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# After So Much Effort: Is Faculty Using Cooperative Learning in the Classroom?

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## ABSTRACT

Cooperative learning (CL) has been lauded over the years as one of the most successful teaching/learning strategies employed by professors of science, mathematics, engineering and technology (SMET) in institutions of higher education throughout Puerto Rico. The goal of the research project presented here was to examine the effectiveness of CL as perceived by SMET faculty who use it in the classroom at member institutions of the Puerto Rico Louis Stokes Alliance for Minority Participation (PR-LSAMP). As a long-term goal, PR-LSAMP researchers desired to use the findings to understand and address the training needs of their SMET faculty. Data was gathered on faculty members' use of CL and their perceptions of the effect of CL strategies on student performance and attitudes. Principal survey results showed that over 60% of faculty felt confident in their knowledge of CL theory and role assignment, although somewhat less confident in conflict resolution, grading activities and individual accountability. Fifty percent (50%) reported using the strategy very often or often (primarily for the exploration and learning of new concepts, in team projects and presentations, and in quizzes). Forty-one percent (41%) described their experience in implementing CL as excellent or very good. In addition, faculty perceived more positive than negative changes in student performance and attitudes. Based on study results, researchers concluded that the success of cooperative learning in PR-LSAMP institutions signals the beginning of a paradigm shift in the islands' educational system. In addition, results of the study were subsequently used to develop a cadre of SMET faculty to train their peers in various areas of cooperative learning.

## I. INTRODUCTION

Since 1991, the Resource Center for Science and Engineering of the University of Puerto Rico has been coordinating the NSF-sponsored Puerto Rico Louis Stokes Alliance for Minority Participation (PR-LSAMP). This alliance consists of the main higher education institutions in Puerto Rico. Its principal goal is to substantially increase the quantity and quality of students receiving baccalaureate degrees in science, mathematics, engineering and technology (SMET) fields. The Alliance also works toward achieving the long-term goal of increasing the number of students who earn doctorate degrees in SMET fields. The core of the PR-LSAMP is its program for curriculum innovation initiatives, which promote the revision of SMET courses and the use of successful teaching/learning strategies to improve student performance. In those initiatives, cooperative learning (CL) has shown to be the most successful strategy for reducing attrition rates in SMET courses.

Over the years, the Alliance has conducted numerous workshops and seminars, and has had the opportunity to document many individual success stories in which the implementation of this strategy has had positive outcomes. However, after putting so much effort into developing the CL aspect of our curriculum innovation initiatives, we wanted to further examine its success. We were interested in gaining a range of information from the SMET faculty who use CL in the classroom, including professors' level of satisfaction with their knowledge of and training in CL, their comfort level in using the approach, and their perceptions of the success of CL in terms of student performance and attitudes. In addition, the UPRM Curriculum Innovation Center and the Center for Professional Enhancement, supported by PR-LSAMP, hoped to use the findings to better understand and address the training needs of the Alliance's SMET faculty.

The survey, which was conducted in 1998, suggested that many SMET faculty members across the PR-LSAMP membership are using cooperative learning strategies to some degree, as part of their teaching methodology. Although incorporating cooperative learning in the SMET classroom cannot be directly correlated with the increase in the number of SMET baccalaureate degrees awarded, it certainly shows a shift in the educational paradigm in which faculty have become more receptive to an active teaching/learning strategy.

Our survey results indicated that both new and experienced faculty seem to be using the strategy, and at all levels. Almost two-thirds of faculty members learned about the strategy by means of formal courses, workshops and seminars, and almost half of those educational activities were 10 hours or less in duration. More importantly, the study indicated that faculty use cooperative learning frequently during lectures and that CL activities are primarily

directed toward the learning of new concepts, team projects and presentations, quizzes, and the exploration of concepts. Over 60% of faculty felt confident in their knowledge of CL theory and role assignment, although somewhat less confident in other areas, such as conflict resolution, grading activities and individual student accountability. Overall, faculty perceived more positive than negative changes in student attitudes.

The study demonstrates the role and impact that the PR-LSAMP CL project has had in the teaching/learning culture at institutions of higher education in Puerto Rico. One of the successes, and long-term impacts, of this project has been the development of a cadre of SMET faculty members who have become CL peer trainers in what we call the "training the trainers" movement. That training group is now sharing its experience and success stories with other professors in Puerto Rico, as well as with educators worldwide via journal publications, seminars, and workshops. We at the PR-LSAMP believe the development of that cadre of peer trainers constitutes the beginning of a paradigm shift in our education system.

