The effectiveness of a professional development program based on action research

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This study documents a school-based professional development activity conducted in a secondary school in the Philippines where five secondary mathematics teachers and the head of school participated in a program of action research. Qualitative research techniques were used to provide rich information on the changes made in teachers' pedagogical knowledge, practices and beliefs. Within the parameters of certain constraints, it emerged that action research as a form of professional development led to important changes.

Introduction

Major changes to the curriculum in the Philippines in the past eight years have led to significant professional development programs, particularly in secondary education. These professional development activities were mostly in the form of seminars or workshops where teachers attended designated training centers. This usually required teachers to travel, which entailed time away from school, and expenses such as transportation costs. While benefits from in-service training of this kind exist, it appears that some writers are questioning such approaches (Castle & Aichele, 1994; Fullan, 1991). Alternate approaches to professional development that are less costly in terms of valuable resources and which have resulted in documented benefits may better suit the needs of the Philippines. In this context, an investigation was conducted into the effectiveness of school-based professional development program based on action research. In particular, the study aimed to determine how the teachers' pedagogical knowledge, practices and beliefs are affected by their participation in this form of professional development, and to identify the constraints in using this approach.

Method

Five secondary mathematics teachers from a public secondary school outside of Metro Manila took part in this study. Four of the teachers taught at one of the four year levels of mathematics offered at the school, and the fifth teacher (who was the department head) taught at the third year level of mathematics. The head of school also participated in the study as an observer and facilitator.

At the time of this study, only two of these participating teachers had attended a one-week seminar on secondary mathematics teaching using the new curriculum that had been fully implemented in 1992. For two of the teachers, it was their first time teaching mathematics in their assigned year level. In the past, they were either teaching mathematics at a different level or teaching in another discipline such as language. All the teachers were taking classes of 50-80 students and had either eight or nine 45 minute lessons a day, except for the department head who took four lessons per day. This meant that they were teaching at least six hours a day for five days.

Action research was chosen as both a vehicle for promoting teachers' professional development and as a method for determining possible change. Action research is a cyclic approach aimed at improving practice through planning, acting, observing, reflecting, and revising (Kemmis & McTaggart, 1988). Cohen and Manion (p. 194, 1994) said that for "inservice development of teachers— improving teaching skills, developing new method of learning, increasing power of analysis, of heightening self-awareness" action research is an appropriate method. Similarly, Kemmis and McTaggart (1988) argued that action

research is a method designed to achieve both change and learning from the consequences of the change.

The study was carried out in four phases during the period July 1995 to February 1996. The first phase involved the selection of a suitable school and participating teachers. The second phase required the assessment of teachers' perceived needs and conditions within the school. The third phase involved the implementation of the professional development program, and the last phase consisted of an evaluation of the project.

The selection of the school was based on two factors: the presence of a teacher who had attended the Philippines Australia Science and Mathematics Education Project (PASMEP) training; and the proximity of the school to the principal researcher's office or home. It was assumed that the presence of a PASMEP teacher would be helpful in facilitating the change which teachers would like to make in their school. PASMEP teachers have attended a wide range of professional development programs that have included a nine month training period in Australia and several training workshops at the University of the Philippines Institute for Science and Mathematics Education Development (UP-ISMED). As the time and distances of travel to schools in the Philippines can be extensive, the proximity of the school to the researcher's home or office was an essential consideration.

The assessment of the existing conditions, which was the second phase, was done through questionnaires, interviews and class observations. In the questionnaires that were administered by the researcher, teachers wrote information about themselves and their professional development needs. The department head and the PASMEP teacher who happened to be the head of school, completed a different set of questionnaires. Individual and group interviews were conducted by the researcher using the Filipino language to informally identify teacher's beliefs about their teaching practices. Classroom observations were carried out by the researcher for six weeks. In each of the first two weeks, each of the participating teachers was observed in at least three consecutive lessons. Visits to these lessons were announced; additionally, one of these lessons was recorded on video. These recorded lessons were viewed with the group and other teachers from the mathematics department where reactions were sought. The rest of the class observations were generally done by the researcher without informing the teachers when they would occur. A written description of all the observed lessons was made.

