plant knowledge. The inclusion of underrepresented minority students enrolled in community colleges in ethnobotanical research can contribute to safeguarding cultural traditions, especially in urban settings.

Resumen

Se desarrolló una estrategia educativa de colaboración para incluir estudiantes de minorías poco representadas en las aéreas de ciencia, **tecnología**, **ingeniería**, **y matemáticas**, **en un estudio científico sobre el conocimiento tradicional de plantas medicinales en la comunidad Dominicana en Nueva York y la República Dominicana**. **Tres estudiantes Dominicanos de Hostos Community College en Nueva York recibieron enseñanza básica en botánica para luego ser entrenados como asistentes de investigación en un proyecto de etnomedicina Dominicana supervisado por el Jardín Botánico de Nueva York**. **El objetivo de la colaboración fue enseñar técnicas apropiadas de investigación científica así como promover la sensibilidad y el aprecio por las prácticas culturales Dominicanas y Latinas en relación a la salud**. **Los estudiantes fueron seleccionados en base a sus logros y potencial académicos, su interés en la cultura y tradiciones Dominicanas y su habilidad bilingüe (Inglés-Español)**. **Al cabo de seis meses**, **los estudiantes demostraron competencia en técnicas básicas de identificación botánica**, **metodología de recolección de plantas**, **entrevistas etnobotánicas**, **y manejo de datos**. **La inclusión de estudiantes de grupos minoritar-**

Correspondence

Flor Henderson, Natural Sciences Department, Hostos Community College, City University of New York, 500 Grand Concourse, Bronx, New York 10451. U.S.A.
Ina Vandebroek, Michael J. Balick, Institute of Economic Botany, The New York Botanical Garden, 2900 Southern Boulevard, Bronx, New York 10458. U.S.A.
Edward J. Kennelly, Department of Biology, Lehman College, City University of New York, 250 Bedford Park Blvd. West, Bronx, New York 10468. U.S.A.

Ethnobotany Research & Applications 10:389-402 (2012)

Published: September 13, 2012

www.ethnobotanyjournal.org/vol10/i1547-3465-10-389.pdf

ios en investigación etnobotánica puede contribuir a salvaguardar tradiciones culturales y conocimientos etnobotánicos, **especialmente dentro del entorno urbano**.

Introduction

A radical change in the cultural knowledge base, and the abandonment of many traditional practices is taking place worldwide as a result of migration, acculturation, and interruption of intergenerational knowledge transmission (Benz *et al*. 2000, Reyes-Garcia *et al*. 2005, Srithi *et al*. 2009), and as O'Brien (2010) suggested, the younger generations are the ones experiencing the highest degree of loss of cultural knowledge. Vandebroek & Balick (2012) found no evidence that ethnobotanical knowledge was eroded among first generation Dominican immigrants in New York City, but acknowledge that it is not unlikely that loss of ethnobotanical knowledge may well occur in subsequent generations. Now, more than ever, ethnobotanists are feeling the pressure to not only help safeguard traditional knowledge, but also to educate younger generations about the importance of plants and culture in the face of urbanization (Ramirez 2007).

Observation of loss of traditional knowledge has resulted in new efforts to assess the degree of loss and to identify areas for intervention (Brosi *et al*. 2007). Some studies have evaluated the effects of social, economic and political changes in the traditional knowledge of students (O'Brien 2010). In addition, there have been attempts to include traditional ecological knowledge in formal education systems to increase students' self awareness of their heritage (McCarter & Gavin 2011). Wagner (2008) demonstrated that botanical knowledge of students in urban colleges is variable and dependent upon noticeable plant characteristics such as well-known crops, common trees, and showy flowers. This stands in contrast to the diminishing familiarity with plants that have less apparent features. Ethnic markets in urban areas also represent potential settings for the development of curricular innovations in ethnobotanical education for undergraduate students (Nguyen *et al*. 2008).

Bennett (2005) provides a thorough analysis of the current status of ethnobotanical education in the United States. He attributes the lack of resources, educational opportunities and theoretical basis as the main limitations for further development of this field. In this context, teaching cultural knowledge about plants has a potential to be incorporated as educational tools to promote experiential learning (O'Brien 2010). However, the challenge of promoting formal ethnobotanical education and training in urban settings faces other barriers, one being the overall lack of participation of students from all cultures in STEM disciplines (Drew 2011). This may be due to an internalized "fear" of science courses traditionally viewed as "difficult" or "hard", or simply lack of awareness about the breadth of the scientific field (Drew 2011). Another barrier is the lack of opportunities for engagement in science related activities. In addition, female and minority students receive less encouragement and fewer science- and math- related opportunities than males or non-minorities, even though they demonstrate equal competence (Oakes 1990). Although, minority communities are the fastest growing segment of the population in the United States, these communities have little representation in the STEM disciplines in all levels of education, and those that manage to achieve science careers very often are not considered for leadership positions. (Committee of Underrepresented Groups 2011, Rochin & Mello 2007).

