

# Center for Resources in General Education (CIVIS): Towards Student Success in General and STEM Education

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**Abstract** - Researchers at the University of Puerto Rico-Mayagüez (UPRM) have conducted an analysis of student needs and have identified strategies to respond to the General and STEM education challenges at UPRM. A Center for Resources in General Education (CIVIS) has been established to deal with these challenges by providing students and professors a new, integrated perspective (focused on General and STEM skills) of the curriculum, and by enabling student academic success through various learning opportunities. CIVIS brings together faculty from Agricultural Sciences, Arts and Sciences, Business Administration and Engineering in order to develop activities that provide interdisciplinary and global perspectives to UPRM's General Education. The Center focuses on two main activities: 1) Paths to Student Success, and 2) Sustainable Context with the use of student learning modules tying the activities together. All initiatives of the Center are supported by a recent grant from the U.S. Department of Education, and are based on the success of initiatives that have been previously tested at a smaller scale at UPRM. CIVIS provides resources to expand the reach of those initiatives and will ensure sustainability by the institutionalization of those initiatives.

*Index Terms* – General education, outreach, writing, learning modules, sustainability, STEM education

## INTRODUCTION

The education requirements at the University of Puerto Rico, Mayagüez Campus (UPRM) has as the core the philosophy of providing a liberal education as well as a more in-depth study of a specific discipline. A liberal education providing these outcomes empowers individuals, cultivates social responsibility, and is the best preparation for the interconnected, global workplace of the 21st century [1]. The liberal education at UPRM is composed of a general education curriculum and a major concentration that deepens the skills and knowledge provided in the general education courses. The major is indeed a complex context in which students are expected to communicate with multiple audiences, evaluate ethical implications and connect with other disciplines [1]. UPRM's Student Learning Outcomes summarize the institution's general education philosophy,

stating that by the time students graduate they will be able to:

1. Communicate effectively
2. Identify and solve problems, think critically, and synthesize knowledge appropriate to their discipline
3. Apply mathematical reasoning skills, scientific inquiry methods, and tools of information technology
4. Apply ethical standards
5. Recognize the Puerto Rican heritage and interpret contemporary issues.
6. Appraise the essential values of a democratic society.
7. Operate in a global context, relate to a societal context, and demonstrate respect for other cultures
8. Develop an appreciation for the arts and humanities
9. Recognize the need to engage in life-long learning

Taken individually, each UPRM College (Business Administration, Arts and Sciences, Agriculture and Engineering) can show the achievement of these outcomes. Nevertheless, many UPRM students take groups of courses without understanding the relationships among courses from different fields of study, a reality aligned with the general education remarks made to UPRM by the Middle State Accrediting Board [2]. This is due in part to a lack of coordination among Colleges in terms of the general education goals of the Institution, and the limited opportunities for undergraduate students (and professors) to engage in interdisciplinary academic activities. Thus, there is a need to provide an overarching goal or framework in which different UPRM Colleges can jointly work to fulfill the Institution's general education goals as expressed in the student learning outcomes.

Many of the problems the World faces are social and global in nature. Nevertheless, in many cases such problems are managed from a mostly technical or economical perspective, instead of approaching them from a more integrative, global perspective. A common trait of these global issues is their interdisciplinary nature, which makes them complex problems difficult to address from one particular discipline. CIVIS, the Center for Resources in General Education was established at the University of Puerto Rico-Mayagüez (UPRM) to provide a new perspective in general and STEM education. CIVIS, which means "citizen" in Latin, brings together faculty from Business Administration, Arts and Sciences, Agriculture

and Engineering in order to develop interdisciplinary activities that furthers UPRM’s mission of shaping productive and committed citizens. The Center challenges the traditional classification of “technical skills” and “soft-skills”, substituting it by an emphasis on the development of the professional and global skills described in UPRM’s student learning outcomes. CIVIS has two main activities: 1) Paths for Student Success, and 2) Sustainable Context. Activity 1 has 3 components: a Bilingual Writing Center, Pre-College Outreach in Science, and Student Learning Modules. Activity 2 has two components: a Sustainable Energy Initiative, and a Ph.D. Program in Agricultural Sciences. Tying the two main activities together is the common goal of improving General and STEM Education.

