



ACP Science
and Technology II Programme

INVOCAB — Improving Innovation Capacities in the Caribbean



Judges listen to students during the Innovation competition at the Mico University College, Kingston, Jamaica (July 2017).

SUMMARY OF RESULTS

An average 12% increase in the passes for external science examinations was achieved for Mathematics, Agricultural Science, Integrated Science and Information Technology at the eight participating secondary schools in Jamaica and Trinidad and Tobago. Teaching strategies and classroom delivery methodologies in both the primary and secondary schools were improved, for instance on the integration of practical activities (simplifying the types of cell division, observing density and polarity, and identifying real life application of vectors). The schools were also provided with laboratory equipment, scientific charts, reagents and models of major human internal systems and organs. The establishment of two 'Science centres' in Jamaica at the Mico University College and the Church Teachers' College facilitated the access to resources not available in all schools. The resource manuals which were produced for teachers will be used in both countries island wide.

BACKGROUND

The Caribbean region can be recognised as consumers rather than producers of innovation due to inadequate incorporation of science, technology and innovation activities in the education system. As a result, students are prepared for employment rather than being taught skills for problem solving and innovation. Hence, the need for inclusion of creativity in the education system has been the focus of the INVOCAB project. The project stimulated an interest in science, technology and innovation, and improved the teaching and learning of science in both traditional and non-traditional settings. The research questions to be answered during the project were:

- Will the provision of laboratory and other equipment result in changes to teaching strategies in schools and student test scores at examinations?
- Will the establishment of 'Science centres' facilitate shared knowledge and experiences for schools?
- Will teacher training workshops and summer camps impact how science is viewed by students and taught by teachers?

The target groups of the project were students and teachers of Grades 4-6 (primary level), and Grades 9-11 (secondary level) from 8 primary schools, 8 secondary schools,

and 2 teacher colleges. Both the primary and secondary schools generally exhibited low performance in 2012/2013 external examinations. At the primary level, this examination is the Secondary Entry Assessment (SEA, Trinidad and Tobago) and the Grade Six Achievement Test (GSAT, Jamaica). At the secondary level, both countries sit the external examinations, namely the Caribbean Secondary Education Certificate (CSEC) and Caribbean Advanced Proficiency Examination (CAPE). The schools often have insufficient teaching resources, low teacher motivation, inadequate or non-existing laboratory spaces and average to poor student literacy. The teacher colleges (in Jamaica) exhibited better pre-project conditions. They were already being accessed by schools in the surrounding communities as a resource centre and offer degree programmes in science education at the primary and secondary levels.

The users of the project results are: the Ministries of Education, school teachers and principals, students, and the Ministries of Science and Technology. The project impacts are intended to guide policy for future implementation of education programmes as executed by the Ministry of Education in both countries. Currently such programmes have restricted hands-on activities.

PROJECT IMPLEMENTATION PERIOD

January 2014 – March 2018

CONSORTIUM

- Scientific Research Council (SRC), Jamaica
- National Institute of Higher Education, Research, Science and Technology (NIHERST), Trinidad and Tobago
- University of Technology (UTECH), Jamaica
- The Mico University College, Jamaica

Associated partners:

- Technische Universität Dresden (TUD), Germany
- Ministry of Education (MOE), Jamaica
- Ministry of Science, Technology, Energy and Mining (MSTEM), Jamaica
- Church Teachers' College Mandeville, Jamaica

