AC 2010-1800: A COLLABORATIVE EFFORT TO TEACH TECHNOLOGY AND ENGINEERING CONCEPTS TO MIDDLE SCHOOL AND HIGH SCHOOL STUDENTS IN THE DOMINICAN REPUBLIC

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A Collaborative Effort to Teach Technology and Engineering Concepts to Middle School and High School Students in the Dominican Republic

Introduction

MACILE - (Matemáticas, Ciencias, Ingeniería y Lenguaje or Mathematics, Sciences, Engineering, and Language) is a Complex Systems Optimization Lab (COSOLA) education program that advances engineering and science education in less advantaged communities in the Dominican Republic (DR). Two core objectives of MACILE are: (1) to develop solutions to optimally increase access to challenging and stimulating learning environments and quality MACILE resources; and (2) to nurture talented young people from less privileged backgrounds. It is hoped that these students will then rise to the highest educational standards, pursue studies and careers in mathematics, science, and engineering fields, and make a difference in the world - creating opportunities to further advance science and technology in their countries and communities and to promote sustainable development.

MACILE started in 2007 in the Hitavo-Nigua (Ytabo) region of the DR. Ytabo is approximately 20 miles southwest of the capital, Santo Domingo. The region includes six towns with an estimated student population of 11,800 (from informal records). The median monthly income is less than US$150. On average, parents have completed through the 5th level of primary school (Survey, 2007). Less than 50% of students completing 8th grade continue to high school and less than 60% of those entering high school graduate. MACILE in Ytabo is currently a summer program. A year-around program is scheduled to start in 2011. The summer program was piloted in 2007 and 2008. The observations regarding the summer program are presented in other parts of this paper.

This paper reports on a collaborative effort between COSOLA and the Technology and Engineering Education (TEE) Program at Brigham Young University (BYU) to design a science and technology program to train in-service Dominican teachers and improve student skills. This collaboration initiated in 2009, following a request from the Director of COSOLA. In the summer of 2009, two members of the faculty of TEE, Dr. Ron Terry and Dr. Steve Shumway, visited the DR and spent three days training the teachers and observing the conditions. They presented several classes in technology and engineering to teachers and students. Despite language limitations, their work was enthusiastically received. In 2010 students and faculty from TEE will return to the DR to continue their work with MACILE. Their experience and future plans are presented below.

MACILE- Ytabo includes six parts:

- Summer Outreach Program for 6-9 grade students
- Summer Research Experience for high school juniors and seniors
- Scholarship
- Teacher Development Institute
- Preparatory School

- Mentoring.

The first three are current programs. Development of a summer institute for teachers, a component of the Teacher Development Institute, started in 2008. Others year-around programs are scheduled to start in 2011. All six of the program components are described more fully below. Together, they aim to increase accessibility to better quality math and science classrooms, build the foundation to introduce engineering education in K-12, and nurture talented students to make difference in engineering and the sciences in their country and communities.

MACILE has been supported by a grant from Buffalo Tungsten, Inc., a US corporation, and by individual donations. Program development and curricula design are made possible by a collaborative multidisciplinary network of university faculty from USA, college students, teachers, and principles.

The remainder of this paper is organized as follows. We begin with a review of the conditions of the education system in Ytabo and the DR, considering challenges and difficulties that must be overcome to effectively advance engineering and technology education in public K-12 classrooms. Next, we describe the components of the emergent MACILE model for Ytabo. Following, we present an analysis of the evolution of the summer program over the pilot phase. Next, we discuss efforts beyond the pilot phase, focusing on the joint collaboration between COSOLA and TEE. Finally, we present future plans for the collaborative efforts.

