Teachers Implementing Mathematical Problem Posing in Classroom:
Challenges and Strategies

Abstract
This paper reports a study about how a teacher educator shared knowledge with teachers when they worked together to implement Mathematical Problem Posing (MPP) in the classroom. It includes feasible methods for getting practitioners to use research-based tasks aligned to the curriculum in order to encourage children to pose mathematical problems. Techniques, challenges, and strategies of implementing an MPP focus were also reported.

Key words:
Mathematical Problem Posing, Enacting Research-based Tasks, Teachers as co-investigators, Implementation, Elementary Math Curriculum.

The research reported was part of a larger research project funded by the National Science Council of Taiwan R.O.C. Opinions in this report are those of the author and not representing those from the funding agency. The author wishes to thank the editor of ESM and the guest editors of this SI for the time and effort in the whole reviewing process; also the few anonymous reviewers for constructive comments on earlier versions of this manuscript; and finally, the school teachers for participation in this research.
Effective mathematical problem solving is a primary goal for mathematics education. At the heart of problem solving often lies a great problem. When mathematicians meet, they share how they find problems, pose new ones, and reformulate novel problems from known problems. The problem-posing aspect of this process has been viewed as important (Polya, 1954; Freudenthal, 1973; Brown and Walter, 1983; Silver, 1994) and emphasized in curriculum standards and instruction (NCTM, 2000; Ministry of Education of Taiwan, 2003). However in practice, the attention paid to problem posing has not been proportionate to this importance. Since research already exists that indicates children’s success in mathematics learning after problem-posing instruction (Ellerton, 1986; English, Fox, and Watters, 2005), a natural next step is to introduce problem posing to practitioners. However, a survey in Taiwan indicated that children barely ever posed problems, teachers were inexperienced in posing activities, and such activities were difficult to implement (Leung, 1994). In addition, teachers expressed a need for skills to enact tasks in class and specific ideas for handling posed problems from children. Without this knowhow, high-level tasks would not function in the way intended (Stein, Smith, Henningsen & Silver, 2009).

The primary purpose of this paper is a close examination of teachers’ experiences in implementing problem posing by using tasks and a coding method that I provide. The research question is, “Why and how do teachers enact problem-posing task materials in an elementary mathematics curriculum?” In addition to studying the reasons for and natures of teachers’ actions, I also study how teachers enact research-based mathematical problem-posing (MPP) tasks, how teachers classify and use children’s work in teaching, and what instructional strategies teachers use when issues arise in teaching. In my attempt to answer these questions, I also attend to a neglected component of research—the professional development of the teacher educator and teachers (Jaworski, 2008). I explore, analyze, and discuss my own learning and that of teachers by recruiting active teachers to connect research to practice.

In this literature review I include mathematical problem posing and teachers’ participation in curriculum reform.

Mathematical Problem Posing
In this study, I refer to problem posing as the formulation of new problems or the reformulation of problems into novel problems (Silver, 1994) where the problem poser is a provider of information (Simon, 1973) and creates problems by attending to
problem structure (English, 2003). Leung (1994) discussed four characteristics of this kind of problem posing. First, MPP can be idiosyncratic. When one is considering some givens and poses a problem, one is trying to connect the various givens to a goal. For example, suppose the given information in a problem is, “There are 10 boys and 20 girls in a class.” A person may pose, “How many children are there altogether?” but another person may pose, “What is the ratio of boys to girls?” Second, the act of problem posing involves plausible reasoning (e.g. “Consider the change in this ratio if the total number of children is the same but the number of boys is 11 instead?”). Third, problem posing can happen before, during, or after problem solving. For example, after posing and solving for the total number of children, one may ask, “What is the percentage of boys in the class?” Fourth, a posed problem which is not yet solved can be insufficiently specified, impossible or even impossible, such as “If 25 bottles were distributed to 10 boys and 20 girls and each one gets one, how many bottles were left?”

In this review, problem posing is viewed as related to problem solving. There are four phases in problem solving (Polya, 1945): understanding the problem, devising a plan, carrying out the plan, and, looking back. These aspects can be seen in Figure 1, with the clockwise arrows representing the simplest case.