CIVIS combines and expands existing efforts at each UPRM college by coordinating individual efforts under the overarching General and STEM Education philosophy, thus providing students and professors with tools and strategies that help them attain the institutional learning outcomes. Figure 1 presents the activities and their respective components. A key strategy of CIVIS is to present students a more holistic perspective of their education to students through communication skills, interdisciplinary work, and team teaching with a strong emphasis being placed on presenting a more integrated curriculum.

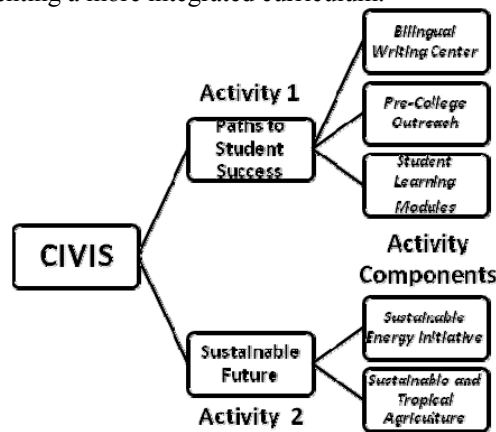


FIGURE 1

Activities of the Center for Resources in General Education

CIVIS is the result of years of successful individual efforts in K-12 outreach, writing projects, instructional modules and STEM education at UPRM. CIVIS represents an umbrella to better coordinate, not control these efforts, providing resources for the expansion of the scope and depth of these efforts, and benefitting not just a limited number of students, but the whole student body at UPRM. The initial focus of CIVIS is on providing these opportunities to STEM students, as a way to broaden their understanding of the context and impact of their professions, and also as a way to encourage retention in STEM fields, by providing connections among the various parts of their curriculum. This will also benefit professors by providing them more tools to better achieve their courses objectives and the Institutional general education mission.

CIVIS is initially funded by a 5-year grant from the U.S. Department of Education. The institutionalization of this initiative beyond this grant will be the responsibility of UPRM’s Office of Academic Affairs. This will occur through Liaison Faculty from each of UPRM’s Colleges who will act as CIVIS personnel, maintaining links to other colleges and continue supporting the new perspective of liberal education at UPRM through integrated and interdisciplinary General and STEM education activities.

**PATHS TO STUDENT SUCCESS**

This first activity of CIVIS builds upon the following existing initiatives: 1) English and Spanish Writing Centers, 2) the GUEST K-12 Outreach and the Science on Wheels Projects and 3) Writing in the Disciplines; Ethics Across the Curriculum; and Social, Ethical and Global Issues in Engineering (SEGI).

*I. Bilingual Writing Center (BWC)*

UPRM undergraduate students are faced with a unique language challenge in that they are expected to master two languages: Spanish, their native language, and English. This bilingual emphasis often leads to insecurity in both languages which causes a drop in UPRM’s students written abilities [3]. Although UPRM’s major programs prepare students in their main areas of study, there is less attention dedicated to the teaching of communication skills throughout the course of their studies. This problem has been identified by prospective employers of our students and an internal UPRM needs-assessment report that demonstrated that many students have difficulties in creating substantive or coherent works in either English or Spanish. [4]. Furthermore, entering UPRM students have demonstrated a decline in their writing abilities on both national and state examinations, such as the College Board, SAT, and the Puerto Rican Achievement Test. The writing problems begin at the Pre-College level, evidenced by the low average scores of the English and Spanish Achievement Tests.

The writing component of Activity One of CIVIS entails a Bilingual Writing Center (BWC) that expands upon the English and Spanish Writing Center Pilot projects (EWC and SWC respectively) and the Writing in the Disciplines Initiative (WID) that began in 2005, 2007, and 2004 respectively. The BWC components have an emphasis in the development of writing as a professional and global skill. To meet the needs of the university student population, both the EWC and SWC effectively use peer tutoring to help students with their writing needs [5-6]. Student tutors work with students on individual and group bases by providing one-on-one, group, and referral tutoring services to help students create coherent texts in all disciplines. Professors can elect to send individual students or groups to the Center for group tutoring whenever necessary.

