

*As a result of my participation in RENEW I have more strategies to engage students in being excited about math. I have more confidence in letting them loose to explore and problem-solve--I've done a lot more of this year.*

*RENEW is an excellent setting to learn and gain more knowledge on how to present certain lessons or activities.*

Many RENEW beginning teachers start the project with little confidence to teach mathematics due to their own mathematics background. The project helps them to gain efficacy in teaching mathematics.

*RENEW helped me feel more comfortable about teaching mathematics. I gained many new ways to teach math. I was exposed to many creative ideas and encouraged to think out of the box.*

The sharing of resources and ideas for mathematics instruction by experienced teachers helps beginning teachers develop vertical curriculum knowledge across the grade level spans while helping to alleviate one of the most pressing needs of the beginning teacher: that of gathering together effective and innovative materials for teaching.

*I've learned a ton of new math activities that can be easily adapted to my own classroom environment and grade level.*

Facilitating group learning at specific grade level also helps beginning teachers gain firm horizontal curriculum knowledge.

*I learned many strategies that I can implement in my classroom. I learned that I can teach different strategies to accommodate the needs of some students that do not get a strategy (you can always teach students another way so they can understand).*

The project focuses attention on facilitating its participants' understandings of student both in terms of their ability to facilitate a diverse range of mathematical abilities in their classrooms by deepening their understanding of students' thinking and in terms of equity and access for ALL students to a rigorous mathematics curriculum.

*I gained a new knowledge with respect to making mathematics more enjoyable and tailored to the needs of my students. I am prepared to instruct all age levels with a plethora of materials.*

*I have learned that equity in math is not just about boys and girls, but about different perspectives. I've learned that all your past experiences affect your learning ability and even how you feel about learning.*

Phase II analyses of participants' open-ended responses from questionnaires and MEPS feedbacks further indicated that beginning teacher learning of PCK was mediated by the following interconnected aspects of RENEW:

1) The practical nature of the project

As one beginning teacher wrote: *"I think the most powerful thing I took away from project RENEW was having a place you could go to and get positive input about teaching strategies to try in your specific context".*

Often it was the ideas and strategies learned from their fellow beginning teachers that was valued.

*There was a lot of sharing of ideas between beginning teachers. This gave me perspective and help in overcoming hurdles in my own situations*

Thus (2) the collegial aspect of the project in which time for beginning teachers to form collegial relationships with their peers and in particular, a setting for sharing experiences was created, helped to generate this support:

*Participating in RENEW has been a great opportunity in terms of connecting with other teachers who are at similar places in their teaching careers. It is great to share ideas and hear other ideas.*

*The connection between teachers is a huge part of the program. Sharing ideas is so helpful. The specific activities and resources are invaluable. Hearing from successful teachers is inspiring and gives much needed perspective.*

At other times the beginning teachers most valued the professional and emotional support provided by their experienced counterparts;

*The experienced members of our group were very supportive and really created a safe and trusting environment for us to share and receive information.*

*We talk about problems—situations that are occurring now in our classrooms, and how we can better respond to them the next time.*

Over 75% of end-of-year Beginning Teacher Questionnaires indicated one or more of these three aspects of the RENEW community in which they participated to be their most significant experience in the project.

Phase III of the needs analysis looked across beginning teachers and results confirmed that RENEW had met the beginning teachers' self-perceived needs. For each of the ten needs categories, between 94%-100% of the beginning teachers indicated on their post Beginning Teacher Questionnaires that RENEW supported them either "a lot" or offered "some support". These results are depicted in the two right hand columns in Table 5 below. Overall, participants feel that their needs are being met through their participation in RENEW, and 90% of eligible teachers reported that they would continue participation for further years. In addition, when asked for ideas to improve the project more than 50% of beginning teachers stated that they liked the project as it was.

*Table 5. Self Perceived Needs of Beginning Teachers and Percentage Who Felt These Needs Were Met Through Participation in RENEW*

Emergent need category from analysis of the (n=105) pre responses	% of beginning teachers from end-of-year questionnaire who felt that RENEW has supported them in the needs category		
	A lot of support	Some support	No support
Investigative/hands-on activities and strategies	77%	23%	0
Curriculum Materials for specific concepts	83%	16%	1%
A renewed interest and understanding of mathematics	79%	20%	0
Curriculum mapping what and when	49%	45%	6%
Work with grade level groups/ grade level activities	66%	31%	3%
Managing multiple levels of understanding of math content	53%	47%	0

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Table 5 continued			
Make math fun/exciting/ interesting/connected to real life	86%	14%	0
Balance between skills and problem solving	62.5%	37.5%	0
Assessment of student's mathematical thinking	44%	53%	3%
Meetings/ building relationship with other teachers	89%	11%	0

***Pre and Post Changes in Beliefs Components of Pedagogical Content Knowledge***

In addition to supporting the beginning teachers in project RENEW and ensuring that their specific needs are addressed by this innovative model, RENEW's goal is to develop the pedagogical content knowledge of its experienced as well as beginning teachers in such a way as to enable them to implement the kinds of mathematics classrooms envisioned in the Principles and Standards for School Mathematics (NCTM, 2000). As illustrated in Table 4 and described in detail above, PCK includes beliefs about subject matter and beliefs about pedagogy as critical categories in its development. In the context of this mathematics professional development beliefs about "doing" mathematics and beliefs about teaching mathematics were considered. Recall that since the Principles and Standards for School Mathematics are the standards to which the project is attempting to move its participants the beliefs scales that were administered to RENEW participants at the beginning and end of each project Year measure the extent to which participant beliefs are "in line" with those of PSSM. Two "math" variables, inquiry and non-procedures and two "teaching" variables, non-telling and reform were used for this purpose. The higher the scores on these variables the more the participants' view of doing mathematics/teaching mathematics is congruent with PSSM. Table 6 below indicates pre post project scores on these variables for both populations of RENEW participants (experienced teachers and beginning teachers).

