The Effectiveness of Short-Term In-Service Training in the Context of Teaching Mathematics for Understanding

Debbie Marie B. Verzosa, PhD
Ateneo de Manila University

Abstract

Despite its obvious limitations, the short-term in-service INSET model is a common form of continuing teacher education in the Philippines. This paper is a qualitative study aimed to determine the extent to which a short-term INSET program can communicate pedagogical principles and transform teaching practice. This article reports on four of the themes that emerged from the analysis; namely, (1) miscommunication, (2) persistent dominance of instrumental understanding, (3) preference for specific classroom strategies, and (4) varying attention to mathematical goals. These results show that the INSET was effective to the extent that teachers understood the pedagogical basis of classroom strategies shared during the INSET. Otherwise, these strategies may be implemented superficially, with little attention to mathematical goals. Implications for teacher educators are proposed.

Introduction

Despite questions surrounding the effectiveness of short-term in-service training (INSET) programs, it has been the dominant model in the Philippines for at least the past 30 years (Nebres, 2006), and there are no visible signs that this will suddenly change. It is thus important to investigate the effectiveness of INSET despite its obvious limitations. Are these programs practical, and is there a way to increase the odds that teachers implement pedagogical strategies introduced during an INSET program? Consequently, this study aims to determine the extent to which a short-term INSET program can communicate pedagogical principles and transform teaching practice.

This study was conducted in the context of a short-term INSET program whose overarching goal was to develop *relational understanding* as opposed to *instrumental understanding* (Skemp, 1986). Relational understanding was developed in the context of teaching place value, which is one of the fundamental ideas of primary mathematics. An indication of relational understanding is the rich connections between concepts and mathematical symbols used in primary mathematics. In a sense, this INSET can be considered ambitious because it targeted higher-order cognitive skills. As Fullan (1985) argued, "teaching basic reading and mathematics is one thing; teaching students to think abstractly, analyze and solve problems, and write effectively is another" (p. 397).

Relational teaching of place value concepts

Relational understanding of place value concepts may be evidenced by solid connections among verbal names, written numbers, and quantity (Shane, 1999). For example, the written numeral 42 must be associated with its verbal name as well as the quantity it represents. Moreover, understanding quantity also involves an understanding of the decimal structure of the number system. Children should be able to connect the digit 4 in the number 42 *both* to the quantity 4 tens or to 40 ones (Cobb & Wheatley, 1988). By having a network of number relationships, they are better able to develop mental strategies, especially for tasks where the decimal structure is apparent (e.g., 47 + 10, 99 – 20). (Ellemor-Collins & Wright, 2011).

The traditional curriculum, however, is often focused on instrumental understanding. Place value tasks are often limited to labeling digits as *ones, tens,* or *hundreds*, with little consideration for the quantities these digits represent. The decimal structure of number is seldom emphasized. The goal of such tasks is to help students master the conventional vertical algorithms for addition and subtraction (Ellemor-Collins & Wright, 2011). However, correct solutions do not guarantee relational understanding. Children who can follow the rules without any mistake may be able to solve a task such as 42 + 39 even without realizing what each number represents. Tasks involving place value "become games about sticks and writing, not about numbers" (Ellemor-Collins & Wright, 2011, p. 44).

The problem with instrumental understanding is that rules can be easily distorted and forgotten, especially as more rules need to be remembered.

Several teaching programs have been informed by the extensive research on place value. For example, Hiebert and Wearne (1992) designed conceptually based instruction that was "built on the notion of constructing connections between mathematical ideas" (p. 99). In their classrooms, children were not taught a step-by-step procedure (e.g., "do the ones first"). Rather, they were encouraged to solve tasks in ways that were meaningful for them. Essentially, such interventions were aimed to develop *conceptual place value* or CPV (Ellemor-Collins & Wright, 2011). CPV instruction focuses on quantity value, with an emphasis on mental computation and structuring multidigit numbers. Teaching materials include ten frames, double ten frames, hundred grids and the like as these promote the concept of ten as a unit (Wright et al., 2012).

Method

This paper reports on a two-day INSET program that the author designed and facilitated. This was carried out within the mandatory INSET of the Department of Education (DepEd). The author took on the dual role of INSET facilitator and researcher. As a facilitator, the primary goal was to promote relational understanding in the context of place value. As a researcher, the aim was to evaluate the classroom impact of the INSET insofar the responsibilities of a facilitator are not compromised.