PROJECT CONTACT

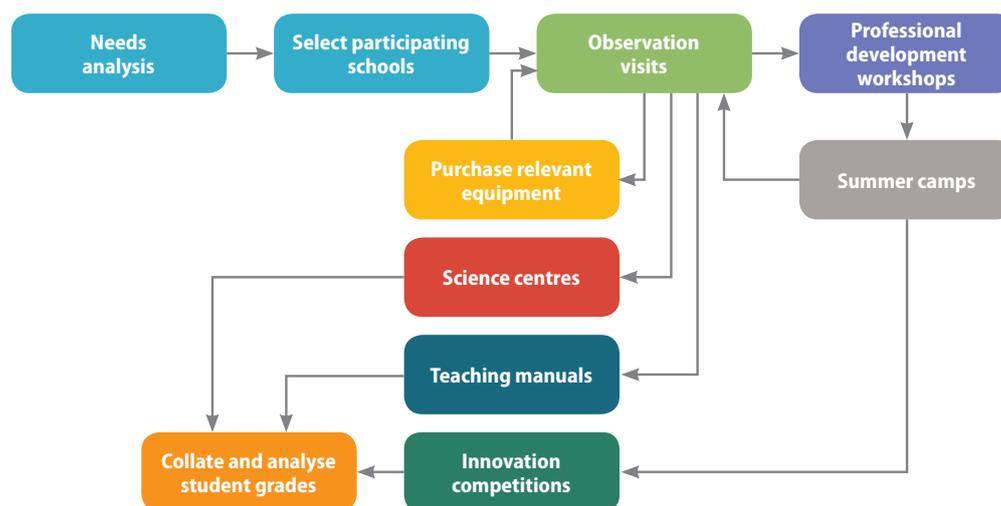
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PROJECT WEBSITE

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METHODOLOGY



Baseline survey

An infrastructural and competency needs analysis was conducted at 46 schools: 30 in Jamaica and 16 in Trinidad and Tobago. The gathered information was used to determine the schools most in need of intervention, with the Principals' interest being a critical factor.

Observation visits

In the 16 selected schools, teachers of science subjects were observed in the classroom (averaging 1 hour in length) and the 'Danielson Rubric' was used as a framework for teaching evaluation. Outcomes were used to prepare other project activities.

Professional development workshops

Subject-appropriate material was developed for the teacher development workshops. Two-day workshops were conducted, separately for the primary and secondary school levels with joint sessions for topics such as classroom management and effective lesson planning. The form of knowledge transferred ranged from practical / engaging / age-appropriate activities to be conducted in the classroom, the design of effective programmes and activities for 'Science centres', to the sharing of 'Education programmes' designed to impact both teachers and students simultaneously.

Provision of laboratory equipment

The baseline surveys and physical visits to existing laboratory spaces determined what equipment was needed for the schools. The various items were purchased in such a way that all secondary schools within a country got identical resources and all primary schools too.

Summer camps

Three annual one-week summer camps facilitated student learning outside of the classroom and also included field trips, sports competitions and a 'Design challenge'. Teachers were exposed to new methods of conducting lessons.

Science centres

In Jamaica, two teacher colleges were outfitted with laboratory and electronic equipment and established as 'Science centres', primarily to facilitate the inclusion of other (non-participating) schools in hands-on and age-appropriate learning. Student teachers are now able to improve their teaching strategies as they have access to the centre's resources and the college lecturers are able to supplement their lectures with practical activities.

Teaching manuals

Teaching manuals on selected science subjects (mathematics and science at both primary and secondary levels; chemistry, physics, agricultural science, information technology and biology at secondary level) were produced which facilitated the improvement and effectiveness of teaching strategies. Difficult topics highlighted during the collection of baseline data are presented in a simplified manner, as well as lists of alternate teaching activities and human anatomical models, field trip options, and relevant integration into real life applications.

Innovation competition

With guidance from teachers, students from the schools' 'science clubs' developed practical projects for solving or mitigating food security and energy efficiency issues in their schools and communities, which are critical areas to small island developing states.

Statistical analysis of student grades

The 'Statistical Programme for Social Scientists (SPSS)' was used to analyse the students' grades obtained in order to determine a correlation between the project activities and the grades obtained hereafter. Improvement in students' performance was determined by assessing their passes in external examinations: SEA (Secondary Entrance Assessment) in Trinidad and Tobago and GSAT (Grade Six

Achievement Test) in Jamaica. Both islands do CSEC (Caribbean Secondary Education Certificate) and CAPE (Caribbean Advanced Proficiency Examination) at secondary level. A comparison was done to determine the percentage pass for the schools before and after the project. The majority of schools obtained a 10% increase in passes, when compared to the baseline year of the 2012/2013 examinations.