However, problem solving means more than a straightforward procedure of passing through these four phases. Going back and forth is common and each switch to a different phase signals a person’s evaluation of what he or she did in the current phase. When a step is not successful the solver will backtrack, which is represented by the counter-clockwise arrows in Figure 1. If a person is solving his or her own problem, rather than a problem that has been given, the initial Understand phase is considered a Pose phase. Subsequently, problem posing can occur at many points too, before or after solving (Leung, 2009). The decisions and actions of posing and solving can be inter-related.

In Kilpatrick’s (1978) studies on problem solving, he classified research on problem solving by task and subject variables. Studies on problem posing can also be classified into task and subject variables. One example of a task variable refers to math content and format, such as writing up a word problem on multiplication and division (Greer & McCann, 1991), or making a difficult and an easy problem on percent (Van den Heuvel Panhuizen, Middleton, & Streefland, 1995). Tsubota (1987) reported six types of problem posing tasks used successfully after systematic
implementation. These six types contain one of the following: an algorithm, text, a figure/table, a math topic, an answer, or a math problem. Tsubota did not report on personal reflections and solutions to difficulties in designing posing tasks. For instance, a crosstab on content and format is a feasible way to establish MPP tasks.

Subject variables (Kilpatrick, 1978) include gender, ability, cultural groups, and grade level. In practice, the grade level variable is often attended to by classroom teachers. Therefore, it is important to tell teachers which tasks to use for which grade, both for alignment to curricular goals in teaching a piece of mathematics content and for teachers to implement problem posing.

**Teachers’ Participation in Curriculum Reform**

In this review, we use the term “teachers” broadly: “[Since] the teacher educator can be regarded as the teacher of prospective or practicing teachers… it makes sense to regard student teachers, teachers, and teacher educators as teachers.” (Krainer, 2008, p. 1) In the third volume of the *International Handbook of Mathematics Teacher Education* (Krainer & Wood, 2008), participants in mathematics teacher education are viewed as individuals, teams, communities, and networks, and very often the growth of teachers is associated with the curriculum reform climate.

In the mathematics curriculum reform occurring in Taiwan, teachers are facing unprecedented challenges to change the way they teach, including incorporating problem solving and posing by children. A call for instructional change often involves teachers needing to set up different types of tasks and to classify students’ work according to rubrics. In this regard, sample tasks and children’s work are helpful to communicate to teachers the necessary knowhow for instructional change (see Parke, Lane, Silver, and Magone, 2003). Therefore, one might expect that when asked to introduce problem posing in their instruction, teachers will need similar research-based resources.

Under curriculum reform, teacher educators have brought interventions to classrooms, have studied the growth of teachers engaging in action research (Kemmis, 1991), and have interviewed teachers about how they teach a topic, as in Ma (1999). However, teachers often find programs offered by teacher educators too theoretical to be applied to their own settings (Hastie, 1992; Sowder, 2008). As a way to make programs more practical, teacher educators should show teachers how tasks can be enacted. Additionally, both parties can work together to solve problems arising in the new teaching methods, thus acting as co-learners (see Jaworski, 1999). For instance, in a study on enacting proof-related tasks (Bieda, 2010), the co-learners were teacher educators and veteran teachers. After a partnership was established between the two groups, both teachers and teacher educators analyzed curriculum and
classified and selected problems in the implementation of the new teaching methods.

Jaworski (2008) reflected on her work as editor of the *Journal of Mathematics Teacher Education* (JMTE) and commented that JMTE’s work mostly falls into the category of a mathematics teacher educator (MTE) passing knowledge to teachers. She drew a Venn diagram to represent how working together can share knowledge. One circle carries MTEs’ knowledge of research and theory while the other circle holds teachers’ knowledge of students and schools. The sharing of knowledge is represented by the intersection of the two circles, which means that the passing of knowledge is bi-directional. That is to say, teachers also pass knowledge to MTEs.

In a comprehensive chapter on teachers as researchers, Henson (1996) discussed teacher educators working with teachers and included three levels of teachers’ involvement: teacher as helper (Level 1), teacher as junior partner (Level 2), and teacher as lone researcher or collaborator (equal partner, Level 3). In most cases, teachers’ level of involvement is at level one—providing a classroom or students to be studied by an outsider (the teacher educator). Very few teachers are able to conduct action research—identifying the problem, conducting the study, and using data and findings. It is reasonable to suggest that research at involvement level two is a way to prepare teachers to become lone researchers. A study on tracing the paths of teachers’ increase in involvement levels is needed.