Research into Latino immigrants' ethnobotanical and ethnomedical knowledge systems in the urban environment in New York City is being intensely explored and has potential as an educational framework. The Institute of Economic Botany of The New York Botanical Garden has a nearly two decade-long tradition of conducting research involving Latino ethnomedicine. Balick *et al*. (2000) and Ososki *et al*. (2002) have conducted research on medicinal plants used by Latino healers for women's health conditions in New York City and the Dominican Republic. In addition, the project Latino Ethnomedicine funded by the National Institutes of Health/National Center for Complementary and Alternative Medicine and private foundations is an ongoing large scale project that has set the standards for the present collaboration (Vandebroek *et al*. 2007, 2010, Vandebroek & Balick 2012).

The educational potential of ethnobotanical research has inspired three institutions of higher education research located in the Bronx area of New York City (Hostos Community College, Lehman College and The New York Botanical Garden) to combine efforts and provide hands-on research training to undergraduate students from underrepresented minorities in STEM disciplines from Hostos Community College. The appeal of Hostos Community College is that most of its students are of Hispanic/Latino origin. During the fall semester of 2010 the majority of matriculated students were Dominicans (66%) followed by Puerto Ricans (10%); other Latino groups were represented in smaller percentages (Hostos 2011) (Table 1). The college offers transitional language instruction for all English-as-a-Second-Language learners along with Spanish/English bilingual education. One of the strengths of this collaboration is that it directly links the transnational Dominican communities in New York City and in urban and rural Dominican Republic with the younger generation of Dominican students pursuing higher education.

Organization and implementation of the internship

The objectives of our collaboration were to recruit students from underrepresented minority groups in STEM

Table 1. Latino/Hispanic students registered in Hostos Community College, Bronx, New York, in the Fall semester of 2010. Source: Hostos Community College 2011. (Selected data corresponding to Latino/Hispanic students.)

Country of Origin	Number of Students	%
Dominican Republic	1127	65.8
Puerto Rico	168	9.8
Ecuador	100	5.8
Mexico	70	4.1
Colombia	56	3.3
Honduras	48	2.8
Peru	27	1.6
El Salvador	19	1.1
Guatemala	13	0.8
Venezuela	11	0.6
Caribbean and Central America (non-specific)	58	3.4
South America (non-specific)	16	0.9
Total	**1713**	**100**

disciplines and to develop their skills to perform botanical and ethnobotanical research (plant collection, identification and interviewing of study participants); to increase appreciation for Dominican and Latino health traditions as a result of their interaction with knowledgeable members of the Dominican immigrant community and their peers who remained in the Dominican Republic; and to develop general skills pertinent to a higher education scholar.

The internship lasted six months (from October 2005 to March 2006). The students were required to dedicate ten hours per week to the internship in New York City. In addition, they participated in a three-week field trip to the Dominican Republic where they spent 8 to 10 hours per week focused on the research project. The students who were selected received a total of 8 weeks of training in basic botanical knowledge and skills, human subjects' research, development of questionnaires, and interviewing techniques. After this training period, students assisted in conducting interviews in New York City for two months. Thereafter, they flew to the Dominican Republic accompanied by the first and fourth authors, conducted interviews in Santiago de los Caballeros and La Vega, and collected and processed voucher specimens of medicinal plants. Upon arrival in New York City they assisted in the development of databases, data entry and management, as well as query-led searches of the databases.

Selection of Students

From a pool of nine Hostos Community College students of second-generation Dominican descent (born and raised in the United States), three female students were selected based on their academic status as science majors, their performance in science course work with a minimum Grade Point Average (GPA) of 3.2 (measured in a 0-4 scale), and their communication skills (English/Spanish bilingual fluency in reading, writing and speaking). Only three students were chosen as this was a pilot initiative utilizing an intensively mentored, hands-on research internship with a limited amount of funding that could accommodate a limited number of students.

Acquisition of Research Skills

The following four research methodologies were subsequently introduced to the students and put into practice.

Human Subjects Certification

The selected students took the City University of New York Institutional Review Board (IRB) online training to get certified in conducting research involving human subjects. This training entails teaching and testing students about the protection of the rights, privacy concerns and well-being of human subjects in research projects. (IRB n.d.). Students received further guidance by staff members from the Institute of Economic Botany at The New York Botanical Garden on research ethics, participant consent, data confidentiality and the protection of intellectual property rights of interview participants during their active involvement in the research project.