## II. BACKGROUND

According to Charles Claxton and Patricia Murrell,<sup>1</sup> studies of learning styles have concentrated on students' preferences or orientations in each of the following four areas: personality, information processing, social interaction and instructional methods. Each of these areas (so-called "levels" of basic personality characteristics) affects learning and, as a distinct research area in the field of education, each has generated theories and models of learning. Richard Felder and Linda Silverman<sup>2</sup> believe that learning takes place through a combination of these characteristics. A learner can be classified according to his or her learning style, that is, in accordance with his or her preferred manner of learning. It is also known that teachers tend to teach according to *their* preferred learning styles. If there is a mismatch in preferred learning style between learner and teacher, poor student performance, a high attrition rate and faculty frustration result.<sup>2</sup>

There are many teaching strategies focused on specific learning styles that are recommended in the literature. A successful broad approach is cooperative learning. Felder<sup>3</sup> defines cooperative learning as "the activity wherein students work in fixed groups on structured learning tasks." Effective cooperative learning must have, among other things, positive interdependence, in which students work toward a common goal and rely on one another to accomplish that goal, and individual accountability, in which each student is responsible for specific tasks. The effects of this strategy on student learning have been extensively documented in the literature.<sup>4-8</sup> Researchers agree that cooperative learning can produce positive effects on achievement but disagree on the conditions under which the approach is effective.<sup>9</sup>

The Louis Stokes Alliances for Minority Participation (LSAMP) program is a multi-disciplinary, comprehensive, undergraduate program sponsored by the National Science Foundation to increase substantially the quantity and quality of participating students receiving baccalaureate degrees in science, mathematics, engineering and technology (SMET) fields. LSAMP facilitates achievement of the long-term goal of increasing the number of students who earn doctorates in SMET fields,

especially those who choose to take faculty positions at colleges and universities.

The LSAMP project supports undergraduate education systemic reform in alliances that include partners from two- and four-year higher education institutions, businesses and industries, national research laboratories, and local, state, and federal agencies. In addition to this principal focus, LSAMP projects also give consideration to the critical transition points in SMET education: high school to college; 2-year and 4-year college; undergraduate study; and graduate-to-faculty career.

Since 1991 several higher education institutions in Puerto Rico, led by the University of Puerto Rico Resource Center for Science and Engineering, have been collaborating successfully in the Puerto Rico LSAMP program. In a period of seven years, the PR-LSAMP institutions achieved a 60% increase in the number of SMET baccalaureate degrees awarded, as shown in Figure 1.

Two of the most critical and successful components of this program, which have led to the improvement of the effectiveness and efficiency of SMET undergraduate programs, are curricular revision and innovation, and the use of successful teaching/learning strategies. Due to institutional diversity among the members of the Alliance, each institution is responsible for its own activities. Nevertheless, two Centers offer assistance island-wide to promote and provide leadership and direction towards a common goal. They are the PR-LSAMP Curriculum Innovation Center and the UPRM Center for Professional Enhancement, co-sponsored by PR-LSAMP. The Curriculum Innovation Center facilitates the assessment, development and innovation of SMET curricula. The Center for Professional Enhancement provides opportunities for faculty development in the areas of teaching, learning, assessment and classroom research through seminars and workshops year round.

One of the most successful strategies for reducing the attrition rate in SMET courses across the Alliance has been cooperative learning. Many faculty members have participated over the years in workshops and seminars, and success stories in reducing student attrition rates have been documented. For example, Figure 2 shows a comparison of improvement in grade distribution of various SMET "gatekeeper" or "bottleneck" courses (i.e., courses with high attrition rates in the freshman and upper levels) with the use of an active learning approach. A compendium of strategies put together by several SMET faculty members in 1995 includes successful strategies used in various SMET courses.<sup>10</sup>

After so much effort, the PR-LSAMP wanted to examine the impact of its endeavor by measuring how many faculty members on the island were effectively using the CL strategy. We were interested in those faculty members' perceptions about CL and about the results they have achieved. The Curriculum Innovation Center and the Center of Professional Enhancement decided to conduct a study throughout the Alliance institutions in Puerto Rico.