Based on the literature reviewed above, it seems that myself being a teacher educator can start by developing research-based MPP tasks, then introduce teachers to consider using those tasks to teach particular math content listed in the curriculum standards document for grade one through six. I take the orientation that teacher educators and teachers are co-learners, and that learning is a process of changing one’s participation in a particular community (Lave and Wenger, 1991; Wenger, 1998).

**Method**

**Case Background**

This study is a case study (Yin, 1994) on an intervention and the context in which it occurred. The case involved a teacher educator and two research assistants (the research team); together with 60 elementary school teachers in the first term of year two of a three-year project. The teacher educator is the investigator will be referred as “I” in this paper. In that project, the teacher educator recruited teachers to participate from one to three years. The first year of this study involved the development of an MPP task inventory by grade, content strand, and type according to Tsubota (1987); 52 tasks were resulted. The case is situated in a district in the south of Taiwan, where 105 elementary school teachers assisted me in collecting children’s responses and
piloted tasks. In the second year of the project, 60 selected teachers participated and used the tasks to teach mathematics while I acted as a facilitator who described and coded the implementation results of teachers enacting the tasks. There were 10 teachers from each grade (grades 1 through 6).

In the final year, three teachers conducted action research and continued their journeys (reported separately). Note that the number of teachers participating in this phase was controlled by me. I chose to allow only a smaller number of teachers as the level of involvement (Hensen, 1996) increased over time.

In Taiwan on every Wednesday afternoon, elementary school teachers do not have class; the time is reserved for attending in-service training and accumulating credit hours. In this project, this series of Wednesday teacher seminars were split into two sections for each term. The first section was conducted for provision of tasks and coding methods before the implementation period (seminar one). The second section was used to share results of implementation (seminar two). The implementation period occurred between the two seminars. As issues arose that required attention, teachers communicated with peers or the teacher educator through emails, phone calls, or by additional meetings in small groups.

Three sessions of seminar one were conducted on the first three Wednesdays of the term with 20 teachers each from the lower (grade 1-2), middle (grade 3-4), and upper grades (grade 5-6). The first feature of seminar one was for teachers to experience MPP in pairs. They acted as children while I acted as an elementary school teacher. These “elementary school children” posed problems, and when they did not understand, they asked questions and the “teacher” showed how to answer these questions. Frequently asked questions were recorded to compare with questions asked by children during the implementation period. The second feature of seminar one was categorizing children’s given problems. This exercise in coding consisted of problems posed by teachers during the seminar as well as those posed by children during the first year of the study. I introduced categorization scheme by Leung & Silver (1997) for this coding component.

Children’s posed problems were classified into 5 categories. The codes were: 1=Not a problem, 2=Non Math, 3=Impossible, 4=Insufficient, 5=Sufficient or Extraneous. Figure 2 below includes one real example of children’s given problems in each category. The scale was categorical, not ratio; a problem coded as ‘4’ is not considered twice as good as a problem.
As seen in Figure 2, the first type is not-a-problem; such “problems” are actually only a description or a phrase. The second example, “Who ate the cake?”, is a problem, but not a mathematical problem. The third is an impossible math problem; no answer can be found using given information; even when more information is supplied. The fourth category, insufficient, is different from the third in that insufficient problems can be solved if missing information is added. Finally, the fifth category is sufficient (this includes those problems with extraneous information).

The implementation period started right after seminar one. Teachers were free to decide on when to use which task and how to use the teaching materials they received at the first seminar. They acted as my junior partners, taking on involvement at level two (Henson, 1996). During the implementation period, teachers collected examples of children’s work in each category and used the provided self-addressed envelopes to share results. At the end of the term, teachers attended Seminar Two, where they reviewed examples of children’s work and discussed how they used children’s own problems to teach. Common difficulties and successes were also reported. All teachers who attended seminar one returned information about actual implementation (tasks used, grade level, children’s scripts). Due to time conflicts 14 teachers had with end of term routines, a total of 46 teachers attended seminar two and completed questionnaires.

Data Sources
Various types of data from the seminars above were collected in the following ways:

Teacher educator’s reflections (TER). I kept a journal throughout the implementation. At each of the meetings, I recorded the types of problems that teachers posed as well as the types of questions that teachers asked as they attempted to categorize posed problems. During seminar two, I collected data pertaining to tasks used by teachers, selected children’s posed problems, and problems that teachers encountered as well as how they solved these problems. I also recorded the emails or phone contacts of individual teachers or small groups.