Both centers are viewed by students and faculty as useful mechanisms for writing help. This is demonstrated

by the increase of use of both Centers from the dates of opening to the present.

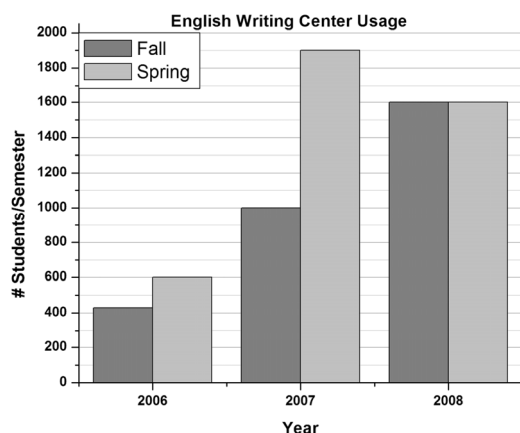


FIGURE 2  
Attendance to English Writing Center

Furthermore, of a survey conducted in 2007 two-thirds found that their writing skills had improved, and 30% found that they had improved skills in English after only one semester of using the EWC. Likewise, in this same survey, approximately 20% of the students found that the Center required more space and student tutors. These last comments may explain the drop in usage in 2008. In the SWC, the surveys demonstrate that the students who use the Center are pleased with the results with over 90% indicating that the SWC helped them with their writing in Spanish and over 95% recommending the Center to other students.

The BWC will also include expanded Writing in the Disciplines (WID) and Community Outreach sections which will provide professors and teachers with materials and practice for incorporating writing into non-writing specific classes at both the university and pre-college levels without sacrificing time for the core content of the courses. Workshops serve the double purpose of improving the writing abilities of UPRM students and the pre-college students of Puerto Rico. As part of the WID Initiative, writing workshops are held during the year for UPRM faculty and Pre-College teachers using writing as a means for learning and teaching of content material.

## II. Pre-College Outreach: Communicating Science, Engineering, and Arts to Pre-college Students

Effective learning often requires more than just making multiple connections between present and past information, it requires the restructuring of critical thinking abilities that allow the interchange between new and old ideas. Students may sometimes begin their university studies with intuition, original beliefs, and misconceptions that do not necessarily represent the realities of the world. It is Pre-College teachers who provide the insights and paths for transforming their students' knowledge, skills, communications abilities, and direct experience in the classroom itself. To facilitate

activities that can lead unerringly to enhance teachers and pre-college scientific communication and inquiry, UPRM has successfully established in several outreach programs a link between the university and the K-12 educational environments. The initiative, "Graduate and Undergraduate Students Enhancing Science and Technology in K-12 Schools" (GUEST K-12) is one such outreach programs whose purpose is enhancing the understanding of chemistry and technology of K-12 teachers and students. This program began fifteen years ago and has motivated the development of other outreach programs in Puerto Rico. The program employs graduate and undergraduate student fellows (i.e., tutors) who work and interact with K-12 teachers and students. Currently, three sub-initiatives form the relationship between university student fellows and pre-college students and provide the educational activities for K-12 teachers and students: (a) Science on Wheels (SONW) that uses demonstrations to promote and communicate the world of chemistry to teachers, students, and the general public [7-8], (b) Global Learning and Observations to Benefit the Environment (GLOBE), that helps integrate chemistry and environmental measurements into the pre-college curriculum and experimental discovery [9-11], and (c) Calculator Based Laboratory (CBL) which uses graphic calculator and sensors to incorporate mathematics, chemistry, and technology into the pre-college classroom.

