Understanding Beginning Teachers' Needs: The Effects of RENEW, A Retention and Renewal Mathematics Project

Sarah Hough,
University of California, Santa Barbara

Stella Erbes,
Pepperdine University

Nancy O'Rode,
University of California, Santa Barbara

Nancy Terman,
University of California, Santa Barbara

Project RENEW at: http://renew.education.ucsb.edu

Abstract

The purpose of this paper is threefold: (1) we review the current beginning teacher research literature and synthesize findings related to beginning teacher needs and concerns, and specific difficulties faced by beginning teachers; (2) we use data collected from a study of RENEW, an NSF-funded beginning teacher initiative to understand beginning teachers' needs and their perceptions of how the project facilitates the construction of district specific communities of practice, that are designed to offer them support as it relates specifically to mathematics teaching and learning; and (3) we report on pre post project change in critical aspects of beginning and experienced teachers' pedagogical content knowledge. Data collected from beginning and experienced teachers who participated in the second year of the project were analyzed to explore the effects of RENEW. Results indicated that the needs and concerns of participants focused specifically on the content and pedagogy of mathematics and were similar to those found in the literature. The emergent RENEW model is described and illustrates how these needs and concerns were met.

Project RENEW is funded by the National Science Foundation, Grant # ESI-0101995. Opinions expressed in this paper are those of the authors and do not necessarily reflect those of the funding agency.

Introduction

The Leadership for Excellence and Renewal in Mathematics Education Project (RENEW) is a five-year National Science Foundation (NSF) funded project that started in 2001 and was motivated by the following question: *How can a model be developed that both supports and retains competent beginning teachers and develops the leadership capacity of experienced teachers while increasing both groups' abilities to effectively teach mathematics based on the vision outlined in the Principals and Standards for School Mathematics (NCTM, 2000)?*

According to the Glenn Commission Report *Before It's Too Late* (2000), "over the next decade two-thirds of the teachers in America's schools will be replaced, either by retirement, attrition, or job change" (p. 14). In addition to the high attrition rate of new teachers, many veteran teachers report that they and their colleagues are experiencing "burn-out" from the increased pressure of high-stakes testing, attacks on public education, inadequate physical and curricular resources, and a lack of respect for the profession. In particular, the training and quality of educators who are involved with the teaching of mathematics is in need of improvement, and this has been made evident in the documented shortage of qualified math teachers at the secondary level, as well as a lack of proper training in math content for elementary school teachers.

The contribution of RENEW to this situation is the development and testing of a model to keep beginning mathematics teachers in the teaching profession while at the same time helping them to improve their teaching of mathematics. Unlike other teacher support programs that focus on newly credentialed teachers, RENEW focuses its attention on teachers in their first to fifth years of teaching. In addition RENEW does not restrict its support solely to teachers with a credential. Rather, the project encourages the participation of school districts that have a high number of non-credentialed teachers. Though the research literature presents evidence of the effectiveness of beginning teacher support or induction programs that have been

implemented to address the needs of novice teachers during their first two years in the profession (Swanitz, 1998; NTPI, 1997; Brown & Warnbach, 1987), studies that reveal systematic programs that help teachers after they survive these initial years of teaching remain scarce. It is at these later stages that beginning teachers need and are more ready to focus on the critical issues of pedagogy and content. Lastly, RENEW is unique in its focus on the support of beginning teachers in the context of mathematics education a discipline in which teachers are struggling to reconcile state content standards with the national standards. Recognizing these needs, RENEW seeks to support, empower, and develop the teaching performance of beginning math teachers, along with their experienced counterparts.

After a review of the literature on the self-reported needs and difficulties that beginning teachers face, this study examines the specific needs of RENEW participating beginning teachers, and their perceptions of how the project meets those needs as beginning teachers of mathematics. We then present evidence to support the development (in both beginning and experienced teachers) of critical aspects of pedagogical content knowledge.