Interview techniques

Hands-on training in questionnaire design and interview techniques was performed at the Institute of Economic Botany. Through role-play exercises, students learned how to develop unambiguous questions and a functional questionnaire for querying people about their background and traditional knowledge of using medicinal plants as home remedies. Students also learned how to approach participants for interviewing, obtain prior informed consent before interviewing and how to properly conduct an interview that would keep study participants actively engaged. Interviews were always conducted in Spanish and tape recorded if participant consent was granted. Initially, the interns observed experienced interviewers conducting interviews during approximately four weeks. Thereafter they began conducting interviews under supervision. During training, they received suggestions for improvement and listened to their recordings for self critique.

Botany fieldwork training

Field collection of medicinal plants reported by interviewed participants was conducted during three weeks in January 2006 and two weeks in March 2006 in Santiago De Los Caballeros and La Vega, Dominican Republic (Figure 1). Interns were trained in specimen collection techniques, field annotations, and methods for plant identification. In the herbarium, they learned how to process specimens for drying and labeling. Preliminary specimen identification was done using Liogier's (2000) botanical dictionary in Spanish. Finally, interns were taught to enter plant information in a database to produce collection labels.

Plant use data management

Students were taught to manage interview data in Microsoft Excel and Access and create relational databases on medicinal plant use. They entered the interview data they had collected and learned how to extract query-specified data from these databases to answer a question such as "which medicinal plants are most frequently cited by all interview participants for health condition X?"

Acquisition of General Education Skills

The project targeted three areas of General Education (GenEd) Core Competencies in Higher Education: Knowledge, Research Skills and Global Citizenship established by the Association of American Colleges and Universities AACU (2007) and adopted by Hostos Community College's Center for Teaching and Learning (CTL) (Hostos Community College 2012a) (Table 2).

Knowledge acquisition

The three selected students had all completed the required two-course sequence of general biology for their major prior to their internship. Since general botany courses are not required for graduation at Hostos Community College, and basic botany knowledge is a necessary skill for ethnobotanical fieldwork, students received basic botanical instruction over a four week period from the first author. Classes focused on morphology and anatomy of vegetative and reproductive plant organs, plant classification, binomial nomenclature, and traditional plant uses worldwide. Theoretical instruction was supplemented with hands-on training in herbarium collections acquisition and management at The New York Botanical Garden, with special emphasis on vouchered medicinal plant collections of the authors from the Institute of Economic Botany.

Research Skills

Students were introduced to the methodology of conducting ethnobotanical research through one-on-one training and observation. They were trained in interviewing techniques to develop their interpersonal skills (Figure 2 A, B), and in botanical fieldwork to develop their abilities to observe, describe, collect, and identify specimens (Figure 3 A,B).

Global citizenship

The basis of global citizenship consists of using knowledge as a formative skill to teach appreciation, understanding, acceptance, and respect of ethnic and cultural perspectives. The project offered the means to learn about the wealth of Dominican medicinal plant knowledge directly from people who practice traditional medicine.