## III. SURVEY OBJECTIVES AND METHODOLOGY

The objectives of this survey were:

- To determine the level of knowledge of, and education in,

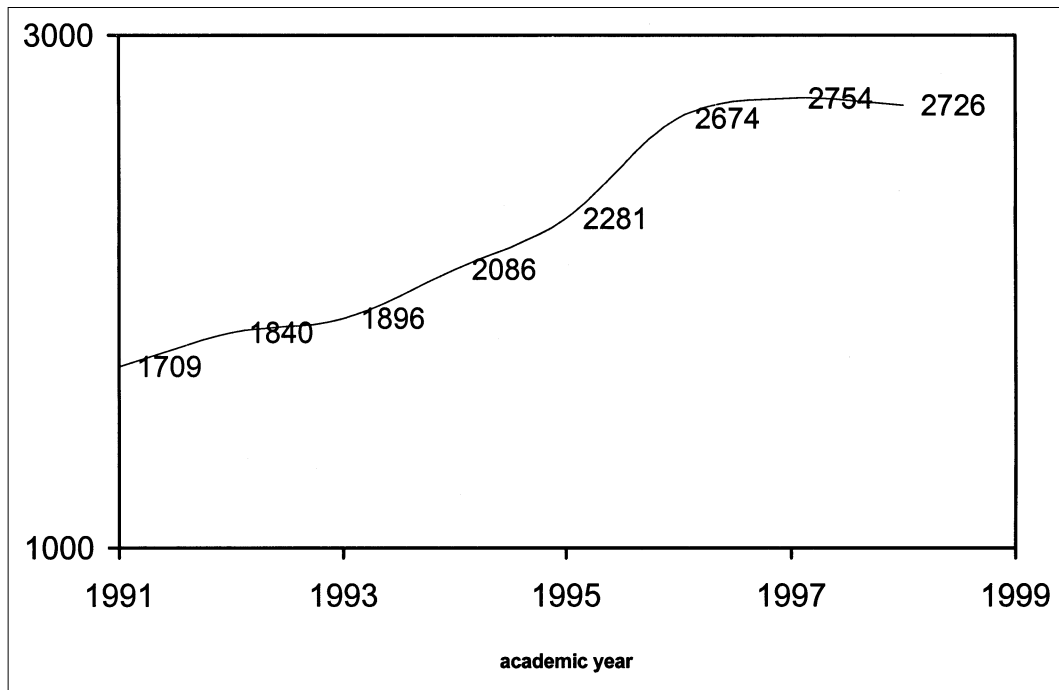


Figure 1. PRAMP degree production curve.

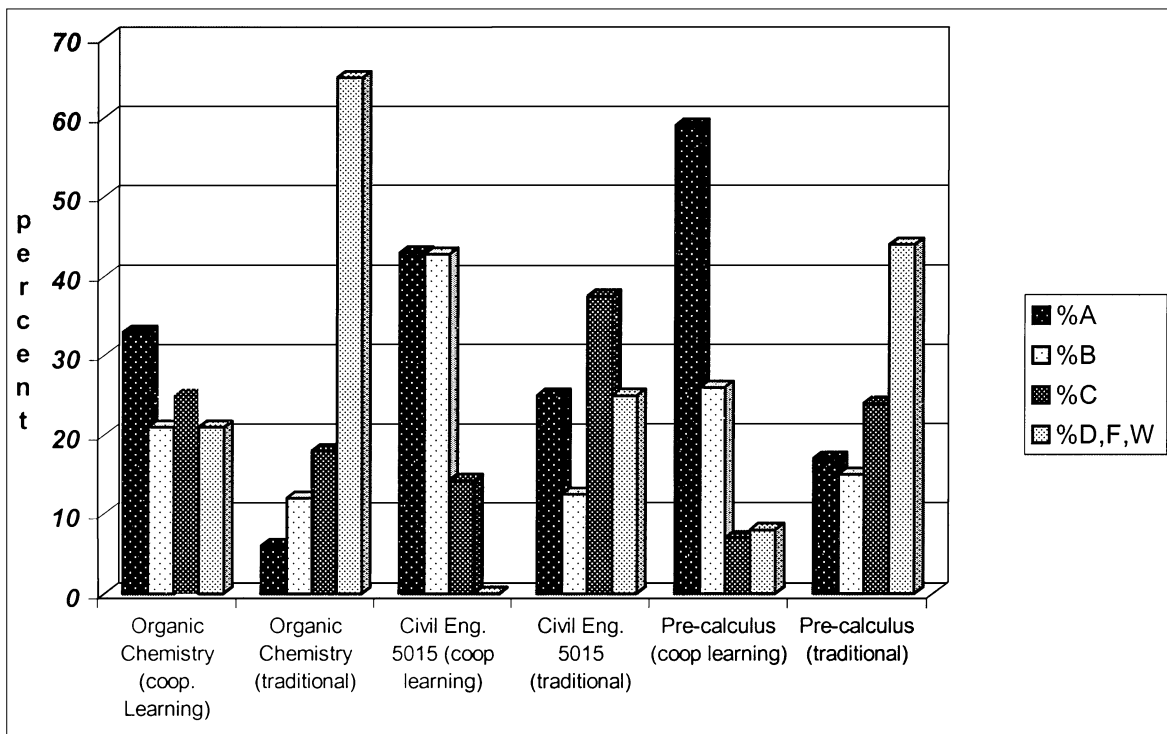


Figure 2. Grade distribution in SMET courses.