Research Questions

1) What are the self-perceived needs and concerns of RENEW beginning teachers in specific relationship to the teaching and learning of mathematics?

2) Do the beginning teachers feel that RENEW has met these needs at the end of the second year of the project?

3) How does the RENEW model address the needs of its beginning teacher participants while at the same further the development of pedagogical content knowledge in all its participants?

4) What evidence is there that the project is developing key components of participant's pedagogical content knowledge (specifically participants' beliefs about mathematics and participants' beliefs about teaching mathematics?

Review of Literature

In order to understand the relationships between the RENEW model and beginning teacher support, a review of the literature was conducted that pertained to beginning teachers' needs, common difficulties faced by beginning teachers, and teaching practices. This review has served as a key source in seeking to understand the resources needed by beginning teachers.

Self-Perceived Beginning Teacher Needs and Concerns

The self-perceived concerns of beginning teachers have been well researched and results of some of the most pertinent of the findings from these studies are described briefly below. Varah, et al. (1986) stated that frequently cited problems of beginning teachers are discipline, isolation, evaluation of student work, and use of appropriate material. Gordon (1991) suggested a set of potential high-priority needs of beginning teachers which included: Managing the classroom; acquiring information about the school system; obtaining instructional resources and materials; planning, organizing, and managing instruction and other professional responsibilities; assessing students and evaluating student progress; motivating students; using effective teaching methods; dealing with individual students' needs, interests; and collaborating with colleagues. Veenman (1984) conducted a study from which he ranked the difficulties teachers most frequently reported, these included: classroom management, student motivation, dealing with individual differences among students, assessment of student work, obtaining sufficient materials for adequate instruction, dealing with students' personal problems, and heavy course loads with inadequate preparation time

These findings were again reflected in a more recent study of the Beginning Teacher Support Program, currently a state mandated post induction program, in one Southern California region. It was found that the most cited needs of teachers in their first two years of teaching were managing curriculum (obtaining resources and

materials), establishing positive rapport with students, receiving administrator support and classroom management.

The world of beginning teachers is typically marked with endless, stressful hours of work that involve dealing with many common difficulties. According to Gordon (1991) many of the difficulties beginning teachers face are grounded in the culture of the teaching profession and the conditions of school and districts as a workplace. Results of this study indicate six categories of difficulties for beginning teachers: (1) Difficult Work Assignments, (2) Unclear Expectations, (3) Inadequate Resources, (4) Isolation, (5) Role Conflict, and (6) Reality Shock.

Teaching Practices of Beginning Teachers

Various dimensions of teaching have been studied in terms of the teaching performance of beginning teachers and their more experienced counterparts. Though the literature uses terms like *expert, experienced, veteran,* and *well-regarded* when comparing the skills of expert teachers to those of novice teachers, a clear distinction to define the differences between these two categories of teachers is often overlooked and not established by the researchers in the literature. In this paper we use the term experienced to indicate that a teacher is a RENEW mentor and has had at least 6 years of classroom experience, and use the term expert to indicate an experienced teacher whose teaching practices is indicative of something exemplary. The articles reviewed here demonstrate that there are many differences found in the pedagogical content knowledge of experienced and beginning teachers. The findings discussed here have investigated the practices of experienced and beginning teachers to uncover possible differences in the ways in which they are able to transform content knowledge for their students. The term *pedagogical content knowledge,* which was coined by Lee Shulman (1986), represents a blend of content, pedagogy and a certain understanding of ones student that provides teachers with an understanding of how particular subject matter topics, problems, and issues are organized, represented, and adapted to the diverse interests and abilities of learners, and then presented for instruction.