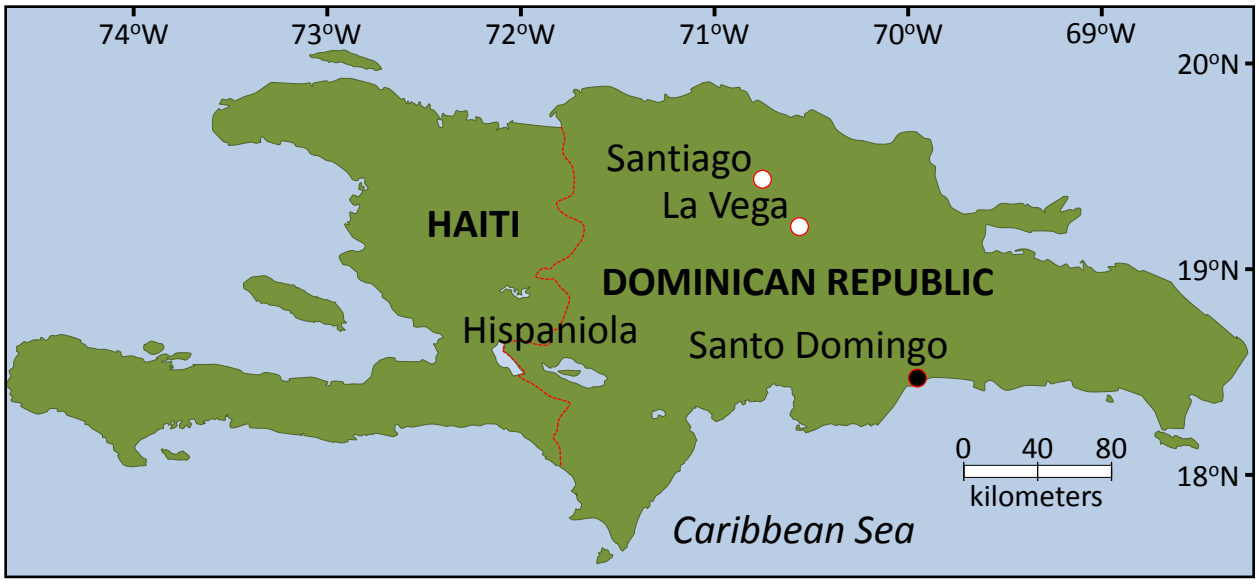

Figure 1. Fieldwork areas: Santiago de Los Caballeros and La Vega, Dominican Republic on the island of Hispaniola.

Table 2. Research skills acquired while participating in Ethnobotanical and Botanical Research in New York City and the Dominican Republic (October 2005 - March 2006).

Core Competencies	Ability at Entry Level	Focus of the Training	Essential Learning Outcomes
Knowledge: Botany and Ethnobotany	Rudimentary botanical concepts.	Introduction to basic botanical concepts as extracurricular training.	Student is able to:
			Describe basic plant morphology.
			Understand the rules of binomial nomenclature.
			Understand the rules of plant classification.
			Explain the importance of plants in today's society.
		Introduction to herbarium collections, uses and importance.	Student is able to:
			Utilize herbarium materials as a source of information.
	Minimal ethnobotanical concepts.	Introduction to ethnobotanical research.	Student is able to:
			Recognize plants as important sources for human livelihood as sources of food, medicine, fuel, construction materials and others.
			Understand the cultural richness of medicinal plants in New York City and the Dominican Republic.
Methodological Skills: Ethnobotany Research	No formal training in interviewing processes.	One-on-one training, modeling, and gradual immersion in interviewing processes.	Student has:
			Increased her interpersonal and communication skills.
			Developed the ability to conducted interviews independently.
			Retrieved knowledge on medicinal plants from Dominican interview participants.
	No formal training in plant collection techniques.	Field training in structural botany and botanical collection.	Student is able to:
			Select plants for specimen collection.
			Collect and process good quality specimens.
Global Citizenship: Appreciation and understanding of cultural and traditional values	Basic knowledge of Dominican medicinal plants.	Expansion of background knowledge and acquisition of new information of medicinal plants in Dominican culture.	Students:
			Enhanced their perception of Dominican cultural heritage.
			Validated the importance of the traditional knowledge of medicinal plants by Dominicans.
	Awareness of the usage of Dominican medicinal plants in urban areas.	Appraisal of traditional knowledge of medicinal plants among city dwellers.	Students:
			Increased their knowledge of Dominican medicinal plants and cultural traditions in urban settings.
			Acknowledged the significance of maintaining traditional knowledge.

These interactions were essential to allow students to analyze and reflect on the value of traditional knowledge and its relevance in Dominican culture.

Follow Up Survey

A small survey consisting of 11 questions was conducted online five years after the end of the internship experience. The survey was created using Survey Monkey (www.surveymonkey.com/home/). The questions dealt with students' acquisition and retention of knowledge and skills, cultural and traditional awareness, and overall significance of the project in their professional lives (Table 3). The survey was meant as a quick formal post-hoc evaluation of the internship experience by the students and is supposed to add to the informal feedback that we got from them while working closely together in the field.

Figure 2. **A**. Students recruiting participants for interviews in the locality of Villa Gonzalez, Santiago de los Caballeros, Dominican Republic. **B**. Interviewing participants at their homes in Villa Gonzalez, Santiago de los Caballeros, Dominican Republic.

Bridging the Gap between Education and Research: The internship experience

Before the start of practical training, we felt it was necessary to teach introductory botany owing to participants' total lack of formal education in this topic. During the actual internship, their theoretical knowledge about botany was transformed into practical knowledge and the skills acquired through original ethnobotanical fieldwork conducted in New York City and the Dominican Republic become well grounded. Plant collection in the field consisted of trips in the presence of a local person. Students were taught not only appropriate botanical methods but were also given an opportunity to obtain a general appreciation for the living trees, shrubs, or herbs, many of which are dried and sold in New York City **botánicas**, urban specialty shops that sell plants and products for traditional medicine and spiritual well-being (Gomez-Beloz & Chavez 2001, Viladrich 2006). In total, ninety-six vouchers (numbers FH1200 -1295) belonging to 71 species and 40 plant families were collected, processed, identified and deposited by the interns and the first author at the Jardín Botánico Nacional Dr. Rafael M. Moscoso Herbarium of the Dominican Republic (JBSD) and the William and Lynda Steere Herbarium of The New York Botanical Garden (NY) (Appendix 1).