CL among SMET faculty at member institutions of PR-LSAMP.

- To determine the extent of CL usage in the classroom, with regard to type and frequency of activities used.
- To identify areas of need for professional development in CL among PR-LSAMP SMET faculty.

- To inform stakeholders of the impact of this teaching/learning strategy.

With the help of an education and survey specialist, a short survey was developed and distributed among SMET faculty members at AMP institutions in Puerto Rico. Fourteen (14) campuses of five (5) AMP universities participated. Eighty-five (85)

TEACHING EXPERIENCE	PERCENT OF RESPONDENTS
Less than 5 years	20
6-20 years	48
More than 20 years	14
Teaching basic courses	50
Teaching advanced undergraduate courses	38
Teaching graduate courses	12

Table 1. Survey faculty profile.

surveys were returned, which represented 8% of the SMET faculty population.

#### IV. RESULTS

Of the 85 faculty members who returned the survey, 78% were from various campuses of the University of Puerto Rico. Table 1 shows the survey's faculty profile:

The survey indicated the sources of faculty members' exposure to CL. Sixty-two percent (62%) of the faculty had learned about CL through formal courses, workshops and conferences; 36% had learned through self-education. A PR-LSAMP institution or the PR-LSAMP project itself sponsored 69% of the faculty development activities attended by surveyed faculty members. Forty-nine

percent (49%) of those surveyed reported an average of 0–10 contact hours of training” and 26% reported between 11–20 hours. Fifty-two percent (52%) of those surveyed had last attended a CL development activity six (6) months to two years earlier.

The survey attempted to discover how the academic community felt about the education and training in CL that they have received, and how valuable that training has been in preparing them to use CL in the classroom. The level of faculty comfort and satisfaction with their knowledge of CL theory and activities is illustrated in Figure 3. Over 60% of faculty members surveyed felt confident in their knowledge of CL theory and role assignment, and felt somewhat less confident in other areas, such as conflict resolution, grading activities and individual accountability.

Frequency of use of this teaching/learning strategy is shown in Figure 4. Fifty percent (50%) of those surveyed reported using the

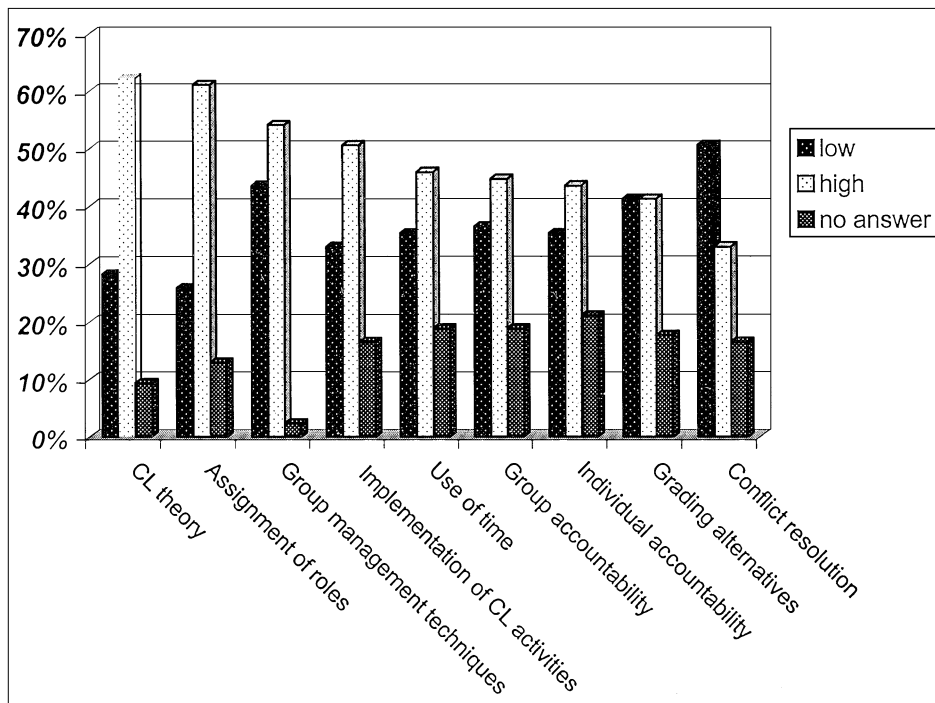


Figure 3. Level of satisfaction with knowledge of CL areas.

