

THE PUERTO RICO COLLABORATIVE FOR EXCELLENCE IN TEACHER PREPARATION (PR-CETP): DEVELOPMENT OF A KNOWLEDGE BUILDING COMMUNITY OF PRACTICE

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Extending the Science and Mathematics Education Reform to Teacher Preparation Programs

Until recently, the predominant practice of science and mathematics education consisted of communicating the results obtained by scientists and researchers to students. While knowledge of these results is important, a lack of understanding of the knowledge building processes followed by scientists and mathematicians hinders the development of conceptual understanding and the capability for the proper application and creation of knowledge. Furthermore, this approach to education thwarts the development of the learning capabilities needed in the global, knowledge-based society in which we live. The Puerto Rico Collaborative for Excellence in Teacher Preparation (PR-CETP) has been a crucial step in overcoming the results-centered view of science and mathematics education, by serving as a catalyst for the transformation of teacher preparation programs on the Island towards the adoption of a constructivist approach to teaching and learning, which asserts that all students can learn if actively involved in the creation of their own knowledge.

PR-CETP is one of several interrelated systemic K-16 reform initiatives in Puerto Rico, co-sponsored by the National Science Foundation and spearheaded by the Resource Center for Science and Engineering of the University of Puerto Rico system, in alliance with the major universities throughout the Island, the Puerto Rico Department of Education, and numerous other public and private organizations in Puerto Rico and abroad. PR-CETP builds mainly on two systemic endeavors: the K-12 reform implemented by the Puerto Rico Statewide Systemic Initiative (PR-SSI), and the Puerto Rico Louis Stokes Alliance for Minority Participation (PR-LSAMP) which focuses on the reform of undergraduate education in science, mathematics, engineering, and technology. The articulation of these systemic reform initiatives into a single coherent strategy has been critical to ensure a synergistic effect that advances the transformation of the K-16 science and mathematics educational system throughout the Island.

The PR-CETP journey began close to four years ago when a group of professors from the main institutions that prepare science and mathematics teachers, most of whom had been involved in PR-SSI and or PR-LSAMP, realized the need to do something about the gap between the K-12 reform and teacher preparation programs. If future teachers were expected to sustain the K-12 reform, the transformation of teacher preparation programs was necessary. The urge to reform teacher preparation was spurred by the evidence produced by evaluation efforts of both PR-SSI and PR-LSAMP, which pointed toward the effectiveness of the constructivist approach in promoting conceptual understanding among students. The conception of PR-CETP was nurtured by many of the experiences, resources, and strategies developed through these initiatives, which were incorporated into the design of PR-CETP through a planning grant from the NSF. The collective dialogue and critical reflection of science, mathematics, and education professors, K-12 teachers, and future teachers on the prevailing situation of teacher preparation programs on the Island served as the foundation for the elaboration of the *Blueprint for the Reform of Science and Mathematics Teacher Preparation Programs in Puerto Rico*. The *Blueprint* sets forth a common vision of the principles and strategies to be enacted in order to ensure the alignment of teacher preparation programs with the local and national standards of excellence for K-12 science and mathematics [1-7]. In 1998, the NSF approved the PR-CETP proposal, which gave way to the full-fledged implementation of the reform of teacher preparation programs in Puerto Rico.

PR-CETP: Partners and Strategies

The teacher preparation institutions brought together through PR-CETP include: the University of Puerto Rico (UPR) at Río Piedras, UPR at Mayaguez, UPR at Cayey, and UPR at Arecibo; the Inter American University System (four campuses), the University of the East of the Ana G. Méndez University System, and the Pontifical Catholic University of Puerto Rico. While each one of these institutions target particular disciplines and educational levels in their teacher preparation programs, they all share a deep commitment to the improvement of science and math education. The diversity of these institutions constitutes one of the strengths of the PR-CETP alliance, as each one brings unique contributions and assets to the reform, thus optimizing the cross-fertilization of efforts. Other fundamental partners in the PR-CETP endeavor are the Puerto Rico Department of Education, the Arecibo Observatory, the International Institute of Tropical Forestry, the Puerto Rico College Board, and local industries including Bristol Myers Squibb, SmithKline Beecham, and AMGEN. The partnership with the Puerto Rico Department of Education facilitates the collaboration of K-12 teachers, and access to the 25+ schools that serve

as Regional Centers for Professional Development and Dissemination of the K-12 Science and Mathematics Reform, developed through the PR-SSI, where exemplary teaching practices are modeled.