Figure 3 shows the number of students per school entering to study a bachelor's degree at UPRM in science (biology, chemistry, agronomy, geology, biotechnology, and physics) from both visited (dark bar) and non-visited schools (light-color bar), from 2001 through 2005. This figure shows the impact of the interaction between pre-college students, teachers and student fellows. As can be seen, in 2001 the 226/324 ratio shows that 226 students were admitted to study a BS in science from the 324 schools not visited by the program, while the 101/90 ratio shows that 101 students were admitted from 90 schools belonging to the Pre-College program. These results demonstrate an exponential increase in the number of students admitted to UPRM from the schools impacted by the program. Thus, from 2001 through 2005 there is a 2.2 fold increase in the number of students from the participating schools, while the number of students from schools not visited by the expository program remains almost constant. A major and innovative component to this success is the graduate and undergraduate fellows who become actively involved as critical contributors, to the efforts focused on enhancing teachers' teaching practices and research knowledge.

Despite all these successes, the majority of Pre-college students in Puerto Rico are still extremely unfamiliar with the knowledge and information provided through UPRM's outreach programs. This limits students' and teachers' visualization and understanding of science and scientific processes present in areas such as: nanotechnology, biotechnology, atmospheric and oceanic studies, thus limiting the diversity of the student population of the University. Currently, nearly 60% of the entering students

come from the local geographic area, suggesting that an extensive outreach program is needed to increase the diversity and the number of students coming to UPRM from others cities in the Island.

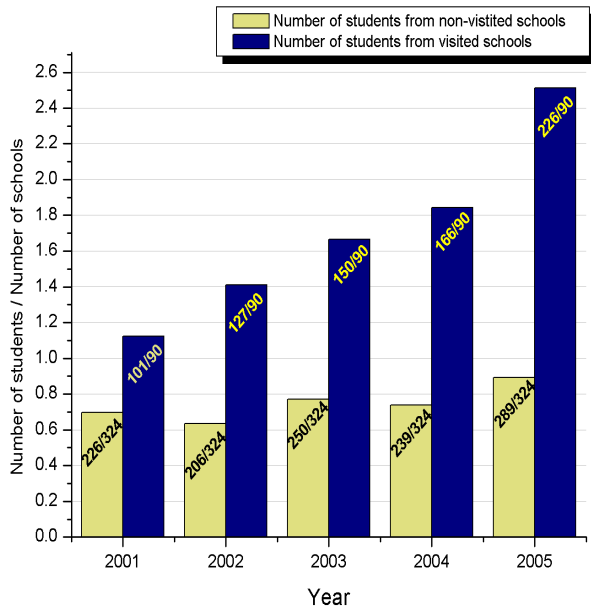


FIGURE 3

Ratio of students from visited and non-visited schools

Therefore, it is a goal at UPRM to close the gap between the Pre-college and university education so that more students can have the opportunity to pursue a degree in a STEM career or in arts, or business. The SONW philosophy is being expanded and institutionalized within CIVIS, so that it can be an even more effective means to close this education gap and provide knowledge and tools for students to make a more informed career choice, and increase their understanding of STEM fields and skills.

III. Student Learning Modules (SLM)

The third component of the Paths to Student Success activity is the development of Student Learning Modules (SLM) and their integration into content-specific courses. The Faculty of CIVIS will be responsible for developing student learning modules designed to integrate professional skills across the curriculum. This component is based on past successes within UPRM and current projects centered on a modular approach to education. For example, ethical considerations have been effectively integrated into the Engineering curriculum at UPRM. An ethics module is being used successfully in the curriculum of first year engineering students and also in capstone design courses [12-14]. UPRM’s Center for Professional Ethics has developed over 30 case studies on Ethics that are being refined and assessed in Engineering and Computer Ethics courses for integration across the curriculum in Engineering and Business. The success of the ethics integration in Engineering prompted the creation within the College of

Engineering of a Social, Ethical and Global Issues in Engineering Initiative [12], with a goal of providing a link between social sciences, humanities and engineering courses for engineering students. This initiative is using the modular approach to integrate social, ethical and global perspectives into engineering courses.