Children’s scripts (CS). I received by post the children’s scripts sent by
60 teachers after the implementation period. A script contained a collection of children’s work pasted onto a single sheet of paper (A4 size, vertical, see Figure 2). The paper format was specified in seminar one. The top of the script contained the item itself. Below the item were five horizontal blank boxes marked “1” to “5”. They were designed for teachers to collect sample work from each of the five categories. Children wrote at least one posed problem to each given item. The teacher categorized problems as “1” through “5”. When all posed problems to each item from the whole class were coded, the teacher selected and pasted at least one representative work onto the script for that item. The research team double checked the results of the categorization after receiving the CS in the mail.

**Teachers’ questionnaires (TQ).** Finally, during seminar two, we collected questionnaire data that examined how teachers and children felt and performed when MPP was implemented. We also asked if they were interested in doing action research in the coming year. The questionnaire consisted of the following probes:

1. What type of tasks will teachers consider in MPP?
   *When deciding on a task, what concern(s) do you have?*
   *In implementing the task, how did you get your children to do MPP?*

2. What types of problems are produced by children? Can teachers categorize them?
   *Is there any difficulty in using the categorization scheme?*
   *Is there any recommendation for revising the scheme?*

3. What are the successes and difficulties of teachers during implementation?
   *Did your children understand the task? Did they ask questions? What did they ask? Please describe the feelings of the children. Please describe how the teacher felt when seeing children pose problems. Write about any fun or pain about implementing posing problems.*

4. Are you interested in doing action research in the next school year?

**Data Analysis**

Each of the methods for collecting data was analyzed separately, using either quantitative or qualitative analyses. For children’s scripts, teachers coded responses according to the problem types they practiced during seminar one. The investigator and graduate research assistants double checked that children’s work on the scripts was placed by the 60 teachers into the correct categories (Leung & Silver, 1997). Descriptive statistics showed counts for each of the five categories from tasks 1 to 52. I began with a particular analytic framework with expected categories of responses (Leung & Silver, 1997) and examined how teachers used the framework. For teachers’ journals
Results and Discussion

In this study, teachers were actively involved in research when they chose to do problem posing with the tasks that they picked, coded children’s work, and used results of posing in teaching. They were no longer helpers in data collection (level one) but they were also not yet action researchers (level three). Therefore, teachers were at involvement level two (Henson, 1996), where both teacher educators and teachers function as learners in a mutual reciprocal influence of knowledge (Jaworski, 2008); where both are teachers in a broad sense by Krainer and Wood (2008).

Instead of teacher educators designing programs to influence the methods of classroom teachers, this study indicted that teacher educators can work and learn together with teachers. Below, I report and discuss what I learned from walking through the implementation journey with a group of teachers. I used the three data sources (TER, CS, TQ) to improve my knowledge of how my teachers a) considered and used tasks, b) used the coded children’s work and results in teaching, and c) responded to matters arising in teaching. In each case, I used at least two of the three data sources to inform my understanding.

What did I learn from working closely with teachers? I consider why and how teachers enact research-based tasks, how teachers use the coding scheme to analyze children’s posed problems, and the techniques, challenges and strategies they employed in enacting MPP.

Enactment of Research-based Tasks

MTE shared knowledge of research-based tasks. As mentioned in detail above, seminar one consisted of a briefing on problem posing tasks. Teachers were divided into groups of two and were asked to pose problems as elementary school children. I purposely asked teachers to watch how I responded to questions and led the discussion when the teachers orally presented the problems they posed. When the learners asked for a problem-posing example, I did not give an example but said, “No, no. Try to think it over. If I give you an example, you will pose a problem similar to my example!” All the problems posed by teachers during seminar one belonged to the sufficient category.

Teachers shared knowledge from enacting MPP tasks. After seminar one, I made notes on how teachers posed problems, raised questions, or gave suggestions. In my reflections on curriculum integration, I realized that the teachers were concerned with the alignment of the tasks to their curriculum.
They also wondered if they could prompt children to pose problems that were suitable for specific topics (e.g. “What if children pose a problem that does not belong to that chapter?”, “What if the problems are too difficult for them to solve?”). The teachers also asked questions about the format of students’ answers to the tasks (e.g. “Can children draw or read out loud instead of writing?”, “Do I need to give examples?”). Finally, teachers made suggestions on the wording and format of the tasks (e.g. “Algorithm” is a difficult word for lower grades. Question number “30.” and the beginning of item “15” should be separated to avoid children reading it as a decimal “30.15”).