Participants

The Department of Education typically includes INSET during the summer and/or semester breaks. The content and organization of the program is left to the division or school head. This study was conducted within one such program, located in a rural area. There were roughly 54 participating lower primary mathematics teacher, and one observer (the principal). The number of teachers varied across the three days because of various reasons (e.g., some teachers of kindergarten were suddenly asked by their supervisors to join the program; some teachers were suddenly called to perform other school duties). Excluding the opening ceremonies for each day, the morning and afternoon session each lasted 2.5 hours.

The INSET program

The aim of the INSET program described in this study was to develop relational teaching strategies in the context of place value. There was an intention to strike a balance between presenting pedagogical theories and concrete classroom strategies. The strategies presented during the INSET had been piloted with a group of students in one public school. A detailed overview of the INSET structure is provided below.

Day 1, Session 1 (AM). The teachers were engaged in a "Memory Game" activity adapted from Skemp (1986). They were asked to memorize the same set of 15 symbols in four minutes. However, for half the teachers, the connections between the symbol and the concepts were stronger. For the other half, the symbols seemed to be random. For example, in the "strong connection" group, the symbol for ship was an amalgamation of the symbols for *container*, *moves*, and *water*. However, for the "random group", the symbol for ship consisted of the symbols for *infinite, slide*, and *smooth*.

After four minutes, the teachers were given tasks that required them to draw the symbols for some given words, like *driver* and *captain*. They were also asked to draw the symbol for *swimmer*, which was not on their list. This exercise was an introduction to a 20-minute discussion on the importance of linking symbols to concepts. The objective of this exercise was to provide a concrete experience of the difficulty of memorizing symbols devoid of concepts, the short-term nature of memory, and the low likelihood that memory alone can facilitate successful solutions to new tasks (such as the *swimmer* task above).

Day 1, Session 2 (AM). The second session was entitled, *What if we only had six fingers?* The activity involved adding and subtracting in base six notation. The author's purpose was *not* to teach how to perform operations on base-six notation. Rather, the activity was used as a way for teachers to understand how young children may grapple with place value concepts by exposing them to the same competencies in elementary mathematics, but in the unfamiliar territory of base six notation. To do this, the author taught addition and subtraction of two- to three-digit numbers in base six, using an algorithmic procedure, while intentionally *not* emphasizing

connections between the numeral and the quantity it represented. The objective was to help teachers understand the difficulties their students may encounter when they try to learn the standard algorithms without understanding by exposing them to instrumental teaching. The session was followed by a discussion about the mathematical knowledge necessary for solving multidigit addition and subtraction tasks with understanding. These goals were consonant with McClain's (2003) work with pre-service teachers, where she asked teachers to solve base-eight additive tasks situated in the real world.

Day 1, Session 3 (PM). This session connected the morning activities with pedagogical theory. Specifically, the key concept of the INSET was introduced. The term "Knowing numbers" was used, for easy recall. By *knowing* numbers, students gain access to connections and develop a relational understanding of the topic. There was also a discussion of the importance of communicating mathematical concepts through various modes of representation. Some classroom strategies presented were subitizing[1] tasks (Clements, 1999), number composition and decomposition, the forward and backward number sequence (Wright et al., 2012), locating numbers on a number line (Wright et al., 2012), and estimation tasks (McIntosh et al., 1997). Strategies were selected based on whether they can be carried out in a few minutes (Shumway, 2011), knowing that teachers are often bound by the curriculum and time constraints. Several teaching materials such as ten frames, double ten-frames, ten strips, and hundred boards (Wright et al., 2012) were presented. A list of possible tasks based on these teaching materials was presented and provided as hand-outs. Towards the end, concrete strategies for fractions were presented, but this topic is not the focus of this article.

Day 2, Session 1 (AM). Recreational puzzles were presented, primarily meant as a "warm up". However, some mathematical goals included the development of non-routine problem solving ability as well as tenacity to solve a seemingly difficult problem. After the activity, the author facilitated a discussion about how teachers felt as they tried to solve the puzzles.

Day 2, Session 2 (AM). After a short review of the previous day, the author engaged the teachers with a discussion of relational versus instrumental (or what was termed "cookbook") teaching styles. The classroom strategies presented during the first day were also extended. At the end of the morning session, teachers formed groups of five or six, and each group was assigned a set of classroom activities aligned with the INSET goals. Some activities were lifted from books or teacher journals. Each group was tasked to present the activities as if they were in their own classrooms. The group presentations were expected after the lunch break.

Day 2, Session 3 (PM). Each group delivered the group presentation.