Figure 3. **A**. Collecting plant specimens in the field, and **B**. learning the steps of preparing herbarium specimens, La Vega, Dominican Republic.

Table 3. Post-Evaluation of an internship experience in Ethnobotanical Research conducted five years after the conclusion of the project (March 2012). Responses (number of students selecting the response).

Questions	Responses		
	Not much	Something	A lot
1. How much have you learned about botany (plants) during your internship?	0	1	2
2. How much have you learned about Dominican medicinal plant knowledge during your internship?	0	0	3
3. How aware has this internship made you of the richness of plant knowledge of Dominicans?	0	0	3
4. If you compare the beginning versus the end of your internship, how has your comfort level changed when conducting interviews with people?	Less	Somewhat	Very
I became _____ comfortable.	0	0	3
5. From the skills you were taught, which one (s) have you found the most useful in your current life? select all that apply:			Most
Interviewing skills			1
Botanical skills			2
Social interaction			2
Team work			2
6. Do you consider it important to preserve traditional knowledge of medicinal plants?	No		Yes
	0		3
7. IF YES, Preserving traditional knowledge is important because:			
I believe in the efficacy of home remedies			2
Medicinal plants are important as part of the cultural heritage of Dominicans			1
Pharmaceutical products are not as effective			0
Home remedies and pharmaceutical products are equally important			0
8. IF NO, Preserving traditional knowledge is not important because:			
I do not believe in the efficacy of home remedies			0
Medicinal plants are not important nowadays			0
Pharmaceutical products are more effective			0
Cultural knowledge is something from the past			0
9. How important is botanical and ethnobotanical research in the rescue and preservation of botanical traditional knowledge?	somehow	very	extremely
	0	0	3
10. Have you been able to use the skills that you have acquired during your internship?			
Not at all			0
On a few occasions			0
On various occasions			2
Most of the time			2
11. Would you recommend this experience to other students in your college?	No		Yes
	0		3

The intensive training and field experience provided a crucial link between academic content, practical knowledge, and skills related to plant processing, identification and curation which is nonexistent to date at the regular community college level. There exists a clear need for better structured botany teaching aimed at improving long term learning. When asked how much they had learned about botany and plants during the internship, two students said they learned a lot, and one student responded she learned something (Table 3: Q.1).

At the end of each field day the interns shared the "chills and thrills" of their daily experiences during informal conversations. We also observed them giving each other support and encouragement, which reinforced a feeling of team spirit. They expressed empowerment in helping the research team planning successful strategies to improve recruitment of interview participants, which included suggesting local institutions or localities to visit, and/or selecting the best time and day when people were most likely to be at home or in the mood to receive visitors. The interns' familiarity with Dominican culture was of great help during the design of the questionnaire. Students spontaneously suggested minor adjustments in the questions to facilitate comprehension without altering the intended meaning. Their Spanish/English bilingual abilities and knowledge of adapting wording to local language variations, especially language used in rural areas, increased trust and disclosure from interview participants during the survey. Furthermore their input on Dominican body language, social norms and interactions between people of different ages and/or social status helped narrow the gap between interviewer and interviewee. For example, one of the students taught the research team that older informants should be addressed with the highest level of cultural sensitivity. The interns conducted 29 ethnobotanical interviews in New York City together with researchers from the Institute of Economic Botany and 41 interviews supervised by the first author in the Dominican Republic. Data collected during the internship is part of a larger dataset about Dominican ethnomedicine (Vandebroek *et al*. 2007, 2010, Vandebroek & Balick 2012).

In the subject area of ethnobotanical knowledge, the three students reported some degree of previous familiarity with popular Dominican medicinal plants when they began their internship. However, all three students reported that they had learned a lot (as opposed to "not much" and "something") about Dominican medicinal plant knowledge during their internship (Table 3: Q.2), which showed that the internship added value to their former knowledge base by expanding it with new information from a significant sample of interview participants through an academically sound approach that revealed an increased awareness about the richness of Dominican plant knowledge (Table 3: Q.3). The initial apprehension that students reported in asking questions to strangers diminished after they became seasoned interviewers. When asked about their comfort level in conducting interviews at the end of their internship, they all responded that they had become very comfortable (Table 3: Q.4).