Challenges to Engineering Education in K-12 in the Dominican Republic

MACILE in Ytabo is the first program designed to advance engineering education in K-12 classrooms in DR. MACILE emerges to find an effective approach to address two important challenges:

- First, in the DR the educational infrastructure is basic but at the same the country must be an innovative actor to achieve sustainable economic expansion in the renewable energy based global economy of the 21st century.
- Second, recognition of the need to harness and develop the wealth of human potential available in marginal communities as a condition for achieving sustainable development in less developed countries in this century and beyond. This is true for wealthy nations, but more pressing in countries like the DR where most of its young population is from marginal communities. Young people are the country's most valuable resource. It will be difficult for the DR to emerge as an innovative player in the global economy without developing this wealth.

In addition to resources and cost, lack of prior experiences in the country with programs like MACILE has made the program design more challenging. Another limitation has been the lack of studies dealing specifically with the conditions of education in Ytabo or the socio-economic characteristics of the communities. Research works dealing with education in the DR have been very general. A study phase was necessary, as a result. This phase helped develop trusting relationships with the stakeholders and generate ideas and solutions to improve the program design. The study included assessment of the school facilities and working conditions of the

teachers, classroom observations, and consultation with all stakeholders. COSOLA has also conducted a survey of 400 families and has been compiling data to produce a more complete profile of the region and the schools. The pilot summer programs (2007 and 2008) allowed us to conduct a better assessment of the skill levels of the teachers and the students. They also helped us to gain better understanding of the operational conditions in the schools, as well as needs, preferences, and constraints. The pilots were also beneficial for the stakeholders. While the importance of MACILE has never been a question, there have been some concerns about our commitment, objectives, and methods. Teachers and school principals are mindful of the problems they are facing and understand their complexity. They know it will take a lot time and resources to produce meaningful changes. They also want to evaluate what we are offering. The pilot helped overcome these concerns. They have grown to like our method and trust our commitment,

A review of the Dominican public education system provides a problematic outlook. Public K-12 schools place at the bottom of the quality scale nationally and internationally. A handful of elite private schools provide quality K-12 education for the privileged few that can afford the high tuition and fees. However, most private schools do not provide any better education than the public schools. [2,3]

Unlike in the USA, where multiple well-designed math and science standards are available and significant resources are invested to improve STEM curricula[4,5,6], the Dominican Republic lack clear math and science standards. There are no expectations for technology education in k-12. The DR devotes few resources toward the development of standards or quality curricula. Far reaching educational reforms adopted since the 1980s show willingness to import ideas and curricula from the USA, Europe, and Asia; however, they have not produced the intended results. The country is still struggling to define its own vision for science and technology. Its budget for research and development is dismal as is the education budget. Indeed, the overall educational budget in the DR has never been higher than 2.7% of GDP in any period[1]. Education research has been marginal.

The reforms have also failed with respect to access to public schools. While accessibility for children age 6-13 has increased substantially over the past 15 years (91% enrolment), that for 14-17 years old has remained relatively low (36.5%). Increased access to elementary education has been achieved by reducing the school day. Schools operate 2 to 3 short shifts daily, reducing the effective school day to about 3 hours without decreasing crowdedness. These conditions and ineffective teachers have increased desertion and child labor. In 2005, 65.5% of 15-19 years olds had completed 8th grade or beyond and less than 60% of those enrolled graduated from high school. In rural areas and marginal communities like Ytabo the high school graduation rate remains less than 50%[1,3].

Schools in Ytabo operate under precarious conditions, lacking not only well prepared math, science, and languages teachers, but also basic needs such as safe drinking water and appropriate sanitation; appropriate school facilities and textbooks; and electricity. Working conditions of the teachers are difficult. Most work 2-3 shifts per day at one of more schools. They generally teach 4 courses each shift, which often vary per shift and school. Class size ranges between 37 and 60 students. In addition to these conditions, learning at public schools in Ytabo is also impaired by

limited parental involvement and growing socio-economic ills (i.e., high unemployment, crime, HIV/AID, drugs, alcoholism, and noise) affecting the communities (2007 survey).