The interinstitutional structure of PR-CETP allows for an optimal collaboration level among all members of the alliance. To facilitate this collaboration, the Center for Excellence in Science and Mathematics Teacher Preparation was established at the Resource Center for Science and Engineering, as a central coordinating and communication unit that also provides overall leadership and coherence for the PR-CETP reform. All participant universities are represented in the PR-CETP Interinstitutional Committee, which serves as the steering group for the initiative. Each university has established its own PR-CETP Institutional Committee that integrates participants from science, mathematics, and education faculty, breaking the traditional disciplinary boundaries that segregate the faculty and prevent the cross disciplinary collaboration that is needed to transform the preparation of future teachers; particularly, to articulate the content and methodology of science and mathematics teaching.

The key foci of the PR-CETP reform are: (1) the curricular reform of teacher preparation programs based on constructivist education principles; (2) the enhancement of science, mathematics, and education faculty knowledge and skills in the constructivist approach to teaching, learning, and assessment; (3) the development of student support mechanisms to foster a smooth transition from recruitment to induction into teaching; (4) the establishment of institutional policies and practices to sustain the transformation of teacher preparation programs; and, (5) the evaluation of the processes and outcomes of the transformation of teacher preparation programs. These foci are organized into distinct programmatic components that are closely interdependent and feed into each other. An additional component of the PR-CETP is the NSF Teaching Scholars Program which provides incentives for over 25 outstanding K-12 science and mathematics education students, and supports their development as future leaders of the K-12 educational community.

As with all reform efforts, PR-CETP has had to formulate strategies that are highly effective in facilitating profound changes at all levels. In undertaking this challenge, it has been particularly important to identify and implement strategies that are successful in overcoming the obstacles, and resistance, that are a natural element of all reforms that entail paradigmatic transformations. The main strategy enacted by the PR-CETP to usher these changes has been the creation of a knowledge building community of practice, in which new knowledge is constructed

among members through various collaborative processes coordinated and facilitated by the Center for Excellence in Science and Mathematics Teacher Preparation. Susan Millar, member of the PR-CETP National Visiting Committee, and Director of the LEAD Center University of Wisconsin-Madison, has noted in her 2001 site visit report that the PR-CETP promotes the development of this type of community through activities (retreats, workshops, congresses, project meetings) that foster a sufficiently safe environment in which faculty are able to reflect on shortcomings in their own teaching from genuinely new perspectives [8]. According to Millar, the concept of a knowledge building community of practice as developed by Derry and DuRussell [9] is a useful model for understanding how the PR-CETP works: through processes of negotiation, argumentation, and information sharing facilitated by apprenticeship and mentoring, participants from heterogeneous backgrounds are able to evolve new ideas, methods, and tools that allow boundaries to give way to new constructs, language, and behavioral norms that shape and are shaped by teamwork. As a result of working together, each individual team member's mental models of group tasks, community constructs, and the community itself become more aligned. Using a term coined by Schon [10], she points out that faculty are becoming reflective practitioners of the art and science of teaching. Millar indicates that, "As individual reflective practitioners, they are better able to teach what they know to others, and also more able to abandon practices that do not work, and further develop those that do." [8]

To know more about the efforts and products of the PR-CETP, please visit our webpage at <http://cetp.crci.uprr.pr> or contact the individual authors of the articles.

The Articles

The articles included in this issue are a sample of the diverse initiatives supported and promoted through PR-CETP, such as: science and mathematics course transformations based on a constructivist approach to teaching and learning; the development of innovative courses for science education majors; creation of new courses for cooperating teachers who supervise future teachers; research on the effectiveness of the NSF Teaching Scholars Program; and the PR-CETP program evaluation. These articles should give the readers a clear idea about what is happening in the PR-CETP promoted reform with specific examples in various areas of science and mathematics. The investigative approach PR-CETP follows in order to improve the effectiveness of our activities is exemplified in the article about the NSF Teaching Scholars—an article that started as a class project. Our Project Evaluator, Milagros Bravo, describes in detail the efforts of

one of the key components of PR-CETP. The assessment and evaluation component has been a major driving force, guide, and cohesive factor of PR-CETP from its beginnings.

We hope that in sharing our successes and our struggles in the implementation of such an ambitious and complex enterprise through the articles presented in this issue, we are able to stimulate and encourage others who are interested in embarking in similar systemic endeavors. ■

Bios

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