Data Collection

In planning the data collection, the author was mindful of two limitations. First was the short duration of the INSET program. Having the dual role of researcher/facilitator, the author found it important that the data collection did not take too much time from the program itself. The second limitation was related to the difficulty of following up on the teachers after the INSET. The teachers' access to the Internet was very limited, making communication via email unrealistic. Classroom observations were also not feasible because as an outsider, the author's presence in classrooms can be taken as intrusive or threatening. Nevertheless, the author collected a range of data sources, as described below. All teachers were informed of the research and signed a consent form.

Fieldnotes. Immediately after each day of the INSET, the author recorded the INSET as it was experienced. The fieldnotes were both descriptive and reflective (Howard, 1995). It contained personal observations and feelings about the INSET.

Teacher Evaluation. At the end of the workshop, the teachers were asked to respond to an evaluation form. A total of 41 teachers completed this form. Seven open-ended questions (e.g., What part of the workshop can you try in your classroom?) were asked.

Follow-up interview. Five months after the INSET, the author interviewed 13 teachers who

[1] Subitizing refers to the ability to instantly recognize the number of objects in a given set. Humans can recognize small numbers (1,2,3) very quickly, but usually rely on strategies (e.g, grouping) to recognize larger numbers (Clements, 1999).

taught in 6 of the 14 participating schools. These 6 schools were selected based on accessibility—these were the schools that were close to the highway, and thereby accessible by public transportation. In one school, the two teachers were interviewed individually but for the rest, teachers in the same school were interviewed at the same time. This resulted in 7 interviews. The goal of the interview was to assess how (or if) the teachers used the strategies suggested during the INSET in their own classes. Interview questions covered the teachers' previous INSET experience, the aspects of the INSET that they liked most/least, the aspects they found most useful, and whether their students found place value, addition, and subtraction difficult.

Audio Record of the Group Presentations. The group presentations at the end of the INSET were audio-recorded, in order to provide a glimpse of how teachers interpreted the INSET and how they may use the strategies in their classrooms. The audio records can provide additional bases for analysis because classroom observations were not feasible.

Data Analysis

The interviews and the audio records of the group presentations were transcribed. These, together with the fieldnotes and the teachers' responses to the evaluation form make it possible to cross-reference findings and establish triangulation. Using a process of theoretical coding (Auerbach, 2003), each data source was initially scanned to get a sense of the data. During the second reading, a set of approximately 30 repeating ideas and responses were noted. These repeating ideas were grouped in clusters, with the goal of identifying a small number of themes and produce a coherent account of the INSET program.

For example, some repeating ideas are (1) based on the evaluations, 12 teachers enjoyed the group presentation because these are fun; (2) manipulatives and were thought to be important because these are what children enjoy, or also because these can be used to represent particular mathematics concepts; (3) mathematical games were implemented in a way that the mathematics is lost; (4) interviews revealed that teachers were also concerned with non-mathematical demands such as developing reading, doing house visits, etc. These repeating ideas were clustered under the theme "Varying attention to mathematical goals".

Five themes emerged from the data, four of which will be discussed in this paper. As each of these themes will be discussed, supporting evidence from the set of repeating ideas will also be provided, to give basis for how each theme was generated.

Results

This study aimed to investigate the extent to which a short-term INSET program can communicate pedagogical principles and transform teaching practice. Five themes emerged from the analysis: (1) miscommunication, (2) persistent dominance of instrumental understanding, (3) preference for specific classroom strategies, (4) varying attention to mathematical goals, and (5) language obstacles. Due to space constraints, only the first four themes are discussed in this article.

Miscommunication

Being the INSET facilitator herself, the author clearly knew her ideas were intended to be interpreted. Lapses in communication are not necessarily due to deficiencies, but may also be due to how the facilitator and teacher filter messages through their own notions. Some clear forms of miscommunication occurred during the INSET, as when some activities designed to help teachers reflect on their own teaching were interpreted as activities for first- to third-grade children. For example, the activity "What if we only had six fingers" activity (Day 1, Session 2) was intended to help teachers reflect on the kinds of knowledge necessary to understand place value and multidigit addition or subtraction. However, the observing principal (who was also a former mathematics supervisor) saw the value in the activity differently. He expressed to the whole group that the activity was ideal for children who always count with their hands. He proposed telling children, "*Bilang ka nang bilang* [You're always counting]. What if you only had six fingers, how can you count?" Two teachers also wrote in the evaluation form that counting with six fingers will not be easy to do in the classroom because "it is not easy pupils to count in this manner". The author's frustration was recorded in my fieldnotes: "*Kahit sabihin ko pang paulit-ulit na hindi ito pambata, para sa inyo lang ito, nangyayari may* notion *pa rin sila na* [Even if I say it over and over that this activity is not for children, it's only for you, what happens is that they still have the notion]

that I'm suggesting that they have to use this strategy for children." Even the recreational puzzles that were intended to help teachers reflect on the mindset necessary for problem-solving were interpreted as puzzles suitable for young children: "I as a teacher hard up already in solving the puzzles, how much more if my pupils do it".