Most research on teachers' pedagogical content knowledge has focused on comparisons between beginning and experienced teachers' PCK. Shulman and his colleagues have uncovered important differences between beginning teachers and their more experienced counterparts, suggesting that beginning teachers lacked the pedagogical content knowledge derived from classroom experiences to help them transform their subject matter content knowledge successfully both in their planning and teaching. Clermont, Borko, & Krajcik (1994) sought to explore the pedagogical content knowledge of science teachers who are experienced and those who were beginning in conducting chemical demonstrations of abstract science concepts. The results of this study indicated that "experienced teachers possessed a much broader and richer set of mental representations for demonstrating the concepts of density and air pressure than did novices" (Clermont, Borko, & Krajcik, 1994, p. 436). Experienced teachers were also "more cognizant of the complexity of some chemical demonstration systems and the ways in which this complexity might generate confusion among middle school students and thus interfere with learning" (Clermont, Borko, & Krajcik, 1994, p. 436). The findings also support Wilson et al.'s (1987) hypothesis that experienced teachers are likely to possess multiple mental representations for teaching specific subject matter concepts. Clermont, Borko, & Krajcik (1994) concluded that:

> ...*pedagogical content knowledge growth among beginning teachers is generally slow and incremental, and is related to the time required for these teachers to plan, gather resources, teach, reflect and re-teach specific topics with increased effectiveness and fluency. Growth of teachers' pedagogical content knowledge also appears to be dependent on the motivation, creativity and pedagogical reasoning skills of teachers...the knowledge base and patterns of thinking that characterize expertise typically develop after years of preparation and extensive experience in classrooms.* (p. 419-420, 438)

Although teachers may possess a level of expertise in knowing subject matter, the challenge for all teachers is to take that expert knowledge and transform it into a form that is comprehensible and well thought out for students to understand and learn. Thus, both expert and novice teachers alike are challenged with creating and

implementing effective teaching methods to present the subject matter in a form that is understandable and appealing to students.

Recent work by Copeland, et.al, (2000) which consisted of an extensive review of the research on teacher development and the subsequent building of a framework of teacher change, suggests that to improve their pedagogical content knowledge, teachers develop understandings (beliefs and knowledge) about certain sub areas of content, pedagogy and student. For instance in relationship to content knowledge, through thoughtful intervention, teachers can develop in their understandings of specific subject matter, their understandings of curriculum and their beliefs *about* the content area, all of which contribute to the development of PCK. Similarly, in relationship to students, there is evidence to suggest that teachers develop in their understandings of student diversity as well as their understanding of student thinking (in a subject matter area), both of which contribute to PCK. Lastly, teacher develop in their understandings of effective instructional strategies, their understanding about their role in the classroom and their efficacy to teach their student, all of which contribute to the pedagogy component of PCK.

Given the professional and emotional needs of beginning teachers it is clear that new teachers stand at the beginning of a long process of growth, change, and professional development as they work to become confident and effective in their classrooms. Without systematic forms of support in place that directly address their needs the *leaving rate* among teachers in their first few years of teaching will continue to rise (National Teaching Policy Institute, 1997).

Goals of RENEW

RENEW addresses the needs and difficulties of beginning teachers by developing and testing a model to support them in their first five years in the profession while at the same time helping them to improve their pedagogical content knowledge and teaching of mathematics. The overarching goals of RENEW are to:

- Develop the leadership capacity of teams of experienced teachers who in turn offer year-round support to beginning teachers both professionally and emotionally by creating communities of practice in their district contexts; and

- Increase the mathematics pedagogical content knowledge of beginning and experienced teachers paying particular attention to developing participants' ability to work with diverse students;

Methodology

The focus of this study was to understand beginning teachers' needs and their perceptions of how RENEW offered them support as it related specifically to mathematics teaching and learning.

Perspective

We sought to understand the effects of RENEW on its participants from a constructivist view of learning and development. Through this perspective we assume that changes in individual participant's understandings occur as they participate and negotiate meaning in the social setting of the RENEW community and subsequently in their unique school and district settings.