Table 6. *Pre and Post Beliefs Mean (std. Dev.) Scores for RENEW Participants*

	Beginning of RENEW		After One or More Years Participation in RENEW	
<b>Beliefs about Doing Mathematics Variables</b>				
	Experienced (n=29)	Beginning (n=57)	Experienced (n=27)	Beginning (n=70)
Inquiry	4.6 (.38)	4.4 (.67)	4.5 (.47)	4.3 (.86)
Non-Procedures	3.5 (.73)	3.3 (.57)	4.1 (.46)*	3.3 (.48)
<b>Beliefs about Teaching Mathematics Variables</b>				
	Experienced (n=29)	Beginning (n=57)	Experienced (n=27)	Beginning (n=70)
Reform	4.2 (.51)	4.1 (1.04)	4.4 (.55)	4.4 (.97)*
Non-Telling	3.8 (.45)	3.5 (.68)	4.0 (.33)	3.8 (.53)*

\*univariate statistically significant difference at  $p < .05$

\*\*univariate statistically significant difference at  $p < .01$

In summary, the results in Table 6 above indicate:

- No statistically significant differences were found between the beginning teachers' pre and post *Beliefs About Doing Mathematics*. ( $F(2,124) = 1.26, p = .28$ )
- A statistically significant difference between experienced teachers' *Beliefs About Doing Mathematics* and that of the beginning teachers' (Inquiry:  $t(94) = 4.55, p < .01$ ; Non-procedures:  $t(94) = 9.22, p < .01$ )
- A statistically significant difference between beginning teachers' *Beliefs About Teaching Mathematics* at the start of the project and after one or more year participation ( $F(2,124) = 3.53, p < .05$ )
- No statistically significant difference between beginning teachers' and their experienced teachers' *Beliefs About Teaching Mathematics* after one or more years participation in the project (Reform:  $t(94) = 1.143, p = .26$ ; Non-telling:  $t(94) = 1.79, p = .08$ )

In terms of beliefs about teaching mathematics, both beginning and experienced teachers' beliefs became more consistent with those of PSSM. Furthermore at the end of one or more year in the project, there was no significant difference between the beginning and experienced teachers' beliefs on these constructs. In terms of *Beliefs About Doing Mathematics* for the beginning teachers, our results are consistent with other research in this area in that they indicate that these beliefs are often more resistant to change than are beliefs about teaching (Raymond, 1997). There was,

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however, a statistically significant increase in experienced teachers beliefs about mathematics. At the end of year two there remained a statistically significant difference in the beliefs of experienced and beginning teachers.

## **Concluding Remarks**

RENEW has developed and is testing a model to retain both beginning and experienced math teachers in the profession while simultaneously helping them to improve their teaching of mathematics. Indeed, preliminary results indicate that 93% of beginning teachers who participated in RENEW for one or more years, remained in the teaching profession at the end of a three-year period. The results described above show that RENEW facilitates the development of critical aspects of teachers' pedagogical content knowledge, that special mix of understandings of content, pedagogy and student necessary to teach subject matter in a manner understandable to students. RENEW is quite unique in that it centers its support program on the content area of mathematics. It is in doing so that enables the project to focus on the development of pedagogical content knowledge in its participants. Through the doing of mathematics and subsequent discussions of pedagogy the mathematics participants are able to learn subject matter first hand, they talk about learning of mathematics and situate their knowledge in context by having opportunities to adapt what they learn to their grade level.

RENEW fulfills several critical needs that are not addressed by other support programs. Unlike other programs, RENEW does not restrict its support solely to credentialed teachers. Rather, RENEW encourages the participation of school districts that have a high number of non-credentialed teachers. According to the Center for the Future of Teaching and Learning (2002), higher concentrations of beginning teachers are teaching at low-performing schools. Moreover, it is five times as likely that children in low-achieving, high-poverty, high minority schools will be taught by a non-credentialed teacher, thus the need for more effective support programs like RENEW.

RENEW also extends support to teachers in their first through fifth years of teaching in contrast to many other beginning teacher support initiatives. Our results indicate that teachers in their third through 5<sup>th</sup> years of teaching (and beyond) still need support and help in developing their pedagogical content knowledge. The research shows that it is at these later stages that teachers are more ready to focus on the critical issues of pedagogy and content (Fuller, 1969).

Lastly, RENEW focuses on building relationships between professional and personal communities of educators committed to teaching appropriate mathematics to ALL students. The social and psychological dimensions of educational change are areas that are often neglected in professional support and development projects (Weissglass, 1994). With systematic forms of support like RENEW available for the development and support of beginning and experienced math teachers, the teaching profession will have invested in not only retaining teachers but in building and preserving highly-qualified, talented, and renewed teachers for the future.

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