The magnitude of the problem comes into sharper focus as we consider some observations from the summer program. MACILE targets 6-9 grade students in top 20% of the class. Despite being talented, these students have math and Spanish skills far below minimum acceptable levels for their grades. Even the teachers lack fundamental reading and writing abilities. In-service teachers participating in the MACILE workshops had a lot of difficulties solving simple math problems. They had serious difficulties with critical and analytical reading and writing. Observations of some classrooms in Ytabo show similar pattern. Teachers lack confidence. They teach by the book and are uncomfortable with some materials. They emphasize passive memorization and show poor classroom management skills. As a result, classrooms are often chaotic.

These conditions are clearly challenging. Improvement cannot be easily accomplished in a short time, which limits the process of introducing engineering education in K-12 classrooms. This effort requires a collaborative, multidisciplinary and comprehensive system-based approach with process-specific strategies that consider continuous improvement over time. The key to the success of this initiative is developing the teacher capacity, training master educators. It is also necessary to design robust math, science and language standards and curricular guidance to lay the foundation for effective MACILE curricula. Assisting the schools with quality improvement programs, developing better texts, and increasing access to quality learning resources are critical needs. Our strategy considers these challenges. The MACILE Program builds collaborative multidisciplinary networks of faculty, teachers, and professionals with expertise in the fields, and leaders from industry and the community to fulfill its mission.

MACILE-Ytabo: Overview of the Main Components

MACILE-Ytabo is an emerging solutions-driven model. The main focus is engineering a robust and efficient system to increase access to challenging and stimulating MACILE classrooms and resources, thereby producing a growing pool of talented young people interested in engineering and the sciences. The model integrates teacher development, student skills development, curriculum and material development, selective preparatory education, and access to essential resources. MACILE-Ytabo has limited scale and a wide scope. It targets two critical groups: (i) talented students in the top 20% of the class and (ii) teachers that want to excel in their fields and become master MACILE educators. The latter will improve the quality of the processes in their own classrooms and the schools thus increasing access to better education. Talented students, as they become empowered, will pursue studies and careers in engineering, sciences, and mathematics, and become teachers, innovators, and entrepreneurs who will in turn create opportunities for further advancement, in the fields. That is, over time these groups will increase opportunities for more students and teachers to access challenging and stimulation learning environments. MACILE's accessibility model is a flipped pyramid that emerges over time.

The main components are:

- **Summer Outreach Program.** This is a rigorous 5 weeks program for students in grades 6-10. The curriculum includes math, languages, and science/technology courses designed to build students' skills, improve their analytical abilities, and stimulate interest in math,

science and technology. The program was piloted in 2007 and 2008.

- **Traineeship Experience Program.** A 5-week mentored summer traineeship program for MACILE students who have completed at least 10th grade. Learning through research and discovery is the main focus. An aim is to engage students in relevant and interesting projects, showing the roles of engineering and technology in improving human lives. Other aims are to:
    - Improve understanding of the scientific process, engineering problem-solving, and the application of technology
    - Improve communicate skills results
    - Promote effective team work
    - Increase awareness about the natural environment and sustainability
    - Strengthen competence in science and technology.

  A pilot is expected to begin in 2010 with a robotic program in collaboration TEE students and faculty.

- **Preparatory School**. The mission of this school is to nurture a talented student body. Preparatory MACILE education for talented young people is a strategic alternative for faster development of a pipeline of exceptional engineering, science, and math candidates. The school will serve as a training laboratory for MACILE master teachers. Design planning started in 2009 with the collaboration of faculty and students from the Construction Management Program at BYU. Operations are expected to start in 2011.

- **Teacher Development Institute (TDI)**. TDI will train effective master MACILE educators. It will offer professional development for in-service teachers and new graduate to improve quality in the classrooms. A summer program started in 2008. The year-around program is expected to begin in 2011.

- **Scholarship Program**. The main goal of this program is to encourage academic excellence and reduce drop out due to financial hardship. It increases opportunities for qualified students to attend well-rated private high schools in other cities. It provides financial assistance to students showing good academic performance that are at risk of dropping out for economic reasons. The program is merit-based. It began in 2008. There are currently 10 students receiving scholarships. This number is expected to double in 2010. The limit is 40-50 scholarships each year. The amount of a scholarship ranges from UD$125 to US$600 per year.