Participants

During the 2002-2003 academic year, 99 beginning teachers (in their first five years of teaching mathematics) from eight districts in three Southern California counties participated in RENEW. During the summer of 2002 an additional 55 beginning teachers participated in a RENEW Beginning Teacher Summer Institute but did not subsequently participate in the year-long RENEW program. In addition to these two beginning teacher cohorts, 29 experienced and well-regarded teachers with between 6 and 30 years of teaching experience were participating in mathematics leadership development to work with these beginning teachers during the second year of the project. The beginning and experienced teachers work in K-6, 7-8, or 9-12 settings and have varied mathematical backgrounds that range from pre-algebra to mathematics analysis. The eight participating school districts in which these teachers work vary in

terms of size and student populations. The size range is from small (6 schools and a total student enrollment of 3,400) to large (20 schools and a total student enrollment of 21,000 students). The language capabilities of the students enrolled at these schools ranges from very homogenous English speaking populations (2% English Learners) to districts that have high proportions of English Learners (49% English Learners). Districts range considerably in the number of students eligible for free and reduced price lunch, from 17 % to 78%).

Table 1. *Participating School District Demographics* (2002/2003)

	#Schools in District	# Schools participating	District Enroll-ment	#EL	%Free lunch	#Experienced teachers from district	#Beginning teachers from district	Grade levels of Beginning teachers
	Los Angeles County							
a	10	4	6,513	118	23.1	4	9	K-8
	Ventura County							
b	19	11	16,249	8,028	74.7	9	16	K-8
c	5	1	14,552	2,927	34.4	1	8	9-12
d	6	4	3,478	1,262	59.0	4	19	K-6
e	5	2	3,730	1,359	58.4	2	3	4, 9-12
f	7	5	4,096	1,646	78.2	1	14	K-8
g	20	6	21,181	1,387	17.3	3	17	K-12
	Santa Barbara County							
h	10	9	4,455	1,385	31.4	4	13	K-6

Data Collection Procedures

Pre & Post Questionnaire. At the beginning of the 2002/2003 academic year, all beginning teacher participants were asked to complete a RENEW researcher designed *Beginning Teacher Questionnaire* . The purpose of this pre-questionnaire was to gather data about their thoughts regarding mathematics, their beliefs about mathematics pedagogy, and their needs (both in terms of implementing effective mathematics practices in their classrooms and in terms of their self-perceived needs as beginning teachers in general.) In particular, the question, "Please let us know in as much detail as you can, what specific support you would like from this project," yielded the most

relevant data pertaining to the research questions for this study. At the end of the year, beginning teachers responded to a modified version of the *RENEW Beginning Teacher Questionnaire* which, in addition to the data gathered above, asked them to state the extent to which the project met their needs and to reflect on what they felt they had gained as a result of their participation in the RENEW community.

Experienced teacher participants completed the *RENEW Experienced Teacher Questionnaire* at the beginning and end of the project year. The purpose of these questionnaires was to gather data on their views about mathematics and mathematics pedagogy, and their understandings of both their role as mentors and their views on equity as it relates to access to effective mathematics instruction for ALL students.

Reflective Writings. Participants meet at least once a month for district Mathematics Education Professional Seminars (MEPS), at which time all beginning teachers were asked to reflect in written form to what they had found most helpful during the seminar that was attended. All feedback responses from district Mathematics Educational Professional Seminars and other reflective activities were added to the data corpus. Together, these data were used to better understand the effects of RENEW on the beginning teachers' beliefs and practices.

Participant Observations. Two of the authors attended and participated in selected MEPS. Reports from these MEPS were added to the data corpus.

Needs Analyses

The need analyses were conducted in three phases.