Persistent dominance of instrumental understanding

With the exception of Mrs. Rodrigo (a pseudonym), all teachers who were interviewed associated the learning of place value with correctly labeling the digits as ones, tens or hundreds, with little consideration for the quantities these digits represent. They also observed that their pupils often confuse the digits with each other: "*Magaling naman sila sa* place value. *Kaya lang minsan binabaliktad nila. Kung ano yung nasa* last digit, *yun ang nagiging* ones. [They're competent in place value. However, they sometimes confuse the digits. The last digit becomes the ones.]" In connection to this, the teachers described multidigit addition and subtraction with regrouping in terms of rules, and there was no mention of quantity. One teacher indicated that some of her students make errors because they add the digits starting from the tens place (whereas in the conventional algorithm, digits are added starting from the ones). One teacher observed, "*Kahit walang* regrouping, *i*-regroup *nila.* [Even if regrouping is not needed, they still regroup.]" Another recalled, "*Pag napunta na kami sa* subtraction *at* multiplication *na, pag mayroong* time *na* addition, *nakakalimutan na nila yung* regrouping. [Once we reach subtraction and multiplication, then go back to addition, they forget how to regroup.]"

Accordingly the teachers' classroom practices are meant to support their students' ability to remember the rules. To lessen confusion about place value, the teachers give reminders rather than highlight quantity: "*Kaya sinasabi ko basta yung* right *na* number, ones *yun. Sa* middle, tens. [That's why I say, the number on the right should be the ones. The one in the middle, tens.]" Similarly, when teaching multidigit addition, they focus on rules: "*Pag ang* sum is one to nine, *yun na ang* without regrouping. *Pag yung* sum *na* is ten *na*, *nag-umpisa na ang* ten, *yun na ang* regrouping [If the sum is one to nine, that is without regrouping. If the sum reaches ten, starting from ten, that's regrouping]." Even the observing principal who was formerly the mathematics supervisor relies heavily on rules, with little thought to how the rules are based on quantities. For example, he volunteered to explain that 1/8 is larger than 1/10 "because when comparing unit fractions, the fraction with the larger denominator is smaller." Teachers seem to be satisfied with this kind of explanation.

The teachers' view of mathematics as a set of rules may be an obstacle to extending the range of tasks or activities they can present in class. To illustrate, consider the following task presented during the INSET: "I have two numbers. Their difference is more than 10 but less than 20" (McIntosh et al., 1997). Because this task could not be readily transformed to a straightforward calculation, it provided an opportunity to think about quantity rather than perform symbolic manipulation. Further, it allowed for multiple solutions, thereby providing opportunities for many students to participate. When teachers were asked to construct a similar task, they struggled to do so while keeping the task objectives in mind. One teacher reverted to the more familiar single-calculation task when she proposed, "I have two numbers, their sum is even and one of them is 15."

The dominance of instrumental views of mathematics may partially be due to the teachers' limited opportunities to learn about teaching mathematics relationally. Interviews as well as conversations during the INSET revealed that teachers had never experienced an INSET program that focused only on mathematics for young pupils (Grades 1-3). Instead, their regular INSET topics were mostly focused on other subjects and the content was not necessarily on pedagogy.

Aside from a lack of INSET in mathematics, the teachers in this study also had limited access to professional resources. There was no bookshop in their area, and the Internet was not readily accessible. Thus, when teachers were provided excerpts of activities taken from teaching journals for their group presentations, they found it difficult to proceed. Fieldnotes indicate, "they were just staring at the paper. *Parang basa lang sila nang basa*. [They just seem to be reading and reading.] Then after maybe 15 minutes, *binalikan ko 'yung* [I went back to] Group 7, they were asking me what they should do."