CIVIS personnel will expand these efforts by developing student learning modules (SLM) in topics such as global awareness, social impact, writing in the disciplines, financial and information literacy. SLM can be constructed from many sources such as books, movies, novels, journals, videos. Because the modules could be integrated into very diverse courses and for a diverse audience, they need to be stand-alone. Each module must start with the fundamentals, be generic and provide an overview of the topic, so that other professors can adapt and use them without the need for deep prior knowledge on the topic. Each College can expand the modules to specifically address the specific needs of their students. Professors can integrate the modules as they feel best complement their courses, depending upon the nature of the topic under discussion and the intended audience of the module. The modules are not intended for substituting any UPRM course, but to provide students with an awareness of various issues, as well as an introduction to the courses available at UPRM in each of the module topics. There are over 10 disciplines represented and various collaborators that will be working in module development. The SLM standard length will be 3 hours, although the time will remain flexible. Professors will receive guidance and help from CIVIS faculty on the integration of the modules in their specific disciplines, including from their respective College Faculty Liaison.

The SLMs will be created according to the templates of a General Education Toolkit (GET). The GET consists of an online environment to enable the sharing of best practices in general education by modeling the practice of open source code development. The GET not only allows for dissemination of the SLM, but also promotes the sharing of best practices in general education, and the institutionalization of the learning modules. The GET is based on the Ethics Across the Curriculum (EAC) Toolkit Project (NSF SES-0551779) whose idea is to build and support a community of educators who collaboratively develop educational resources and share best pedagogical practices via the Internet [15-16]. Because GET will serve as a continuous virtual retreat/workshop, it will build an online community for engineering, science, business and GE educators to come to GET, interact, and collaborate. Updating, refining and expanding the GET’s materials will become a self-sustaining process as the supporting community is formed and solidified by the very Toolkit it will come to sustain. Figure 4 shows a pictorial representation of a module, with multiple activities, hyperlinks, presentations, and both a user’s and an instructor’s sections. Readers can see some examples of the ethics and entrepreneurship modules in [17-18 cnx2].

**Moral Exemplars in Business and Professional Ethics**

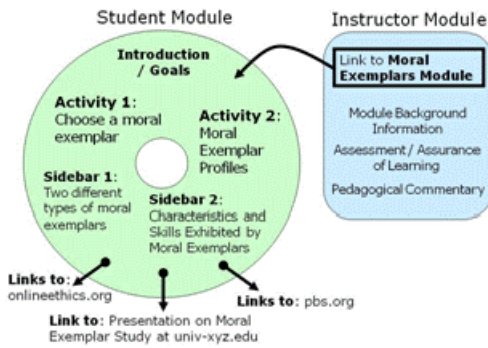


FIGURE 4  
Example of a Learning Module and its Structure

**SUSTAINABLE CONTEXT**

This is the second activity of CIVIS built upon the following UPRM expertise: 1) UPRM’s long history being a Land Grant school, 2) extensive and successful research resources in energy and tropical agriculture. A sustainable future is a vision desired by all sectors in society. A classic definition of sustainability states that the present generation should meet its needs without compromising the ability of future generations to meet theirs [19]. A balance among the social, economic and environmental dimensions of any issue must exist in a sustainable future as shown in Figure 5.

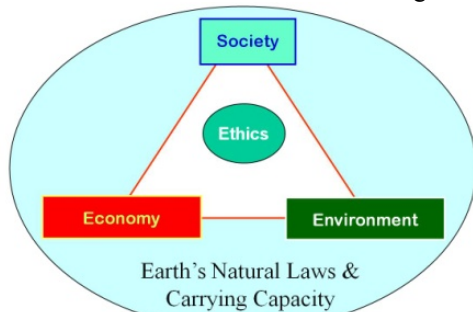


FIGURE 5  
Sustainability and Ethics

Any of the proposed schemes for attaining a sustainable future will require sustainable methods and practices in both agriculture and energy. The components described in this section will improve the STEM skills of UPRM students through a sustainable learning context that provides not only contents, but also a motivation and a global perspective of their education in engineering and agricultural sciences. Within this context students are also expected to deepen their general education skills, since they need a holistic perspective to better grasp the two sustainability components discussed below.