- **Mentoring and Guidance Program.** This program will provide essential services and resources not accessible to students from disadvantaged backgrounds such as mentoring, counselors, tutors, and access to a wide range of information that can broaden their horizons. It is intended to build confidence, improve performance and increase graduation rates. Students from disadvantaged communities have no access to scholarships, better colleges, or better job opportunities. They are marginalized socially. This program will help in these respects.

Program Design Efforts: First Two Years

The MACILE summer program in 2007 and 2008 had four main goals:

- to assess math and science skills of teachers and students
- to gauge the students' interest in math and science
- to develop workable relationships with the schools and other stakeholders
- to evaluate the resources and capacity constraints further

Summer Outreach Program 2007

The program lasted three weeks and included only mathematics. Sixty-four students, ranging from grade 7 to 10 and from age 11 to 54 were recommended by a teacher coordinator or the director of the school and admitted without further review. 47 attended regularly and completed the program. They came from 2 of the 8 public schools in the region. Their average attendance was 93%. Students are recommended by a teacher coordinator or the director of the school. The schedule was from 8:00 AM to 12:00 noon, Monday through Friday and a healthy breakfast-snack was provided. Students were divided into two groups and received 2 hours of math instruction daily as well as tutoring. Classes were taught by a college professor from the United States who was assisted by a local teacher. The curriculum included standard sixth and seventh grade math in accordance with textbooks required by the Dominican Secretariat of Education. Improvement was monitored through homework assignments and class dynamics.

Observations: In general, students were unfamiliar with the content. Their math skills were far below the levels expected. In addition, their language skills were also very poor. Most students could not write their names correctly and their work contained many errors. Further assessment showed unequivocally that the students had only elementary literacy skills. This was an unexpected constraint. Despite these deficiencies, however, many students showed remarkable disposition toward the work and great enthusiasm. They tried to complete all the assignments and observed good attendance. Some high school students showed noticeable improvement. They organized themselves into highly inquisitive and very hard-working teams. The remaining students felt into broad groups. The first group observed good attendance and behavior, but they rarely tried to work problems they did not understand. They did not ask for help, but accepted it when offered. The second group had the lowest math skills and was disruptive. Most couldn't organize the digits of a sum correctly. Their work was incomprehensible. These students were less likely to arrive on time and often did not attend. Some dropped out; the more disruptive were dismissed.

Summer Outreach Program 2008

This year the program was redesigned based on the information obtained during the first summer outreach program and from the research conducted. The duration was extended to five weeks and the curriculum included math, science and technology, Spanish literacy and analysis, and activities: chess, puzzles, field trip, and guest speakers. The admission process was more closely aligned with the program intention. Thirty-five out of 80 recommended students were admitted. (MACILE targets talented student on the top 20% of their class.) The students were from grades 6 to 10 and ages 12 to 17. They came from 4 of the 8 public schools in the targeted region.

Students were divided into two groups for math and Spanish and brought together for the science

and technology activities. Classes and activities were from 8:00 AM to 4:00 PM, Monday through Friday. Students received a healthy breakfast and lunch. There was a required student orientation and a meeting with the parents. At the end of the program, the student completed a short evaluation of the program, consisting of two questions: "What did you receive from the program?" What was your contribution? Their answers were also used as writing examples and compared to examples taken at the beginning of the summer to measure improvement. The students also completed a mathematic test.