Preference for specific classroom strategies

The structure of the workshop began with a discussion of pedagogical theory (which was introduced by the memory game adapted from Skemp (1986)), followed by a range of classroom strategies. Again with the exception of interview responses from Mrs. Rodrigo, who recognized the importance of connecting quantity to numerical symbols, there are no other data indicating that teachers remembered or appreciated pedagogical theories. In fact, two teachers specifically indicated that they did not find value in the discussion of pedagogical theories. One wrote, "The long lecture is the one I like least because I am not fun of listening. I want manipulative works," and the other liked the "first day of the workshop" least because "there is a lot of talking but at the end I've learned to enjoy also." By contrast, teachers appreciated the classroom strategies shared during the INSET. In the evaluation where teachers were asked to identify the part of the workshop they liked most, 24 responses pertained to teaching "techniques" or "strategies". One teacher preferred the present INSET over her previous INSET experiences where "*parang yung in*-introduce *lang 'yung kwan, yung* term *na 'yun*. *Tapos bahala ka na* teacher *kung pa'no mo gagamitin sa klase mo* [they just introduce the terms. It's up to you, the teacher, how to apply them in your classroom.]

Some teachers can remember and identify some of the teaching strategies that they found useful. For example 18 of 41 responses to the question about useful aspects of the INSET involved specific strategies (e.g., "Counting numbers backward and forward by 10s, 5s, etc. This is to let the pupils understand about numbers.") However, a large number of generic or vague responses in the evaluation form and in the interviews indicated that the potential for classroom use may be limited. In response to the question about what aspect of the INSET teachers liked most, 5 teachers said all (e.g., "all techniques presented are excellent, so I like most of them") and 12 identified non-specific classroom strategies that were shared (e.g., "Games, with the use of different strategies it will help us meet where our pupils are"). At times, the teachers who were interviewed struggled to remember details about the INSET.

Despite the teachers' appreciation for concrete classroom strategies, many were not convinced that the strategies can benefit their lower achieving students. For example, some did not find a game involving missing addends appropriate because children "are hard up to think of the correct answers immediately". Rather, they selected strategies that they felt were within their students' abilities, such as counting up and down by tens and ones because "it is easy for Grade 1 pupils to understand." During interviews, when asked whether they tried the count-by-ten strategy shared during the INSET in class, one teacher reported, "*Sa kwan lang* Ma'am, fast learners [Only to the fast learners]," and another teacher stated that only the fast learners were able to produce correct answers. The lack of confidence in using classroom strategies for lower achieving students occurred despite the fact that the author recounted how she herself had used these strategies with low-achieving children. In fact, many of the strategies that were shared were taken from work with low-achievers in mathematics (Wright et al., 2012).

Among all aspects of the INSET, teachers seemed to put the most value on those that involved concrete teaching materials. In the evaluation form, 19 of the 41 teachers included time to make materials as part of their recommendation—"I wish I could make all instructional materials being presented in today's workshop but limited financial assistance." Also, 5 of the 7 interviews revealed that the lack of time to make materials was a weakness of the workshop—"I think all the techniques presented are all applicable but the only problem is the time to prepare the visual aids used and the materials needed."

It seemed that the teaching materials were central and even indispensable to the discussion of improving one's teaching. None of the teachers who were interviewed reported any major change in their teaching that was divorced from the use of teaching materials. When asked what parts of the workshop were applied in the classroom, teachers from 2 of the 7 schools mentioned a game, while teachers from the other schools described the teaching materials they created (or the materials they wanted to create). For example, 3 of the interviewed teachers exerted significant effort to construct teaching materials out of cheap, recyclables, or readily available materials. One teacher animatedly described how she made dot cards and ten frames out of soapbox containers from the local store. Mrs. Rodrigo made hundred square grids through checkered table cloths commonly sold

in the public market. She also lamented her co-teachers' disinterest in constructing teaching materials: "*Sa akin, tingnan niyo, matanda na ako, ako ang pinakamatanda sa inyo, sabi ko* actually *sa kanila*, [I said, look at me, I'm old and I'm the oldest among you] but then you find me interested making these visual aids."

Varying attention to mathematical goals

Teachers interpreted the strategies presented during the INSET in two different ways. Either the mathematical objectives drove the application of classroom strategies, or these were merely incidental to the process of implementing classroom strategies.

