

## The Impact of a Professional Development Program on Teachers' Self-Efficacy

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This presentation examines the impact of the Rice University School Mathematics Project's (RUSMP) Summer Program for PreK-12 teachers on teachers' self-efficacy. Results support the prediction that manipulation of self-efficacy antecedents increase teacher self-efficacy. How to utilize RUSMP's model for catalyzing large increases in teacher self-efficacy is discussed.

Professional development programs are widely recognized as being successful in their ability to augment teachers' feeling of confidence for teaching mathematics. An individual's confidence for performing a task has been termed "self-efficacy" by Bandura (1986), which is specifically defined as "...people's judgments of their capabilities to organized and execute courses of action required to attain designated types of performances. It is concerned not with the skills one has but with judgments of what one can do with whatever skills one possesses" (p. 391).

### *Self-Efficacy*

Research indicates that self-efficacy is an adaptive, dynamic construct. That is, it is possible to enhance an individual's self-efficacy in a given performance domain, particularly those with lower baseline levels of self-efficacy, if they are provided with the proper environment and motivation. The literature has outlined four modalities through which self-efficacy can be effectively influenced: physiological and emotional arousal, verbal persuasion, mastery experiences, and social modeling. Arousal can affect one's self-efficacy through its effect on anxiety. Verbal or social persuasion, discussion of the task and the individual's performance (e.g. in the teachers' lounge, or at professional conferences) can impact one's confidence in performing the task. Mastery experiences

are opportunities an individual has to demonstrate their ability, and being given chances to reach for and attain achievable goals can lead to greater self-efficacy. Social modeling, the observation of how high-performing colleagues handle relevant tasks, can also enhance self-efficacy.

Enhancing self-efficacy has been repeatedly found to improve performance and productivity (Bandura, 1997). High self-efficacy is associated with setting more rigorous and challenging goals for oneself, and subsequently putting more effort into planning, strategy development, and ultimately better performance outcomes (Earley & Lituchy, 1991). Looking specifically at education, possessing high self-efficacy leads to positive outcomes for teachers, which in turn allows for positive student outcomes. Students reap the benefit of more confident teachers, as evidenced in both measured ability and attitudinal variables. Research has demonstrated that students who have been taught by teachers with high self-efficacy as compared to teachers with low self-efficacy score better on the Iowa Test of Basic Skills (Moore & Esselman, 1992). Students not only report an increased interest in school, but are also more likely to retain a perception that what they are learning is important, when they are taught by teachers with high self-efficacy (Tschannen-Moran, Woolfolk, & Hoy, 1998).

### *Self-Efficacy and Education*

Preliminary research on self-efficacy in the domain of education has indicated that teachers with high self-efficacy employ teaching techniques and behaviors that uphold the NCTM *Principles and Standards for School Mathematics* (2001) for mathematics education (Smith, 1996). Teacher self-efficacy and NCTM's *Standards* are intimately related. Past research has demonstrated that high teacher self-efficacy has been

correlated with a number of positive teaching outcomes. Teachers who are high in self-efficacy employ more interactive instruction techniques in their classrooms (Smylie, 1989), and are more open to innovation and new ideas in the educational context (Stein & Wang, 1988). Students learn best through dialogue, discussion, and interaction. Teachers with high self-efficacy are much more likely to provide opportunities for student communication. Using a variety of models to meet the needs of all learners (working individually, in pairs, and in groups), is also much more likely to be upheld by a teacher with high self-efficacy. Research has shown that high self-efficacy teachers are more likely to divide the class into small groups rather than teach to the class as a whole, thereby allowing the opportunity for more individualized instruction (Tschannen-Moran, Woolfolk, & Hoy, 1998).

Unfortunately, studies have failed to more explicitly investigate the link between self-efficacy and NCTM's *Standards*. The demonstrated importance of raising teacher self-efficacy warrants more research in the realm of mathematics education. The purpose of this presentation is to examine antecedents of self-efficacy that can be manipulated by professional development programs in order to increase teacher self-efficacy.

Additionally, the presentation seeks to explore the specific outcomes of high teacher self-efficacy within the classroom, as related to NCTM's *Standards*.

#### *The Rice University School Mathematics Project*

This study examined the impact of the Rice University School Mathematics Project's (RUSMP) Summer Campus Program for PreK-12 teachers on participating teachers' self-efficacy. RUSMP was established in 1987 with a grant from the National Science Foundation to foster a closer relationship between researchers in mathematics

and related fields at Rice University and mathematics teachers in the Houston area.

RUSMP's goals are to enhance the mathematical and pedagogical skills of mathematics teachers and administrators, to encourage collaboration among teachers, to promote the integration of manipulatives and technology in the classroom, and to support reform-based approaches to instruction and teaching goals in accord with the NCTM *Standards*.