College professors, conforming to MACILE's learning philosophy of emphasizing critical thinking, developed the curricula. The goal was to have friendly and respectful classroom atmospheres where students engage actively in class discussion and collaborate with peers. The focus was to build basic skills in the following areas:

- **Mathematics.** The curriculum followed an incremental learning approach. It introduced the concepts of the tool-box and the master musician to improve problem-solving through practice and pattern recognition. The material included numbers, operations, fractions, algebra, geometry, and trigonometry concepts.
- **Spanish. Activities** focused on improving reading and writing skills, introducing students to the analytical thinking process. Dominican history, culture, and literature were the foundation. Grammatical structures, orthographical rules and other principles of the language were woven into the lessons without being their main objects. They derived naturally from the readings and discussions of the underlying topics. This approach departed from the traditional mechanistic way followed in Dominican classrooms, which emphasizes passive memorization of grammatical and orthographic rules.
- **Science and Technology.** Classes included hands-on activities in solar energy, balance and forces, and chemical mixing. We used available kits and activities: *Solar Deluxe Educational Kit*, *Thames & Kosmos CHEM C-1000*, *Toothpick Bridges from Lego Education*. Students were divided in groups of 5. A bridge design competition was the highlight. The goal was to introduce them to learning by doing, motivate creativity, and bring into focus the interactions among math, science, and technology.
- **Activities**. They included games (chess, puzzles, reading club, Scrabble), field trip to historical sites, and speakers. The president of a prestigious firm spoke about requirements to secure employment in reputable companies. The Director of the International Scholarship Program of Secretariat of Education spoke about accessing scholarships to foreign universities and colleges.

A college professor assisted by three Dominican teachers taught classes. The teachers received one week of training in the math and Spanish curricula prior to beginning of the program. Teachers and students received the texts and all the required materials. As in 2007, the program was conducted at Hitavo public school. There were several difficulties with the facilities and the location including: (1) lack of running water and workable bathroom; (2) no kitchen; (3) excessive noise from the streets and adjacent basketball court; (4) poor conditions of the blackboards; and (5) a persistent flow of curious children from the neighborhood attracted by the food and games.

Observations: Students responded exceptionally well to the challenge and rigor of the program. On time attendance was excellent (98%) and they showed some improvement in reading, math,

writing and teamwork. Students adapted rapidly to the MACILE classroom philosophy and enjoyed the dynamic. Fear of criticism was an initial concern, but it soon disappeared and the students were able to share their work in class, accept feedback, and engage in discussions with peers. Another noticeable improvement was classroom behavior and etiquette. Initially, students spoke all at once and loudly. Some were not respectful to others. Over time, they learned to listen to each other and to speak calmly. They also bounded as friends. The positive nature of the students' experience was illustrated in the feedback we obtained at the end of the summer:

1. "I learned many examples about good behavior…"
2. "I learned a lot about bridges, solar energy, mathematics, and other things. I also learned that I should not speak with a loud voice and not to disturb others. I also learned that working on team is extremely important to achieving my goals."
3. "I learned that I should ask questions when in doubt. If I remain silent I will never learn what I need to learn. I also learned some mathematics and Spanish. I did not know how to write an essay. I used to make textual copy of the material."
4. "This summer I learned to read better, how to express my thoughts, and how to analyze problems…."

In a follow-up meeting five months latter, the students indicated high level of satisfaction with MACILE and believed their academic performance had improved. They showed ability to listen, exchanging point of views without argument and calmly. The school director present was impressed. Five months before, an exchange of that kind would have turned chaotic.

But, five weeks was insufficient to make needed improvements in math and Spanish skills. Despite being talented and showing great disposition toward learning, the students' skills were still far below those expected for their grade levels. A summer program alone is not sufficient to provide learners with the experiences and skills needed to succeed in formal, challenging post-secondary engineering, science, and technology programs. The best vehicles to fulfill these requirements are the classrooms.

Teacher Development Program 2008

This program had two main goals: (1) to prepare teachers who would assist in the MACILE classrooms; and (2) to improve the teachers' math and Spanish skills. The program offered short workshops: Spanish (one week) and elementary math for 3rd to 6th grade teachers (three weeks). Classes were held Monday through Friday for 2-3 hours each day. Eleven teachers participated. Two of them volunteered to work with MACILE that summer. Teacher motivation was the main challenge in organizing the workshops. As indicated above, working conditions in the schools are difficult and teachers are reluctant to compromise their summers even when they recognize the benefits of the program.