Students acknowledged the importance of acquiring botanical skills and learning how to interact socially and work as a team as valuable skills in their professional development (Table 3: Q.5). Overall, the internship enhanced their perception of their cultural heritage and traditional knowledge of Dominican culture. At the end of the experience, they declared their surprise and pride in the amount of knowledge of medicinal plants preserved by Dominicans in New York City and the Dominican Republic. They found new value for their cultural traditions and respect for the knowledge they obtained from the people they met during their experience. They spontaneously engaged and connected with their own grandparents over this topic, citing remedies and recipes that their grandparents know and prepared for them as a child. The three students reported to be very aware of the importance of preserving traditional knowledge of medicinal plants (Table 3: Q.6).When asked to choose reasons to preserve this knowledge two students viewed medicinal plants as efficacious home remedies and one student reiterated their importance as cultural heritage of Dominicans; interestingly none of the students challenged the effectiveness or importance of pharmaceuticals by comparing them with medicinal plants (Table 3:Q.7).

The relevance of botany and ethnobotany as essential fields of research in the preservation of traditional knowledge was ranked as extremely important (Table 3:Q.9). The interns understood the interconnectedness between these two areas of research as a tool to study their own traditional heritage. Finally, the project showed a long term impact in the skills and abilities of the participating students. When asked five years after concluding this project how frequently they had been able to use the skills they acquired during their internship, their responses ranged from "on various occasions" to "most of the time" (Table 3: Q.10), and all three students stated that they would recommend the internship to other students. (Table 3: Q.11).

The opportunity to conduct a systematic scientific analysis allowed the participating students to use their critical thinking abilities to identify patterns in medicinal plant knowledge. For example they ranked responses from interviewees to determine which plants are most commonly used for a particular health condition. In addition they compared plants reported by Dominicans in New York City versus the Dominican Republic to learn how the use of some plants has been maintained for certain health conditions and transformed for other conditions as a consequence of migration.

All three interns have achieved academic success and graduated in a timely manner from Hostos Community College obtaining Associate Degrees in Science. The

graduating class in 2006 included 386 students of which 11% obtained Associate in Science degrees (Hostos Community College 2012b). Following graduation, they all matriculated to senior colleges of the City University of New York to pursue Bachelor's degrees in the areas of Psychology, Culture and Communication, and Special Education. At present, one of the students has just finished a second Bachelors' Degree in Speech Pathology while another student is pursuing an On-line Master's Degree in Communication. They all agreed that the internship experience expanded their understanding of the sciences and of what it means to be a researcher.

Conclusions and Recommendations

The formal and informal feedback we received from our students is very encouraging. However, some observations on the nature of the project and student collaboration are worth making to improve the outcomes in future projects. First, a ten-hour per week requirement falls short in connecting the intricacies of botanical and ethnobotanical knowledge with practical training. Second, it is imperative to set clear expectations by conveying the idea that scientists are not the typical 9AM-5PM workers and that conducting a research project is a continuous process where unpredictable events might occur and are necessary to address regardless of day and time. A gradual increase in the level of engagement and responsibilities of students throughout an internship could further enhance their interest in the project and make it more relevant to their personal objectives, increase their feeling of ownership, and reduce their "salaried worker" expectations. Third, it is necessary to devise better ways to evaluate intern progress; one possibility being that interns maintain a journal with periodic entries detailing new skill acquisition and reflecting on personal progress. Another possibility would be to write a narrative using double-entry charts stating "What They Knew" and "What They have Learned" in the areas of research skills, botanical knowledge, ethnobotanical knowledge, team work, and social skills. These reflective practices would facilitate active learning by making connections between students' background knowledge and newly learned concepts (Fishman 1997).

Although students were limited in their academic preparation in the areas of botany, they possessed a certain amount of background knowledge on medicinal plants because of their upbringing in Dominican culture. The inclusion of students who are new immigrants or descendants of immigrants of the cultural group under study benefited the project in many ways, particularly during fieldwork. Their familiarity with the socio-cultural aspects of the research site facilitated planning and logistics allowing time saving and reducing budget. Their familiarity with the population buffered initial exchanges, and eased interactions by reducing the "foreigner" barrier. Interpersonal skills were also key factors during participant recruitment and interviews, and bilingual language skills were extremely useful in the selection of commonly used Spanish words as well as regional idioms.

While training the interns in the urban field of New York City or the rural field in the Dominican Republic, faculty and researchers were able to share knowledge and teach skills in less hierarchical ways as compared to classroom teaching and show their personal passions for their area of specialization. By making students full-fledged partners in the research team they became increasingly aware of their importance in achieving the research project's pre-set goals. By analyzing the best ways to conduct their work for the success of the project they spontaneously started practicing critical and analytical thinking which transformed them from passive learners to active researchers using tools and strategies to enhance the knowledge of their own culture.