RUSMP currently hosts several professional development programs, but its centerpiece is the Summer Campus Program. The Summer Campus Program is a four-week professional development program in mathematics content and pedagogy for Houston-area PreK-12 teachers. Participating teachers are placed in classrooms where instruction is focused on material appropriate for the grade-level that they normally teach. Each classroom is led by two Master Teachers. The Master Teachers are experienced educators who have demonstrated teaching techniques consistent with those advocated by RUSMP and NCTM. In the classroom, the Master Teachers demonstrate techniques that encourage student thinking, activities, creativity, products, and group work. Outside of the classroom, participating teachers attend weekly colloquia with speakers from Rice University.

Nearly 4,000 teachers have participating in the Summer Program since 1987, and it has had a demonstrable impact on both the teachers and their students. RUSMP has been cited as one of the top four professional development programs at the elementary grades, one of the top two in the high school grades (Killion, 2002a, 2002b, 2002c), and one of the top seven in the middle school grades (Killion, 1999). Independent evaluations of RUSMP indicate that teachers who participated in the RUSMP Summer Campus Program changed their beliefs about mathematics and their classroom practices to better

align to the NCTM Standards, and their mathematical knowledge increased. Furthermore, their students performed significantly better on standardized tests than comparable students whose teachers had not participated in the Summer Campus Program (Brown & Dial, 1994; Dial, 1996, 1997, 1998 1999a, 1999b; Willis, 2000a, 2000b, 2000c; McCoy, 2001a, 2001b, 2001c; McCoy, 2002a, 2002b, 2002c).

### *The Present Study*

During the 2003 Summer Program, 101 Houston-area mathematics teachers participated. Seventy-seven percent of the participants were female, 53 percent were Caucasian, 21 percent African-American, 13 percent Asian, and 11 percent Hispanic.

Teachers were administered questionnaires prior to the start of the program, and follow-up questionnaires at the end of the program. These pre- and post-measures consisted of demographic questions, questions regarding beliefs about teaching and learning mathematics, and a self-efficacy measure adapted from Quiñones (1995) consisting of eight items relating to the perceived ability to teach mathematics (see Appendix A). A sample question is "I feel confident in my ability to teach math effectively." The self-efficacy scale demonstrated strong internal consistencies at both administrations (alphas = .86 and .82, respectively).

The first questionnaire was given to the participants on the first day of the program, before they received any mathematics instruction. Teachers were separated into five different classes for the duration of the program, determined by the grade-level the teachers normally instruct. The two master teachers leading each class demonstrated techniques for encouraging in-depth learning about math and alternate ways of presenting concepts to students. Participants spent four days a week in class, for eight hours each

day. On the last day of the program, four-weeks after completing the first questionnaire, participants were given the second post-program questionnaire.

The pre- and post-measures of self-efficacy were compared using a dependent samples *t*-test. Results indicated that there was a significant increase in teachers' self-efficacy after completing the Summer Campus Program,  $t(100) = 2.85, p < .01$ .

### *Discussion*

These results show that teachers' self-efficacy is enhanced after participation in RUSMP's Summer Campus Program. This result is to be expected, given what we know about the antecedents of self-efficacy. Participants had ample opportunity to engage in social modeling, as they were exposed on a regular basis to exemplary educators demonstrating best practices in the field of teaching. The teachers also had many opportunities for mastery experiences. The teachers were frequently asked to participate in the activities they would potentially be giving to their students. By working in classes with other teachers who teach at the same or almost the same grade level, the teachers were exposed to verbal and social persuasion. Observing their colleagues engaged in learning new material is likely to have helped increase each participant's own self-efficacy.

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## Appendix A

Questionnaire on Mathematics Teaching*Instructions:*

This questionnaire is anonymous, and there are no right or wrong answers.

Please use the following scale to rate the degree to which you agree or disagree with the following statements regarding your opinions about teaching math:

- |                      |   |   |   |   |   |                   |
|----------------------|---|---|---|---|---|-------------------|
| Strongly<br>Disagree | 1 | 2 | 3 | 4 | 5 | Strongly<br>Agree |
|----------------------|---|---|---|---|---|-------------------|
1. I feel confident in my ability to teach math effectively.  
1      2      3      4      5
  2. I think I am or eventually can become an exemplary math teacher.  
1      2      3      4      5
  3. I do not feel that I am as capable of teaching math as other people.  
1      2      3      4      5
  4. On average, other people are probably much more capable of teaching math than I am.  
1      2      3      4      5
  5. I am a fast learner when picking up better math teaching techniques, in comparison to other teachers.  
1      2      3      4      5
  6. I am not sure I can ever be a highly effective math teacher, no matter how much practice and training I get.  
1      2      3      4      5
  7. It would take me a long time to learn how to teach math effectively to my students.  
1      2      3      4      5
  8. I doubt that I will be able to improve my math teaching ability.  
1      2      3      4      5