Observations: We expected the teachers' math skills to be low, but the results were surprising. With one exception, teachers participating in the workshops did not have a fluid sense of how to combine numbers, manipulate fractions, select tools to solve problems, or manipulate large

numbers. They had difficulties solving simple math problems mentally and using paper and pencil. Another surprise was the teachers' language skills. Teachers had serious difficulties with critical and analytical reading and writing. Essentially, they did not know proper reading and writing. Observations of some classrooms showed similar pattern. Teachers taught by the textbook and were uncomfortable with the materials. They emphasized passive memorization and showed poor classroom management skills. These weaknesses in the teacher skills are likely the best explanation for the poor skill levels of the students.

We also conducted a follow-up meeting with the teachers five months after to gage their satisfaction with the program. They were very impressed and appreciative. Teachers that worked with MACILE and some that participated in the workshops were trying to implement MACILE's active learning philosophy and the Spanish curriculum in their own classrooms. Some claimed that they were observing significant differences in the performance of the MACILE students, their aptitude toward learning and work ethic.

It was clear from these results that, while valuable, short workshops during the summer were insufficient to address these levels of deficiencies. The idea of a year-around teacher development institute resulted from this realization.

Program Design Efforts in 2009

In 2009 we focused on increasing teacher participation, curricula development, and quality improvement. In-service teacher participation increased over 100% from 2008. Twenty-five teachers completed the summer program. Five of them assisted in the math and Spanish classrooms. These teachers represented all public schools in Ytabo and from two adjacent towns as well as a private school. The increased teacher participation was mainly due to the volunteer teacher coordinators and directors promoting the program in the schools and the quality dimension that visits from faculty from US universities was adding to the program. Other factors were better recognition of MACILE and increased trust. Teachers have grown comfortable with the MACILE approach. They are mindful of the problems and appreciate the opportunities for improvement presented to them, but they worry about assessment. Familiarization with MACILE's method has dissipated apprehensions and is making work enjoyable to them,

The faculty visiting were Dr. Rosario Swanson from the Spanish Department at Marlboro College, and Dr. Steve Shumway and Dr. Ron Terry from the TEE Program at BYU. Dr. Swanson is the Director of the MACILE Spanish Language Program and has developed the Spanish curriculum. COSOLA requested collaboration with Dr. Shumway and Dr. Terry on the design of the technology and engineering program last spring. They visited for a week in the summer of 2009. They worked with in-service teachers and students and surveyed the conditions. Their instruction was enthusiastically received and the collaboration will continue in the summer of 2010. More about their experience, and future plans are detailed below.

In addition to the teacher institute the summer outreach program continued to expand in 2009. The number of new applicants increased although the number of participants was kept relatively constant. Better-trained teachers are still needed. The program relocated to the school Padre Zegrí to address issues with the facility. All schools from Ytabo were represented. In addition,

there were students and teachers from schools in two adjacent towns and a private school. There were several changes to the curriculum. More noticeable were the addition of the Spanish Literature class for the high school group and the introduction of rocketry activities. But, the most significant change in this area was marked by the joint efforts with TEE faculty. This joint effort will improve the technology and engineering component of the MACILE (read below).

The outcomes achieved during the summer of 2009 were good. There was remarkable improvement in the language skills of the students that had been with MACILE for three years. Students show interest in the science and technology activities and are able to master scientific research concepts like design and analysis of experiments fairly well. The Spanish literacy and analysis skills of the teachers working with MACILE have also improved. Teachers attending the workshops are putting into practice what they learned. Despite the good results, there remain substantial issues that need to be resolved to improve the quality of the program. Strengthening the student selection process, better training for teachers working with MACILE, and hiring a local administrator are some examples. The main priorities in 2010 are improving the science, technology, and math curricula and increasing resources.

Efforts to Include Technology and Engineering

Last spring, Claudina Vargas from MACILE contacted the Technology and Engineering Education (TEE) Program at Brigham Young University regarding an opportunity to conduct in-service teacher training in the Dominican Republic (DR). Despite their inability to speak Spanish, two faculty members accepted this opportunity and went to the DR and spent three days training the teachers and teaching several classes of students technology and engineering content.