Lastly, I analyzed the teachers’ questionnaire responses by focusing on the reasons for why these school teachers considered tasks and how they used each task. From the analysis I learned that when teachers considered a task, they would check the difficulty level (e.g. “the item with a picture of few eggs and two broken is great for grade one; children automatically made up interesting math problems after getting this item”), the children’s familiarity with the task (“the item showing TV program and time is one I chose because children are familiar with TV timetables.”), and if the mathematical topic was appropriate “I chose the Egg item because children were learning Number composition and decomposition on that day”).

I also learned more about how the teachers set up tasks. Out of 46 teachers, 38 asked children to handwrite the problems and two others asked the students to discuss in groups before orally reporting the problems. One teacher even asked children to rate the task or problems that their peers made. This teacher reported that the children loved difficult problems or problems related to real life situations.

Analyzing Children’s Work Using the Coding Method

MTE shared knowledge on the coding method. In seminar one, the second part of the session focused on coding student work samples. In order to facilitate the transition of roles from experiencing posing as children to categorizing children’s problems as teachers, I announced, “Let us read children’s posed problems. Remember that you are teachers now, not children.” During the categorization exercise, the teachers were amazed to see real examples of children’s problems in the five different categories. Teachers asked me to clarify the distinction between the Not a Problem and Non Math categories as well as the distinction between Impossible and Insufficient.

Teachers’ reports on coding children’s work. After seminar one,
teachers introduced problem posing in their classrooms whenever they found it appropriate. Though teachers worked independently and chose their own tasks, they could discuss with colleagues in the same school. At times, they called me and asked questions like “Can I use grade five tasks for grade six?” Some of them collected children’s diaries on an irregular basis and kept journals themselves. When students posed problems that fell under the Not a Problem or Non Math categories, teachers directed children’s attention to the instructions and asked them to “make up a problem” instead of using the word “pose.”

After students posed their own problems, teachers used the children’s posed problems to teach in the classroom. They invited children to be teachers and to fix the sample problems that were in the other four categories. They found that this type of discussion made other students more aware of the structure needed in order for a problem to be considered sufficient. One teacher noted the success of these discussions in her journal when she wrote, “After we do problem posing, children spot out problematic items on a test and do not even solve them” (TJ).

**Sharing knowledge by reviewing children’s scripts.** The final data analysis was conducted on the work given by children. Teachers returned a total of 2,204 children’s posed problems. Three findings from the analysis of these scripts are of note. First, all 52 tasks were implemented; there was no task that the sixty teachers did not attempt to use in instruction. Second, 84% of all children posed problems were plausible mathematics problems (75% with sufficient information, 9% without). When the teacher educator was working closely with teachers, having them to experience problem posing before enacting such tasks, children generated a high percentage of plausible mathematics problems. In contrast, when researchers have presented problem posing tasks directly to children, the finding was that “children could not pose reasonable math problems” (see Leung, 2009). Third, 11 tasks contained children’s work in all five categories. For the remaining 41 tasks there are missing examples in at least one of the 5 categories. In future training sessions the researcher can use this result to display actual examples (esp. to the 11 tasks) in order to explain the scheme of 5 different types of children’s posed problems.

In seminar two, teachers attended small group meetings to discuss children’s work and noticed that the posed problems revealed the children’s understanding or misunderstanding of mathematical concepts. For example, in one item there is a picture of a mug of hot liquid next to a thermometer
showing 49 degrees Celsius. A teacher reported what her children’s responses to this item revealed. The sufficient math problem (category 5), “Mom heated the tea to 5 degrees higher, what is the final temperature?” indicated a second grader’s consideration of addition of numbers up to two digits (part of the grade 2 curriculum). The problem, “How much tea will 7 mugs contain altogether?” was an insufficient problem (category 4) as the capacity of the mug is missing. In category 3, the teacher’s selected children’s posed problem was, “If my brother had a fever, and his temperature in the morning was 25 degrees and also 25 in the afternoon, what is his total temperature for the day?” This is an impossible problem for two reasons. First, the temperature, 25 degrees, is too low for human beings. Second, the adding of the two temperatures does not make sense as an indicator of the total seriousness of the fever for the whole day. For category 2 (Non-math), the example was, “Do you like soup with steam?” Finally, the example for not-a-problem was, “The temperature is 49 degrees, the capacity of the mug is 4 kg”. It belongs to Not-a-problem category.