Teachers at a training workshop, Kingston, Jamaica (April 2016).



Opening of the Science Centre at the Mico University College, Jamaica (May 2017).



A student of Carron Hall High discusses how the laboratory equipment has helped her complete her practical assignments, St. Mary, Jamaica (March 2017).

RESULTS

→ Outputs

Capacity building

- 18 two-day professional development training workshops for >200 teachers (~30 male, ~170 female) in delivery methodologies on 'difficult to teach' topics.
- 6 one-week summer camps for students and teachers. Each island had 3 annual summer camps (>400 teachers and students).



Students display their project at the 2017 Innovation Competition, Port of Spain, Trinidad (October 2017).

Infrastructure

- 2 science centres outfitted with laboratory and demonstration equipment (microscopes, fixed slides of biological structures, models of the brain / heart / ear...).
- 16 schools outfitted with office, laboratory and field equipment (light microscopes, meter rules, conical flasks, balances, desk top computers, digital cameras...).
- At 4 schools, the security of spaces air-marked for science converted into a functional experimental space.

Toolkits

- 9 curriculum support manuals (under review by the Ministry of Education, Jamaica):
 - *for secondary schools*: Mathematics, Chemistry, Integrated Science, Agricultural Science, Biology, Information Technology and Physics.
 - *for primary schools*: Science and Mathematics.

Visibility

- Project website.
- FaceBook account.
- >50 press productions (newspaper articles, television interviews, radio interviews, and online posts). Examples:
 - Highlights of INVOCAB activities. <http://www.niherst.gov.tt/projects/invocab.html>
 - The Jamaica Observer Online Thursday, February 26, 2015. http://www.jamaicaobserver.com/news/EU-donates-science-equipment-to-local-schools_18469665
 - Ministry of Science & Technology online. <https://www.mset.gov.jm/educators-laud-science-education-project>
 - Sunday Express, August 23, 2015 "Kids enjoy a Summer of Science at NIHERST" (Trinidad).
 - The Jamaica Observer Online: Sunday September 24, 2017. <http://www.jamaicaobserver.com/career-education/>

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- 2 education symposia.

Publications

- 5 academic papers (under preparation):
 - The role of science centres in enhancing science education outside the classroom.
 - Scientific concepts, theories and principles: Key areas addressed by Science Centres.
 - Do summer camps support student learning? The INVOCAB experience.
 - Summer camps as a tool to enhance student learning.
 - Strategies towards improving science performance in Jamaica.



Jamaican teachers review draft manuals during summer camp 2017 at the Mico University College, Kingston, Jamaica.

↑ Outcomes

- Improved teaching skills and knowledge in science subjects by primary and secondary level teachers (>200).
- Increased interest in science subjects by primary and secondary level students (>10,000).
- Science is no longer perceived as difficult, but as a subject that requires observation and enquiry.
- Students actively involved in the development of solutions for agriculture- and energy-based problems within their schools and communities.
- Improved teaching practices in the classroom with the aid of relevant resource materials.
- Improved execution of School Based Assessment (SBA) exercises, as required by the Caribbean Examination Council (CXC) due to the availability of measuring instruments, models, reagents, charts, and microscopes.

- Improved pass rates of primary and secondary school students in external examinations in science-related subjects.

External examination assessment (2014-2016)

- 1 of the 8 participating secondary schools had a 22% increase in pass rates for the CSEC examination compared to previous years.
- Biology external examination pass rates improved by over 10% in Jamaican secondary schools.
- 1 of the 8 participating primary schools had a 12% increase in pass rates for mathematics compared to previous years.
- GSAT students who participated in the summer camps scored significantly higher grades than those that did not participate.
- Primary level mathematics (Jamaica) pass rates improved from an average of 35% to 45%.

- Agricultural science (Jamaica) pass rates improved from 87% at baseline to 96%.
- Secondary level mathematics (Trinidad) pass rates improved from 37% to 45%.