*I. Sustainable Energy Initiative*

UPRM’s strategic plan [20] includes in its mission “To provide excellent service that will contribute to the sustainable and balanced development of our society.” As part of that mission objective, a sustainable campus

initiative, called Green Campus started at UPRM in February 2007. The Green Campus initiative follows a nationwide trend in college campuses to evaluate their ways of doing business so that resource utilization and practices are more sustainable [21]. On the other hand, the Institute for Tropical Energy, Environment and Society (ITEAS in Spanish) was created in January 2007 to combine the energy expertise from different disciplines at UPRM to address the challenges of a sustainable energy future [21-22].

In line with the Green Campus Initiative and to provide academic support to the research projects in ITEAS, a Sustainable Energy Initiative (SEI) has been established within Activity Two to provide a global and practical context for the development of professional skills. A core philosophy of this component will be that the search for solutions to the global energy dilemma should be assumed as a moral obligation. This new perspective on energy will inspire students to form a new perspective on energy from which a more sustainable future may emerge and be passed on to the next generation [23]. Furthermore, a more responsible and aware graduate will emerge from UPRM, prepared to contribute to the solution of the Nation’s energy problems from a global and interdisciplinary perspective. The SEI will have three main activities: Development of energy-related Student Learning Modules, Establishment of a Student Mentoring Program, and Support for Sustainable Energy Laboratories including a novel Community Outreach Laboratory jointly with a NGO.

*II. Sustainable and Tropical Agriculture*

Puerto Rico, Central America, tropical South America and the Caribbean Islands need to increase agricultural production while preserving both agriculture and other natural resources. The lack of advanced research to propose relevant, scientific alternatives is common to the countries of this region. While UPRM is a leading institution of higher learning in the region, the lack of a doctoral program forces our own graduates in agricultural sciences, as well as students from other institutions in the region, to either change areas of study or go to other places for their doctorate. The result is that too few Puerto Rican students pursue a Ph.D. in agriculture as is demonstrated by the very small representation of Puerto Ricans and Hispanics among doctoral graduates in agricultural sciences in the United States. The College of Agricultural Sciences is proposing a Ph.D. program in Tropical Agriculture to enhance its research programs and improve the quality of graduate offerings. The program will promote and enhance scientific research that solves problems affecting agriculture and agricultural industries in Puerto Rico, the Caribbean and the World. It will also expand the scientific knowledge base, particularly as it relates to the ecologically and economically sustainable use of agricultural and natural resources. This component of the Sustainable Context activity is thus aligned with the improvement of STEM education at UPRM.

Existing facilities at the Alzamora Experimental Farm will be improved to provide renovated space for four teaching and research laboratories, classrooms, one meeting room, one administrative office and an office for the doctoral students. There will be an additional laboratory in each of the following areas: Plant Breeding / Plant Sciences, Animal Sciences, Plant Protection, and Soil and Water Resources. The facilities will be administered by the Ph.D. program director, and the Program's Graduate Committee. The facility will also be used by students and faculty from collaborative Ph.D. programs with other universities.

### CONCLUSIONS

CIVIS is a Center for Resources in General Education for students and faculty. It is firmly rooted on the success of individual efforts in K-12 outreach, writing projects, instructional modules, sustainability initiatives and STEM education at UPRM. The initial focus of CIVIS is on providing better resources to STEM students, as a way to broaden their understanding of the context and impact of their professions, and also as a way to encourage retention in STEM fields, by providing connections among the various parts of their curriculum. The first activity "Paths to Student Success" has three components that address the major goals of the University's General Education philosophy. The second activity "Sustainable Future" presents a sustainable learning context that provides both contents and motivation for students regarding their STEM education in engineering and agricultural sciences, while providing an opportunity to deepen their general education skills. CIVIS represents an umbrella to better coordinate, not control, on-going efforts, providing at the same time resources for the expansion of the scope and depth of such efforts. UPRM is committed to institutionalize the Center, thus ensuring its existence and eventually benefitting the whole student body at UPRM.

### ACKNOWLEDGMENT

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