In addition to learning about students’ understandings and misunderstandings, the exercise of classifying responses enabled the teacher educator to see if teachers understood the categorization scheme. In the above item, one teacher regarded “What is the price for a mug of coffee?” as impossible while another teacher considered it as a problem with insufficient data. In reading teachers’ reports such as this one, the teacher educator learned that although the categorization scheme was explained, there were still problems with the distinction between Impossible and Insufficient.

I also explored teachers’ comments from the questionnaire on classifying children’s responses. A total of 36 teachers were able to use the scheme, and 20 said that they needed to ask colleagues for help. Concerning the coding scheme, 17 found it hard to use; nine said, “No opinion;” and 20 said, “Great, no problem.” Those who found the coding scheme hard to use needed more examples to understand the categories of Non-Math, Impossible, and Insufficient. Teachers also suggested rejecting or demoting problems that did not match the given situations and problems that were not realistic (e.g., problems where a boy’s age is greater than his father’s age or the height of a grade one child is 23 cm). Some teachers gave extra credit for wonderful problems. Finally, one teacher wrote, “I prefer only two categories: a problem or not a problem.” Indeed, this simple coding system is user friendly and may be best for teachers at an early stage of attempting to integrate MPP into instruction. However, the more complex coding scale (5
categories) is useful for teachers who are serious about adequately integrating MPP into their teaching.

**Responding to Matters Arising During Teaching MPP**

My motivation for an implementation program was to combine teachers’ needs (e.g. tasks, coding) with my solution of providing examples. Naturally, issues concerning the implementation program did not arise until we began working together since it is difficult to combine an educator’s view of theory and research results with teachers’ knowledge of students and schools (Jaworski, 2008). Five issues that arose as we worked together are described below in detail.

First, teachers discussed the challenge they came across when children asked questions about problem posing. It is interesting to note that the questions that children asked teachers during the implementation period were similar to the questions the teachers asked the investigator during seminar one (e.g., What problems do you expect me to pose? Do I need to solve them? How many shall I pose? Can you give me examples?). Teachers liked to discuss how they dealt with such questions in their classrooms.

Second, teachers were also concerned with children’s ability to understand the process of MPP since it was their new way of learning. The group of 60 teachers was given the opportunity to reflect upon their practice and report success or failure when completing questionnaires in seminar two. At the beginning of the implementation, children did not understand what they were supposed to do. Only 16 teachers wrote “my children understand,” whereas others expressed that the children were having a hard time. Students’ understanding was assessed by the statements they made and the types of questions that they asked during the implementation, such as: Should I use all information? Do I need to supply an answer? Can I pose this problem? Is this problem a wrong problem to pose? What shall I do if I cannot pose? I do not know what I am supposed to pose. I have not done a similar task like this before. During seminar two, teachers reported that students’ frustrations had subsided. Children became used to the activity and loved it.

Third, in addition to the above concern on understanding of MPP, teachers were also attending to children’s feelings toward MPP. Since there were six participating teachers in each school, a pair for each of the grade levels, teachers were free to talk about children’s feelings and also how they felt in teaching MPP. More than half of the teachers replied that their children were positive towards MPP (e.g., “Very excited with being creative.” “There’s a sense of achievement.” “Children loved to share problems in
10 teachers reported mixed feelings from their classes (e.g., students were excited about MPP but it was still painful during implementation; children were excited that they were asked to pose, but they felt pained if they could not pose a legitimate problem according to the given information; students who were able to pose problems easily were excited whereas their less successful counterparts expressed frustration). Finally, seven teachers conveyed negative reactions (e.g., children disliked doing it again and again, not feasible for grade one, exam-oriented children asked how many points they get from posing one problem).

Fourth, I captured teachers’ feelings, 33 were positive towards this implementation. Some of the positive comments made by teachers are listed here:

* I feel easy when I go to class;
* I look forward to the day when I can do posing;
* I do not differentiate high and low achieving children… in posing.
* All can pose problems using their own perspectives.
* Unlike problem solving, children do problem posing without pressure;
* I am touched by what they can do in posing.
* I realized that some of my children have hidden potential;
* now I see their levels and can adjust my teaching to give appropriate challenge at their levels;
* MPP makes my lesson open and free.
* The boys and girls are energetic and are in good moods.