Phase I. Responses to open-ended question of interest were subjected to content analysis (Weber, 1990). Two researchers participated in the analysis and ten mutually exclusive categories emerged. Both intra (α=.97) and inter (α=.94) rater reliability measures were calculated. The categories that emerged from this initial analysis of the participants' questionnaire responses were compared to those found in the research literature. Then, numbers of beginning teachers responding to each of the categories were calculated, and comparisons of these tallies between districts were

performed. Data from these analyses were shared with the eight district teams at the beginning of the academic year to help them plan professional development activities for their beginning teachers. District teams reflected on the data and reported their interpretations to the whole group. This activity was recorded, transcribed, and used to inform further analyses.

Phase II. Reflective writings from all district seminars were collected and analyzed. This process involved a second content analysis in which all the responses were sorted into the a priori categories delineated by the Shulman's (1986) framework for pedagogical content knowledge (described on pages 4-5 above). Within each category, a secondary analysis to compare written responses to participant needs that were reported from Phase I was completed. Along with these written feedbacks, reports of participant observations of the MEPS completed by project researchers were used to triangulate the self-reported data.

Phase III. Based on Phases I and II, an additional graded response item was added to the post questionnaire. This asked participants to respond to how much support they believed that they had received from RENEW in the ten prominent needs categories that they had reported in the initial questionnaire. For example, each respondent was asked if RENEW had afforded them "a lot of support, some support, or no support" in the ten prominent areas. Numbers of responses for each variation were tallied in order to determine which needs the beginning teachers had perceived that RENEW had met. An inter-district analysis was conducted to see if differences could be accounted for in different school settings.

Analyses of Pre and Post Changes in Beliefs About Doing Mathematics and Beliefs About Pedagogy

Beliefs About Doing Mathematics. To monitor the development of participants' views about what mathematics is—the actual doing of mathematics—, a 13-item Likert scale (i.e., the RENEW Beliefs About Doing Mathematics scale) was administered to participants on joining RENEW and then once at the end of each project year. The scale

was designed to place participants on a continuum that reflects the extent to which their beliefs about doing mathematics are in line with those of Principles and Standards of School Mathematics (PSSM). These items are listed in the first column of Table 2 below. Six of these questions were designed so that agreement with the item would indicate alignment with PSSM. These six items were later reversed scored. Seven of the questions were designed so that disagreement would indicate alignment with PSSM. Items 1-6 indicate reverse worded questions (agreement indicates alignment), whereas items 7-13 indicate positively worded questions (disagreement indicates alignment). In order to validate the scale, factor analyses and subsequent reliability coefficients were calculated.

Table 2. *Rotated Factor Matrix on 13 Beliefs About Doing Mathematics Items.*

Cronbach's alpha = .83	Inquiry	Non-Procedural
1. Investigating new situations and relationships among concepts are important parts of doing mathematics. [R]	**.757**	-.180
2. Collaborating with other people to share ideas and verify conjectures is an important part of doing mathematics. [R]	**.717**	
3. Doing mathematics is a creative process. [R]	**.662**	.554
4. When doing mathematics you are discovering patterns and making generalizations. [R]	**.640**	
5. There are many ways to go about solving most problems in mathematics. [R]	**.630**	.366
6. Doing mathematics is thought provoking. [R]	**.508**	.450
Cronbach's alpha = .60		
7. Doing mathematics mostly involves memorizing facts and procedures.		**.596**
8. When you do mathematics there is always a right way to go about doing things and answers are not open to interpretation.		**.481**
9. Unlike most other subjects, when you are doing mathematics you are always dealing with known quantities.		**.264**
10. Mathematics is most often a solitary activity.		**.253**
11. Some people are better at doing mathematics than others because they have a certain kind of mathematical mind.		**.230**
12. When doing mathematics it is not important to understand why a procedure works only that it will give you the right answer.		**.226**
13. Doing mathematics is a step-by-step mechanical process.		**.173**

[R] indicates a reveres item

A maximum likelihood factor analysis of 105 responses from second year of the project to this scale produced two correlated factors that accounted for 53% of the total variation. Subsequent interpretation of the rotated factor matrix gave two constructs: *Inquiry* and *Non-procedures*. The construct *Inquiry* portrays the doing of mathematics as a creative, open-ended group oriented endeavor in which one investigates concepts, examines patterns and problem solves. The construct *Procedures* portrays the doing of mathematics as rote, step-by-step procedures in which memorization and dealing with known quantities are used to obtain unique correct answers, hence Non-Procedures (disagreeing with the items that loaded on this construct) would disagree with this portrayal of what it means to do mathematics. Table 2 shows the items, and their factor loadings on the rotated matrix.