Firstly, teachers may understand the mathematical objectives of the materials. One of the teachers interviewed described her use of double ten frames, "Useful *siya* Ma'am. For example, *ilan pa ang idadagdag natin para maging twenty? Pwede mo siyang magamit na ano*, *ng* subtraction *at* addition. [It's useful, Ma'am. For example, how many more do we add to reach twenty? You can use it for subtraction and addition.]" The clearest explanation for the use of teaching materials came from Mrs. Rodrigo, who was also the only teacher mentioned earlier who explicitly discussed some implications of the pedagogical theory discussed during the INSET. Although the INSET occurred after place value concepts had been discussed in school, she returned to these concepts after the INSET. She observed, "*Karamihan sa mga bata, totoo 'yun, na alam nila yung* number, *pero actually, kung i-present, hindi na nila alam kung ilan talaga yun. Oo, nababasa nila, pero kung actual na presentation kung ilan talaga yun, hindi na nila alam.* [True, most of the children know number, but in reality, when presented, they really do not know how many it is. Yes, they can read, but they do not know the actual presentation about how many it is.]" Her point is clear—even students who can recognize and read numerals do not always know what the numeral represents. For this reason, she constructed ten frames and hundred boards—"It's not for my own…I know *na kailangan ko kasi ay tinitingnan ko, hirap na hirap yung mga bata mag-imagine e*. [I need to do this because I can see that my pupils find it hard to imagine]"

For the most part, however, teachers did not connect the classroom strategies described during the INSET to mathematical objectives. For example, the number clothesline shared during the INSET was used by one teacher to teach the alphabet. For some, the teaching materials were primarily meant to increase enjoyment in learning: "Enjoy sila *pag yung talagang ano ka*, may *mga materials ka talaga*. [They really enjoy it if you have materials]."

The teachers' group presentation offered a glimpse as to how the classroom strategies, if implemented, may not necessarily advance mathematical learning. As mentioned previously, each group was provided some classroom activities that highlight the quantity represented by a number as well as how numbers are structured in groups of ten. However, the analysis of audio transcripts of this session suggests that this objective was lost, or at least not sufficiently emphasized. The focus of the demonstration was more about going through the activity and less about achieving the learning objectives. Each group attempted to implement their assigned activities as these were described on paper, but mathematical ideas were not discussed.

As an illustration, consider an activity assigned to one group. In this activity, four boxes arranged in a 2x2 array are drawn on the board. Upon rolling a die, the result is entered in one of the boxes. Play continues until all boxes have been filled, and the sum of the top and bottom numbers can be obtained. Essentially, the objective is to obtain a three-digit sum. Thus, if children roll a two, it is good strategy to enter two in the ones column, to get a better chance to obtain a three-digit sum. This game has the potential for developing connections between number and quantity because obtaining a three-digit sum may encourage children to think about the quantity that each addend represents. However, when this game was implemented during the group demonstration, the teacher just asked participants to roll one die while she herself entered the numbers in the boxes. No explanation regarding the process of entering numbers was provided. The author had to ask why she entered numbers the way she did. It was only at that point when the objective was stated ("We need to get a three digit number"). When all the boxes had been filled, the teacher said, "After we fill up all the boxes, then the children will be ready to add. So let's add [26 + 51 was written on the boxes]. Six plus one, seven. Then two plus five, seven...So if we obtain a three-digit number, the child gets 10 points. If it's a two-digit number, the child gets 8 points. Whoever has the highest score wins the game."

In this teaching demonstration, the teacher described how the game was supposed to be played (i.e., enter numbers, then add). However, because the objective of the game was not stated in the beginning, the numbers entered into the boxes seemed to have been done randomly. Thus, winning the game was determined by chance rather than by thinking about number quantity. Further, it seemed that the objective of the game was to correctly add two two-digit numbers. Even when the teacher added the numbers, there was no mention of the numbers "twenty-six" and "fifty-one". Instead, the numbers were treated as two separate digits (6 + 1 and 2 + 5), thereby drawing even less attention to the number represented by 26 and 51.

Some groups also modified their assigned activity in a way that de-emphasized the learning objectives. For example, one group was assigned to implement Count Around the Circle (Shumway, 2011). One aim of this activity was to help students count forward or backward by tens mentally. In this activity, students are to form a circle and, in a clockwise direction, take turns to call out numbers that increment or decrement by tens (e.g., 83, 73, 63, 53, 43, and so on). To simulate the activity, one member of the group acted as the teacher and 10 volunteers were chosen to act as the students. The group modified this activity as follows. Each of the 10 volunteer students were assigned a different letter (A to J). The person acting as the teacher called on Student A to start the activity.

Teacher: *Ok, then I'll go to flash a card, and then you're going to say what number that comes backward by tens. And then, uhm, letter A will choose what letter will come next.*

[Teacher flashes a card showing 95. Student A is expected to give the number that is ten less than 95.]