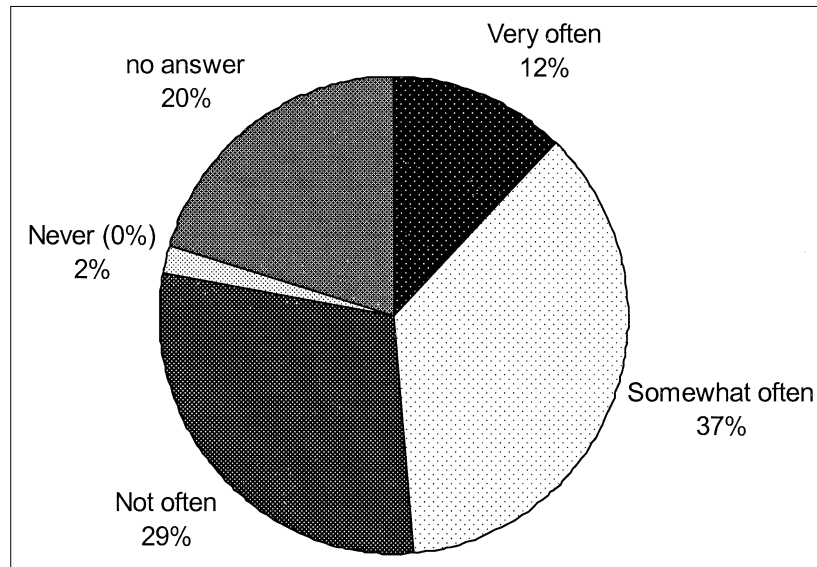


Figure 4. Frequency of using cooperative learning in class.

strategy very often (over 60% of the time) or often (30–60% of the time). Forty-one percent (41%) described their experience in implementing CL in the classroom as excellent or very good, whereas only 5% said it was unsatisfying (see Figure 5). CL activities were most frequently implemented for the learning of new concepts, team presentations in class, quizzes, and the exploration of concepts (see Figure 6).

Comments and suggestions made by the survey sample indicated faculty members' perceptions of changes in the performance and attitudes of students learning under a CL strategy (see Appendix A for complete comment lists). In general, faculty perceptions of student performance were positive. Typical comments addressed areas such as class participation, study habits, performance on tests and quizzes, comprehension of concepts, development of leadership and teamwork abilities, and attrition. Typical comments included:

- “The students performed better in the areas where CL was used.”

- “Class participation increases drastically. Eighty-five percent to 95% participates regularly after implementing CL activities.”
- “My average grades moved towards B's and C's from C's, D's and F's.”
- “Students study more.”
- “Work in less time, more efficiently.”
- “Passing rates increased.”
- “Students enjoy working in groups but some students leave the work to the more dynamic students.”

Typical faculty perceptions of the attitudes of students learning under a CL strategy were reflected in comments such as:

- “Students express satisfaction and enthusiasm.”

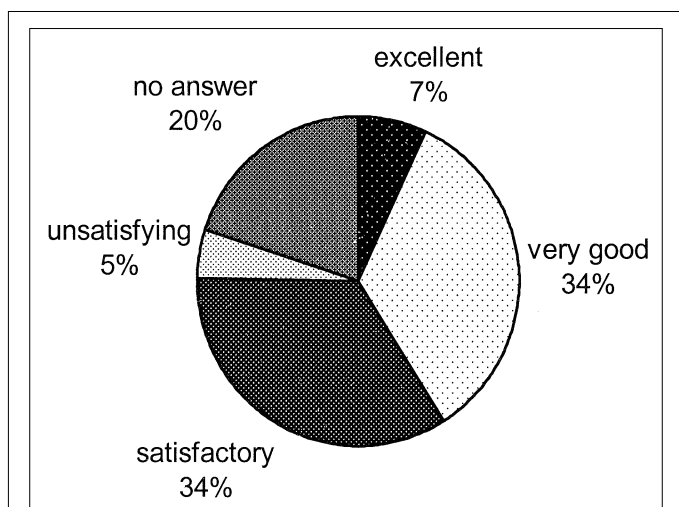


Figure 5. How do you describe your experience in implementing CL in your classroom?