To proceed, numerical values were associated with each item on *the Beliefs About Doing Mathematics* scales, ranging from a *1* associated with *strongly agree* to a *5* being associated with *strongly disagree*. Next, two variables, *Inquiry* and *Non-procedures* were calculated by adding the responses to the items that loaded on the two factors respectively and then dividing by the number of items on that factor. At the end of the second year of the project multivariate statistical procedures (MANOVA) were used to test for pre/post project change in these mathematical beliefs using the two constructed variables as dependent variables. Subsequent F tests were conducted to examine which variable was contributing to any differences found. In addition, univariate procedures were conducted to test for differences between the experienced and beginning teacher views of mathematics pertaining to these variables.

Beliefs About Teaching Mathematics. To explore the development of participants' views about effective mathematics instruction a 10-item Likert scale (i.e., the *RENEW Beliefs About Teaching Mathematics scale*) was administered to participants on joining RENEW and then once at the end of each project year. The scale was designed to place participants on a continuum that reflects the extent to which their beliefs about doing

mathematics are in line with those of the Principles and Standards of School Mathematics (PSSSM). These items are listed in the first column of Table 3. Two of these questions were designed so that agreement with the item would indicate alignment with PSSM. These two items were later reversed scored. Eight of the questions were designed so that disagreement would indicate alignment with PSSM. Items 8 and 10 indicate reverse worded questions (agreement indicates alignment).

A maximum likelihood factor analysis of two years of beginning of year responses to this scale produced two un-correlated factors that accounted for 49% of the total variation. Interpretation of a subsequent rotation of the factor matrix revealed the constructs *Non-telling* and *Reform*. Table 3 below shows the items, and their factor loadings on the rotated matrix. The construct *Telling* views the teaching of mathematics in a traditional manner, one in which the teacher demonstrates procedures, gives the student time to practice those procedures and emphasizes the acquisition of basic skills ahead of inquiry and understanding. Hence Non-telling corresponds to the disagreement with the items that loaded on this construct. These scales were developed (Hough, 2000) with the expectation that the construct Non-Telling would correspond with a *reform* view of mathematics, i.e. one that encouraged students to learn through inquiry and exploration. The fact that the two negatively worded items didn't load on this factor, were interpreted as evidence that this was not the case hence, the construct *Reform* was based on these two items.

A subsequent Chi-Square goodness-of-fit test indicated that this two-factor solution was an adequate model ($\chi^2(26)=29.702$, $p = .280$).

Similarly to the two math variables that were constructed and described above, at the end of second year of the project multivariate statistical procedures (MANOVA) were used to test for pre/post project change in these constructs of teaching mathematics as well as to test for differences between the Experienced teacher and

Beginning Teacher views about them. To proceed, numerical values were associated with each item on the Beliefs About Teaching Mathematics scales, ranging from a *1* associated with *strongly agree* to a *5* being associated with *strongly agree.* Next, two variables, *Non-telling* and *Reform* were calculated by adding the responses to the items that loaded on the two factors respectively and then dividing by the number of items on that factor.