Student A: *Ninety-five, ninety-four [as if thinking], Ma'am, eighty-five.*

Teacher: *Correct?*

All students: *Yesss!*

Teacher: *Student A will choose what letter will answer. Who?*

Student A: *[Looks around to select the next person] Letter C. [Everyone laughs]*

This dynamic continued throughout the activity. Students (who were teachers in this case) enjoyed calling out letters because it gave them the opportunity to play and select the next person to answer. In the course of this activity, it seemed that the focus was on calling out a letter rather than saying the correct number. And because students had to call out a letter after each number, the counting activity was interrupted several times, making it difficult to form connections among the numbers in the sequence.

The rest of the group presentations were also implemented in ways that were neither expected nor intended. Fieldnotes reveal that the author regretted her decision to include these group demonstrations in the schedule. Surprisingly, an observer mentioned that the teachers enjoyed that part of the INSET. Despite the fact that the group presentations did not focus on the intended learning objectives, 12 teachers identified in their evaluations that they liked this part the most, and the general reason was its fun aspect. Some responses include "I like most the presentation of different games by group because it help us on how to make the teaching and learning enjoyable," and "When the teacher had a group work activities, and everybody participated and presented their output. This is to make the seminar lively and so on". The importance of fun and enjoyment also emerged from the teacher interviews: "*Yung* games. *Yung* last part, *yung* by groups. *Kasi dun, mas lalong na-enjoy naming yung kwan, kung paano mo ituro sa klase. Yung mga activities kasi, yan ang gusto ng mga bata. Yung laro-laro.* [The games. The last part, the one done by groups. Because that was where we enjoyed, how to teach in class. It's the activities that children like. The games]."

In fact, the idea of fun and entertainment repeated across multiple data sources. In the teachers' evaluation, 6 out of the 41 responses about what teachers liked most about the INSET involved enjoyment. One teacher reported that she liked the different strategies on "how to teach math in a very exciting manner, because as a math teacher, this will now help me to teach mathematics in a exciting manner". Teachers who were interviewed also appreciated the INSET because "*hindi kami na-*boring [we weren't bored]" whereas in some of their previous INSET experiences, "*talagang* bored *ka, inaantok ka 'dun*. [You're really bored and inclined to sleep]" Even the pedagogical strategies that were specific to mathematics were appreciated in terms of the enjoyment these bring. One teacher wrote the count up/down strategies as the part she liked the most "because it is easier to understand and makes

me happy". In the interviews, one teacher liked the ten frames tool (Wright et al., 2012), subitizing tasks, and the group activity. As she said, "*E kung* nag-enjoy *ang mga* teachers, how much more *sa mga* pupils. [If the teachers enjoyed, then more so for the pupils.]"

The apparent inattention to mathematical goals of many teachers should not be interpreted as negligence. As will be described in the next section, teachers may just have a different conception of what it means to do mathematics. Neither should the teachers' actions be attributed to laziness. In fact, some teachers went beyond their duties and extended free assistance to their students. This assistance may be in the form of regular house visits, summer workshops, and free tutorial services. Also, the teachers may simply be prioritizing other issues. One teacher explained, "*ang problema kasi namin po dito, kailangan magsabay yung* reading *nila 'tsaka yung* love *nila sa* math. [our problem here is that their reading skills should go together with their love for math]"

Discussion

The INSET program described in this article was interpreted by different teachers in different ways, and their interpretations may not necessarily align with the goals of the INSET. Some teachers explained how they applied some strategies in their own classes. Mrs. Rodrigo provided a very detailed account of how she created and used teaching materials in order to help her lower-achieving students connect number and quantity. By contrast, a number of teachers provided vague recollections of the INSET and could not identify specific aspects that could be used in the classroom. Furthermore, some teachers continued to espouse views of mathematics as an organized set of rules. They seemed to be satisfied that their students can correctly label digits as ones, tens, and hundreds, and solve place value and multidigit addition tasks by following rules and algorithms. They dismissed some of the relational tasks as inappropriate for low-achieving children. The differential usefulness of the INSET illustrates Grant, Hiebert, and Wearne.'s (1998) evaluation that "the beliefs teachers hold about mathematics and about teaching and learning mathematics filter what they see and what they internalize" (p. 233). Teachers who hold an instrumental view of mathematics do not see it as a major problem if students rely on rules without understanding. When rules are distorted or forgotten, the blame is on poor memory and an obvious solution is to provide frequent reminders. If the limitations of instrumental understanding are not recognized, then there would be little motivation to apply relational teaching strategies in the classroom.