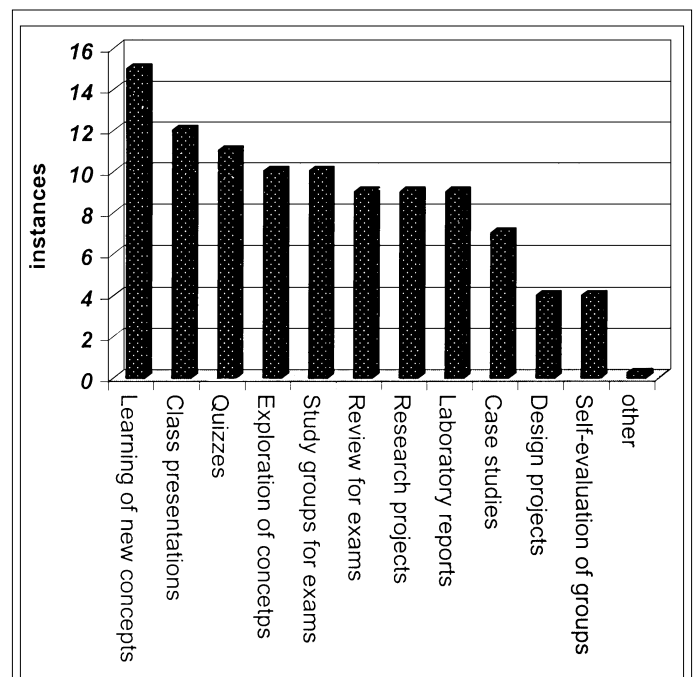


Figure 6. Cooperative learning activities implemented.

- “More positive attitudes, alertness.”
- “Students feel more motivated and free to ask questions and participate in class.”
- “Average students often realize they are very talented in things other than taking exams.”
- “Students participate more, come to the office more often; none of my students withdrew from my courses.”
- “There is an extremely high sense of achievement when a tangible product or goal is reached.”

A more critical observation was that, “The good students do not like to work in heterogeneous groups. They feel happy if everyone in the group is very good. They complain a lot if there are one or two non-fast learning students in the group.”

Forty-five percent (45%) of the faculty surveyed believed that there are no negative results in CL implementation, while 29% perceived some negative effects. Some of the comments regarding negative effects, and possible reasons for them (see Appendix B for complete list of comments), included:

- “You have to give [the students] enough time, otherwise they will not enjoy the activity.”
- “Some [students] feel they are putting too much time [into] this type of learning process.”
- “. . . Few teachers apply CL and many have a negative attitude toward it.”
- “The typical situation is of one student not participating, or leaving all the work to others who are too responsible to leave that ‘role’ unattended.”

## V. CONCLUSIONS

The 1998 survey suggests that many SMET faculty members across the PR-LSAMP are using, to varying degrees, cooperative learning as part of their teaching methodology. Although incorporating cooperative learning in the classroom cannot be directly correlated with the increase in the number of baccalaureate degrees, it certainly shows a shift in the educational paradigm where faculty has become more receptive to an active teaching/learning strategy. Both new and experienced faculty seems to be using the strategy at various levels. Almost two-thirds of faculty members learned about the strategy by means of formal courses, workshops and seminars, and almost half of these were 10 hours or less in duration. More importantly, the study indicates that PR-LSAMP SMET faculty members use cooperative learning frequently during lectures and that CL type activities are primarily directed towards the learning of new concepts, team projects and presentations, quizzes, and the exploration of concepts. Over 60% of faculty members surveyed felt confident in their knowledge of CL theory and role assignment, and somewhat less confident in other areas, such as conflict resolution, grading activities and individual accountability. In addition, faculty members perceive more positive than negative changes in student attitudes.

The study demonstrates the impact and role that the PR-LSAMP project has had in the teaching-learning culture at higher education institutions in Puerto Rico. One of the successes and long-term impacts of this project has been the development of a cadre of SMET faculty members who have become peer trainers, in what we call the “training the trainers” movement. These professors are sharing their experiences and success stories with other faculty in

Puerto Rico, as well as with educators elsewhere through journal publications, seminars, and workshops. We at the PR-LSAMP believe these results indicate the beginning of a paradigm shift in our education system.

## ACKNOWLEDGMENTS

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