Other teachers had more negative feelings towards MPP. These teachers conveyed feelings of frustration when children could not pose problems. Some also found difficulty in implementing MPP when the class was heterogeneous in abilities.

Fifth, the MTE made sure that teachers’ effort were recognized and shared in group settings. At the end of the implementation, 46 teachers met at seminar two. A glossary of real examples or responses to the 52 tasks was distributed to all teachers at the seminar. As teachers turned the pages, read, and pointed to examples they said, “This is the one that I sent back.” Sharing the results of the teachers’ work proved to be a feasible way to empower teachers.

**Conclusion**

In this study, I explored how 60 teachers who were participating in research at level one the preceding year could work at level two, and prepared them to participate as action researchers in year three. I adopted Henson’s (1996) three involvement
levels in research design. Given that the three parts of this MPP research project were developing research-based tasks [I], enacting tasks [II], and classifying children’s work and use results in teaching [III]), then the three levels of teacher participation in research map onto the three parts as follows:

Level One: Teachers assist in developing task by data collection. [Helpers; I only].

Level Two: Teachers decide on when to use which tasks, use coding scheme then suggest how to revise task and coding. They also suggest ways to use children’s work in teaching. [Junior partners; II, III only].

Level Three: Teachers conduct action research. [Equal partners; I, II, III].

In walking through this journey with teachers, I found that a feasible initial step for the implementation of MPP is the use of tasks to integrate with the curriculum. The implementation of a set of tasks based on 24 categories obtained by pairing four curriculum strands with six problem-posing types (Tsubota, 1987) in a program for teachers can provide important data for developing a book of MPP tasks. This book of tasks, with real sample work from children for the five possible posed problem categories (see Leung & Silver, 1997) and a section of tips for teachers who try problem posing in teaching, will allow more depth for teacher training sessions and research on teacher development. An example can be found in Parke et al. (2003) concerning tasks and scoring rubrics for classroom teachers’ instruction and assessment. The findings from this study regarding challenges and strategies will inform the teachers’ action research in year three; three teachers continued to explore additional tasks for MPP for different grade levels and for specific topics, and cases of individual’s or teaching can be documented as exemplars (see Stein et al., 2009).

Building on the findings of this study, future research is needed on how to implement problem posing and the conditions that allow students to perform well on MPP, including teachers’ inexperience with implementation (Leung, 2009). Researchers should strive to find actual examples of children’s work in year 3 rather than made-up examples. One way to do this would be by allowing teachers to invite children to critique and rewrite the problems so that they can be understood and solved by peers. This attempt-report-share in a group setting model provided support in the community and was salient in teachers’ professional development. In sharing, teachers obtained ideas on problem-posing tasks while the teacher educator acquired information about classroom constraints. In this study, teachers voiced their queries and suggestions boldly and the investigator listened patiently. Listening is clearly an important part of in-service programs (Cooney & Krainer, 1996).
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Figure 1. Four Phases in Problem Posing and Problem Solving

Understand (Pose)

Look Back

Plan

Carry Out
Figure 2. Codes, descriptions and examples of children's work

<table>
<thead>
<tr>
<th>Codes/Description</th>
<th>Examples</th>
</tr>
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| 1. Not a Problem   | A can of soda is poured into 8 equal cups, Chin drank 4/8 litres, Lip drank 2/8 litres, Jay drank 2/8 litres.  
|                   | <This is a description, not a problem> |
| 2. Non Math        | Who ate the cake?  
|                   | <This is not a mathematics problem.> |
| 3. Impossible      | A watermelon is cut into 10 parts. Ming ate 4/8, Ying ate 2/8, Wah ate 3/8, how much is left?  
|                   | <The problem is impossible as there's no left over.> |
| 4. Insufficient    | A piece of cake is cut into 8 equal parts. Wah ate 4/8 of the piece of cake, Ming at 2/8 of the piece of cake. How much of the piece of cake does Kong eat?  
|                   | <This mathematics problem has insufficient information to provide an answer.> |
| 5. Sufficient      | After my two sisters ate 2/4 of the piece of cake and 1/4 of the piece of cake, how much can my brother eat? |

35. A piece of cake is cut into 8 equal parts. Wah ate 4/8 piece, Ming ate 2/8 piece, Kong ate 2/8 piece.