Still, some of the classroom strategies shared during the INSET, notably the use of teaching materials, were applied in the classroom. However, even when such strategies were used, there was no guarantee that mathematical goals were pursued. Instead, the goal was more about increasing enjoyment or engagement in the classroom. Akyeampong et al. (2013) observed the same phenomenon across several African countries where "the use of manipulatives was seen mainly as making lessons more appealing to children rather than a critical bridge between the mathematical concepts and operations and their formal representation" (p. 279). In the context of changing classroom practice, teachers may tend to select the easier ones to implement (such as the use of teaching materials) and discard others, particularly when their pedagogical base is weak (Windschitl, 2002). This finding urges us to be mindful of the limitations of disseminating reform-oriented books, materials, or hand-outs, despite their obvious advantages (Nebres, 2006).

Teachers' instrumental view of mathematics may have strong implications on how they interpret aspects of an INSET program. Teaching with relational understanding requires a sound understanding of the mathematics needed for teaching in the elementary grades (Borko et al., 1992). Because many teachers in this study view place value as the ability to label a digit as ones, tens or hundreds, they cannot use place value as the basis for learning other concepts such as multidigit addition and subtraction.

Despite the unintended outcomes of the INSET, it is premature to conclude that INSET programs cannot promote relational mathematics teaching. First, the INSET was able to promote relational teaching insofar as teachers understood the rationale behind the pedagogical theories promoted during the INSET. These teachers were primed to use and even adapt the strategies for their classroom use. Second, although the same impact may not be said of teachers whose views did not (yet) align with

the pedagogical theories, it is also possible that their future experience may build up on this INSET and facilitate a gradual understanding of the broader pedagogical theories upon which the INSET's classroom strategies were based (Gainsburg, 2012).

Implications

Increasing the potential impact of a short-term INSET program is not a straightforward task. Still, it is important to understand how to increase the effectiveness of INSET because for practical reasons, it will continue to be integrated within the strategies of ministries of education and foreign aid.

This study presents a significant obstacle that short-term INSET programs need to address. There is a large chance that classroom strategies presented during INSET will be misconstrued if there is only a superficial understanding of the pedagogical theories. However, understanding a pedagogical theory to the extent that it can form the basis for teaching strategies is not easy to achieve (Grant et al., 1998). Developing teachers' understanding of pedagogical theory (in this case, relational teaching) must not be left to chance and should be a major issue in planning for an INSET.

One potential intervention research project for developing pedagogical knowledge is through the design of tasks and activities, that can be feasibly used in classrooms, so that teachers that transition from instrumental to relational understanding. Indeed, these teaching materials are often what teachers value and appreciate. The teachers in this study seemed to associate the relevance of INSET to new teaching materials. Of course, one caveat is that the use of teaching materials does not guarantee mathematical learning (Akyeampong et al., 2013). However, if INSET facilitators are aware that materials may be used superficially, they can be better prepared to integrate the use of materials in an INSET program. INSET facilitators should realize that teaching materials do not have an inherent feature that seamlessly facilitates learning (Meira, 1998). Rather, the affordances of these materials emerge from the way these materials are used as appropriate settings for classroom tasks (Wright et al., 2012). In the INSET described here, a large number of teaching materials were introduced, but teachers were not given the opportunity to reflect on how these materials can promote relational understanding. A possible strategy is to focus on few teaching materials and at the same time provide teachers ample time to develop tasks using them. It is then a major responsibility of the INSET facilitator to evaluate these tasks and see how they are consistent with the stated objectives of the INSET.

As an example, teachers could have been asked to design two activities that address the same mathematical goal (for example, learning how to increment and decrement by tens) using the same set of materials. However, one activity should adhere to a specific pedagogical theory (for example, connecting number to quantity), while the other one would not. Perhaps by designing such an activity, teachers may gain experience as to how pedagogical theories are connected to the choices they make in the classroom. The focus of the INSET then shifts some attention from the materials to how the materials are used.

As to future INSET programs, a focus on content knowledge is warranted because teachers' notions of mathematical understanding filter what gets communicated during the INSET. Teaching relationally requires an understanding of how mathematical topics fit into a conceptual whole. INSET programs that present classroom strategies and teaching materials are particularly relevant to teachers, but these tools should also be used to facilitate teachers' sense-making of broad pedagogical concepts. There should be opportunities for teachers to examine their beliefs and how these influence their classroom practice. Otherwise, there is always the risk that good teaching practices will be implemented in a haphazard and superficial way.

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