Internal examination assessment

- Overall secondary level female students in both Jamaica and Trinidad and Tobago showed improvements in performance exceeding 10% compared to previous years.
- The examination pass rates for mathematics, information technology and chemistry improved more than 10% in Jamaican secondary schools compared to previous years.
- Primary and secondary level students have improved grades in internal school examinations, especially for students having participated in the summer camps.

RESULTS

Impacts

Usage

- Through the 15 projects submitted for the Innovation Competition, there have been improvements in farming and energy conservation practices that were implemented in some of the schools. It is expected that, with additional support, the most impactful projects will be implemented on a wider scale in schools and communities across Jamaica and Trinidad and Tobago.
- Teachers exposed to new methods of conducting lessons intend to utilise these methods in their individual schools.
- The improvement in teaching methodologies means that students can be more engaged in the learning of topics perceived to be difficult. Coupled with the science manuals and additional learning resources, the performance of schools would be constantly improved.
- The usage of electronic equipment (computers, surge protectors and cameras) enables the schools in data collection, analysis and research for their various projects.

Policy implication

- Recommendations for the adoption of a multi-pronged approach to science education (camps, workshops, equipment, science centres....) have been made to the relevant Ministries, but the actual conversion into policy requires time and willingness of current and new governments. Post-project follow-up by NIHERST and SRC will be required.

Sustainability

- Some aspects of the project activities will continue via the existing programmes of NIHERST and SRC. Their science-based education programmes will now include the schools that participated in the project. As such, monitoring of the schools' performance in external examinations can continue. The aspects of the project that will continue are the innovation competitions amongst schools, as well as the professional development workshops for teachers.

- The schools that participated in the project can take part in activities such as those routinely hosted by the Science centres in Trinidad and Tobago, the essay and oratory competitions (SRC), science fairs, school tours and science-based school societies in Jamaica.
- The sustainability of the results will also be affected by the movement of teachers trained in the project to other schools: participating schools may experience a regression in performance; non-participating schools (that the trained teachers migrate to) may see an improvement in performance. It is expected that teachers who participated in the project will retain and improve on the skills obtained. In the event that those impacted by the project move to other schools, it is expected that they will implement what they have been taught and practiced in their new environment.

TESTIMONIALS



**Mr. Alex Brown, teacher,
Carron Hall High, Jamaica**

“I loved camp! It provided a great means of interacting with my students one-to-one, which is difficult to do during the regular class

sessions. This INVOCAB project is fantastic. As a rural school we don't often get outside help with resources and training. Being a part of the teacher training workshops was good for me as I learned new approaches to lesson planning and developing critical thinking skills in my students. I enjoyed the mathematics sessions done using music to help remember formulae. Thank you for this opportunity.”



**Mr. Dominique Joseph,
teacher, Barataria Boys'
R.C. Primary School,
Trinidad and Tobago**

“INVOCAB has given me the perspective that 'learning can be fun'. It sounds

cliché, but I was able to see first-hand that this is possible. INVOCAB provided the opportunity to teach mathematical and scientific concepts using activities that are fun; it also gave the student the chance to think critically. Children love to have fun and the best part is they are also learning something. One of my main observations was that resources and materials were inexpensive, accessible and available right here in Trinidad and Tobago. At the camps, there was no shortage of resources and materials. Each student had their own to work with, even while working in groups. Overall, I learned new methods of teaching some difficult concepts, especially in mathematics. A lot of these methods helped students and their confidence in the classroom increased, as so did mine.”



**Ms. Raquel Kalloo, teacher,
St. Augustine Secondary
School, Trinidad and
Tobago**

“There was merit for the INVOCAB project. It opened up my mind to

new ways to introduce topics in the classroom. The facilitators were knowledgeable and I was able to receive more training and exposure to creative teaching methods. What was particularly noteworthy for me were the 'Professional Development Workshops'. I appreciated being able to interact with colleagues from other secondary schools and to have the opportunity to exchange ideas and classroom experiences. As a teacher, you often feel as though you are teaching in a vacuum and it is refreshing to learn that other teachers experience the same challenges. These workshops offered us the forum to share ideas and teaching strategies.”