Overall, the internship was enriching not just as a scientific and educational achievement, but also as a cultural experience. Researchers were given the opportunity to go beyond publishing their research to the scientific community and bring in practice what they had learned about Dominican ethnomedicine to help train the next generation of Dominican immigrants in New York City in becoming more aware of the richness and importance of their cultural heritage. Ethnobotanists might be able to obtain funding for their research projects more easily if they can devise ways in which their results are of direct demonstrable benefit to the public community at large, including in such important areas as education, health care, conservation and food security.

The success of this collaborative effort has provided ideas for developing a larger scale project funded by the United States Department of Agriculture (USDA) and directed by the last author since 2009. In this larger scale project, the three main institutions from this paper continue to collaborate while the number of faculty advisors and research opportunities for minority students from the City University of New York has expanded. The USDA project has also allowed to increase the range of student diversity to encompass other cultural groups than Dominicans, and has included the requirement of independent research projects and oral presentations of participating students, among other improvements. Currently, 15 students have benefited from internships at the Institute of Economic Botany of The New York Botanical Garden, the Phytochemistry laboratory of the Department of Biology at Lehman College, the Geographic Information System (GIS) laboratory of the department of Environmental, Geographical and Geological Sciences at Lehman College and the Animal and Plant Health Inspection (APHIS) laboratory at John F. Kennedy Airport.

Acknowledgements

We are very grateful to our students Marleny Acevedo, Yadira Arias and Saneddy Quezada for their enthusiastic participation during and after the project, to our collaborators Jolene Yukes and Andreana Ososki who assisted us in training interns in New York City and the Dominican Republic respectively, and to Dominicans of New York city and the cities of Santiago de los Caballeros and La Vega for their valuable contribution to the knowledge of medicinal plants of the Dominican Republic. This project was supported by the CUNY Community College Collaborative Grant round # CCCG-002-2006. Researchers from the Institute of Economic Botany were supported by a grant from the National Institutes of Health/National Center for Complementary and Alternative Medicine (NIH/NCCAM) Grant # R21-AT001889, PI Dr. Michael J. Balick.

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Appendix 1. Specimens collected in Santiago de los Caballeros and La Vega, Dominican Republic, in 2006 by F. Henderson, M. Acevedo, Y. Arias, A. Ososki, and S. Quezada. Specimens deposited at NY and JBSD.

Scientific Name	Local Name(s)	Family	Collection Number
Allium sp.	**puerro**	Amaryllidacee	1249
Aloe vera (L.) Burm. f.	**sábila**	Xanthorrhoeaceae	1210
Argemone mexicana L.	**cardo santo**	Papaveraceae	1237
Artocarpus altilis (Parkinson) Fosberg	**guen pan**	Moraceae	1273
Averrhoa carambola L.	**carambola**	Oxalidaceae	1281
Bixa orellana L.	**bija**	Bixaceae	1275
Bromelia karatas L.	**piñon de maya**	Bromeliaceae	1261
Bunchosia glandulosa (Cav.) DC.	**cabra**	Malphigiaceae	1257
Capraria biflora L.	**feregosa**	Scrophulariaceae	1242
Carica papaya L.	**lechosa**	Caricaceae	1217
Casimiroa edulis La Llave & Lex.	**pera**	Rutaceae	1252
Cassia fistula L.	**caña fistula**	Fabaceae	1258
Chrysanthemum sp.	**manzanilla**	Asteraceae	1201
Cissus verticillata (L.) Nicolson & C.E. Jarvis	**bejuco caro**	Vitaceae	1228
Cocos nucifera L.	**coco indio**, **coco verde**	Arecaceae	1282,1284
Coffea arabica L.	**café**	Rubiaceae	1256
Costus spicatus (Jacq.) Sw.	**insulina**	Costaceae	1206
Cucurbita pepo L.	**auyama**	Cucurbitaceae	1234
Cupania americana L.	**guaraná**	Sapindaceae	1264
Cuscuta sp.	**fideo**	Convolvulaceae	1235
Cymbopogon citratus (DC.) Stapf.	**limoncillo**	Poaceae	1205
Dalechampia scandens L.	**gratey**	Euphorbiaceae	1231
Desmodium adscendens (Sw.) DC.	**amor seco**	Fabaceae	1278
Digitaria sanguinalis (L.) Scop.	**rabo de zorra**	Poaceae	1230
Eleusine indica (L.) Gaertn.	**pata de gallina**	Poaceae	1280
Eryngium foetidum L.	**cilantro ancho**, **cilantro sabanero**	Apiaceae	1203,1213
Eupatorium odoratum L.	**rompesaraguey**	Asteraceae	1219
Foeniculum vulgare Mill.	**hinojo**	Apiaceae	1271
Genipa americana L.	**jagua**	Rubiaceae	1279
Gossypium barbadense L.	**algodón verde**	Malvaceae	1266
Gossypium ekmanianum Wittm.	**algodón**	Malvaceae	1214
Gossypium hirsutum L.	**algodón morado**	Malvaceae	1268
Gouania polygama (Jacq.) Urb.	**bejuco indio**	Rhamnaceae	1221
Hordeum vulgare L.	**cebada**	Poaceae	1233
Inga edulis Mart.	**guama**	Fabaceae	1263
Inga vera Willd.	**jina**	Fabaceae	1207
Jatropha gossypiifolia L.	**tatua/tua-tua**	Euphorbiaceae	1216,1262
Kalanchoe pinnata (Lam.) Pers.	**topa/bruja**	Crassulaceae	1250
Lantana camara L.	**doña sanica**	Verbenaceae	1220
Lepianthes peltata (L.) Raf. ex R.A. Howard	**broquelejo**	Piperaceae	1270