From information provided by the MACILE administrator, the TEE faculty members anticipated several challenges to delivering the teacher training in-service. The first challenge stemmed from the fact that neither faculty member could speak Spanish. A translator was provided which partially helped solve this challenge. Additionally, the faculty members decided to teach a unit on electricity and electronics, hoping that the math and schematic symbols involved in the teaching could be easily understood by the teachers and students without need of additional translation. These solutions, along with the fact that many of the teachers and students had a familiarity with English enabled the TEE faculty members to provide the teacher in-service without too much difficulty.

The second challenge was related to the lower level of content knowledge and skills of the DR teachers involved in the in-service. When first developing the model for in-service, the TEE faculty considered conducting a morning session with only the teachers and then observe these teachers while they presented the same information to their students during an afternoon session. Before beginning the teacher in-service, the TEE faculty had an opportunity to observe the teachers and students in a classroom setting and determined that given the teacher's limited knowledge of science and technical content and because of the common use of rote memorization as a method of instruction, this model for teacher in-service would not be effective. While very eager and able to participate in the in-service, the teachers needed to not only learn the content, but more importantly needed to have a variety of instruction methods modeled for them to see how this content might be effectively taught. Because of this, the DR

teachers were taught content and participated in the technology and engineering activities along with their students during the morning session, and then these teachers team taught with the TEE faculty during the afternoon session. This allowed the TEE faculty members to model for the teachers instructional strategies appropriate for teaching the specific content and then for the DR teachers to apply what they learned in a mentored environment.

The final challenge was the lack of hands-on materials available in the DR classrooms needed to adequately teach technology and engineering content. To overcome this problem, the TEE faculty looked for inexpensive methods for teaching the specific content to be covered in the in-service. The lesson plans they chose to use came from a series of curriculum projects developed by the Boston Museum of Science called: *Engineering is Elementary*. The specific topic they taught was titled, *An Alarming Idea: Designing Alarm Circuits.* Using inexpensive materials such as batteries and Christmas tree lights cut into individual sections the TEE faculty were able to teach the teachers (and students) about simple electronic circuits, the engineering design process, and several other basic principles of engineering. On the final day of the in-service, each of the groups of teachers and students were able to successfully design an alarm system as a solution to the problem given to them as part of the *Engineering is Elementary* curriculum.

Because the instruction was so well received, the directors of MACILE requested that these teacher educators return on consequent years and provide additional in-service teacher training focused on technology and engineering related domains. During the summer of 2010, TEE faculty will return with university students, who are pre-service technology and engineering teachers, and teach additional topics related to electronics, robotics and rocketry. Consequently this request blends well with faculty research projects, and the mission of the TEE program: to educate learners about the principles, processes, impacts, and domains of technology and engineering.

Future Plans

As mentioned previously, TEE students and faculty from Brigham Young University are scheduled to return summer 2010 to the Dominican Republic to continue their work with the MACILE group. This will take the form of an official study abroad program where students will develop curriculum, conduct research, and receive credit for participation. Eight BYU students and 3 faculty members will participate in the program. Content areas include: energy; chemistry; bridges; rocketry; and robotics. The DR students will be broken up into 4 different class groups: 6^{th}-7^{th} grade; 8^{th} grade; 9^{th}-10^{th} grade; and 10^{th}-12^{th} grade.

In an outgrowth of this program, faculty and undergraduate students from the Construction Management Program also at Brigham Young University will work with a group of stakeholders from MACILE (i.e., school administrators, parents, students, local construction agencies) to design and build a permanent school structure. Specifically, Construction Management interns will team with these stakeholders to design the architecture of the school, procure construction materials, and begin the process of building the school. Teaming with students from the TEE program, the Construction Management students will help teach students the required processes and construction codes, needed to build a school, work with DR teachers to develop curricular

units related to engineering and technology that are appropriate for K-12 DR students, and work with DR teachers and students to implement this curriculum.

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