Table 3. *Rotated Factor Matrix on 10 Beliefs About Teaching Mathematics Items.*

Cronbach's alpha = .76	Non-Telling	Reform
1. When working with slow learners in mathematics teachers should focus a lot of instruction on "basic skills."	.747	
2. Students generally learn mathematics best in classes/groups with students of similar abilities.	.677	
3. When teaching mathematics the teacher should demonstrate the mathematics steps clearly and slowly and then give students time to learn the steps by repetition.	.663	
4. In mathematics students cannot understand high level concepts until they have mastered the "basic" steps of a given procedure or algorithm.	.590	
5. The best way for students to learn mathematics is to do many similar types of problems until they get the procedure down.	.579	
6. Encouraging students to make conjectures in mathematics is not necessary because the purpose of instruction is to get them to remember and apply math facts.	.550	
7. It is better to teach mathematical ideas directly to students than to let then figure out relationships for themselves.	.386	
8. Using cooperative learning techniques in mathematics instruction is not appropriate for high achieving students.	.148	
9. Encouraging students to explore their own methods of solving a problem is as important as teaching mathematical formulas and procedures. [R]		.997
10. To learn math students should be given plenty of opportunities to engage in inquiry oriented activities. [R]		.704

[R] indicates a reversed item

Results

What are the self-perceived needs and concerns of RENEW beginning teachers in specific relationship to the teaching and learning of mathematics?

Analyses of responses to the *Beginning Teacher Questionnaire* revealed the following prominent needs categories (listed in order of requests): (1) Knowledge of investigative/hands-on activities and strategies for teaching mathematics; (2) Help managing multiple levels of student understanding of mathematics content; (3) Opportunities for building collegial relationships with other teachers; (4) Materials to teach specific mathematics concepts (such as fractions); (5) Help making math interesting and connected to student's real life; (6) A renewed interest in and understanding of mathematics for the teacher themselves; (7) Help with curriculum mapping; (8) How to find a balance between skills and problem solving; (8) Time (in seminars) to work in grade level groups; (9) Time management skills; (10) Help in assessing student's mathematical thinking.

The results of this study were similar to those found in those conducted previously, such as beginning teachers' concerns about motivating students, managing instruction to facilitate individual students' needs and using effective teaching methods. Moreover, it was apparent that the categories reported by the RENEW participants were specific to mathematics teaching, such as motivating students by making mathematics connected to real life. We might consider them a little differently if we examine them within Shulman's framework for PCK. Recall that PCK consists of an amalgamation of content knowledge, knowledge and understanding of students and knowledge of pedagogy. We keep in mind here that based on the work of Copeland, et al (2000), content knowledge includes: (a) knowledge of subject matter; (b) beliefs about subject matter; (c) knowledge of horizontal and vertical curriculum. Similarly, pedagogy includes (d) familiarity with effective instructional strategies; (e) efficacy in implementing effective instructional strategies; and (f) beliefs about teaching and the

role of the teacher. We rearrange the ten needs categories found in this study pictorially below with these aspects of PCK in Table 4 below.

Phase II analyses of open-ended response data suggested that the project was meeting its goal of furthering participants' understandings of PCK and at the same time meeting the needs of it beginning teachers. The anecdotes below are representative of our findings.

RENEW is first and foremost a project in which participants learn more mathematics in an investigative context, perhaps differently to the way in which they are used to "doing mathematics".

> *Project RENEW has shown me the importance of teaching for understanding. I have solidified my own math understanding and gained valuable teaching techniques. Most importantly I want to continue learning and growing.*
>
> *I have really learned to look at math in a new way and learned that you can solve math problems more than one way*.

Through re-experiencing mathematics in this way, participants often restructure their beliefs about what mathematics is and how it should be taught.

> *I have gained an understanding that there is more than one way to go about attempting a mathematical problem and that there may not be only one correct answer.*

In RENEW participants, of course, learn many effective instructional strategies for teaching mathematics.

> *I really learned a lot about how to incorporate manipulatives into mathematics instruction. I have learned a lot about effective/inventive ways of teaching math.*

They also have opportunities to try out what they learn in their classrooms under the guidance of their experienced peers and then discuss situations and problems within their RENEW community.