Scientific Name	Local Name(s)	Family	Collection Number
Luffa acutangula (L.) Roxb.	**musu**	Cucurbitaceae	1227
Malpighia emarginata DC.	**cereza**	Malpighiacae	1259
Mammea americana L.	**mamey**	Clusiaceae	1277
Mangifera indica L.	mango	Anacardiaceae	1274
Manihot esculenta Crantz.	**yuca**	Euphorbiaceae	1272
Merremia dissecta (Jacq.) Hallier f.	**almendrillo**	Convolvulaceae	1226,1255
Momordica charantia L.	**cundeamor**	Cucurbitaceae	1211
Morinda citrifolia L.	**noni**	Rubiaceae	1276
Nicotiana tabacum L.	**tabaco**	Solanaceae	1295
Ocimum basilicum L.	**albaha**, **albahaca**	Lamiaceae	1202,1248
Ocimum gratissimum L.	**albahaca de vaca**	Lamiaceae	1287
Ocimum sanctum L.	**albahaquita morada**	Lamiaceae	1290
Pavonia spinifex (L.) Cav.	**cadillo de tres pies**	Malvaceae	1218
Peperomia blanda (Jacq.) Kunth	**aniseto**	Piperaceae	1246
Peperomia pellucida (L.) Kunth	**siempre viva/fresca**	Piperaceae	1204
Persea sp.	**aguacate morado**	Lauraceae	1267
Petiveria alliacea L.	**anamú**	Phytolaccaceae	1209, 254
Pimenta racemosa (Mill.) J.W.Moore	**berrón**	Myrtaceae	1253
Plantago major L.	**llantén**	Plantaginaceae	1241
Plectranthus amboinicus (Lour.) Spreng.	**orégano poleo**	Lamiaceae	1208
Pluchea cortesii (Kunth) DC.	**salvia**	Asteraceae	1244
Portulaca oleracea L.	**verdolaga**	Portulacaceae	1245
Pothomorphe peltata (L.) Miq.	**broquelejo**	Piperaceae	1239
Punica granatum L.	**granada**	Punicaceae	1286
Ricinus communis L.	**higuera**, **higuereta**	Euphorbiaceae	1232
Rosmarinus officinalis L.	**romero**	Lamiaceae	1247
Roystonea hispaniolana L.H.Bailey	**palma**	Arecaceae	1283
Ruellia tuberosa L.	**guaucí**	Acanthaceae	1200,1265
Sabal domingensis Becc.	**caña**	Arecaceae	1285
Securidaca virgata Sw.	**maravelí, maravedí**	Polygalaceae	1293
Sida sp.	**escoba**	Malvaceae	1212
Solanum hispidum Pers.	**berenjena con espina**	Solanaceae	1222
Solanum umbellatum Mill.	**berenjena cimarrona**, **friega plato**	Solanaceae	1215
Spermacoce assurgens Ruiz & Pav.	**Juana la blanca**	Rubiaceae	1243
Spondias purpurea L.	**jobo**	Anacardiaceae	1291
Stachytarpheta jamaicensis (L.) Vahl	**verbena morada**	Verbenaceae	1224
Tagetes rotundifolia Mill.	**clavel de muerto**	Asteraceae	1291
Tamarindus indica L.	**tamarindo**	Fabaceae	1260
Terminalia catappa L.	**almendra**	Combretaceae	1289
Trichilia hirta L.	**jojobán**	Meliaceae	1294
Urena sp.	**cadillo**	Malvaceae	1251

Scientific Name	Local Name(s)	Family	Collection Number
Xanthium strumarium L.	**cadillo de gato**	Asteraceae	1269
Undetermined	**yerba amarga**	Asteraceae	1238