The third phase involved the group conducting an action research program aimed at developing teachers' professional practice. This phase involved attending a number of planning meetings. A brief outline of action research was discussed at the first meeting. The teachers then identified their own problems (Herrington, Sparrow & Swan, 1995) and agreed to initiate an action research program over three cycles that focused on increasing students' participation in mathematics through the use of practical work. To monitor and evaluate progress of the program, several documents were gathered. These documents were the teachers' diaries based on their lessons using practical work, their diaries when they participated in the meetings and their lesson plans. The researcher and, in some instances, the head of school made class observations. During three cycles of the action research, seminars were conducted in which the topics discussed were chosen by the group of teachers.

The last phase which was the final evaluation, was done after the third action research cycle. The group of teachers met to reflect on what was achieved through the project and on the impact of the project on their professional growth.

Results and Discussions

This section will consider results as they relate to determining the effectiveness of action research as form of professional development and the constraints in using this form of professional development in the Philippines. The effectiveness was looked at in terms

the changes made by these participating teachers in relation to pedagogical knowledge, practices and beliefs.

A range of techniques was used to determine the effectiveness of the professional development program. Initially, each participant was given a questionnaire to identify perceived needs. Semi-structured and unstructured interviews were used, either individually or in groups to gather information on teachers' beliefs. In addition, the principal researcher, together with the head of school and in some cases the participating teachers made announced and unannounced classroom observations. Audio and video recording and also still photographs were taken in some of the classroom observations and group meetings to capture the situation and to provide a basis for discussions during meetings.

The qualitative data that were gathered in this study were analyzed using the NUD.IST (Non-numerical Unstructured Data Indexing, Searching and Theorising) computer program. Categorization of the data was guided by the research questions and an initial reading of the data. When the categories were determined the data were organized on an index "tree" and the nodes of this tree were explored to identify any patterns that emerged. The analysis provided a picture of change for each individual teacher and for the group as a whole.

The results of the analysis for the group as a whole and consequent discussion are described below in two parts: changes in teachers' pedagogical knowledge, teaching practices and beliefs; and the identified constraints to change.

Changes in the pedagogical knowledge, teaching practices and beliefs

In this study, pedagogical knowledge refers to the teacher's knowledge or awareness of strategies for teaching mathematics. Teaching practices refer to the action of the teacher as they carry out tasks such as teaching routine exercises, classroom management and the use of resources. The beliefs of teachers relate to beliefs about mathematics, the teaching and learning of mathematics and professional development.

In the first phase of the study, it appeared that teachers were familiar with exposition as the only strategy for teaching mathematics. They discussed this in one of the meetings.

Teresa:	What we are using, it's always the same.
Cindy:	That's it, just teacher exposition. You can't.
Researcher:	What else did you use, when I didn't observe you?
Cindy:	Only that, right?
Teresa:	Yes, because that's the only one.

(Planning meeting)

Classroom observations indicated that the teachers followed a similar expository approach. The teacher would talk in front of the class for most of the time, with occasional use of blackboard and chalk. Students participated by answering the teacher's closed-type questions or going to the board to show the solution to the assignment or practice work.

In the later part of the study, teachers mentioned the changes they had made. An interesting one was on the use of blackboard and chalk.

> Before when we didn't use activities, we just use chalk and board and sometimes manila paper.
>
> (Teresa, final group interview)

> At least I've learned other strategies aside from chalk and board, that's one thing. And also there's an inclusion of humor in mathematics. Not so much now that the students would think of me, "naku, math yan, patay"! [oh, my that's math, scary!].
> (Cindy, final individual interview)

> There's a big difference. It was good. Before, it was blackboard and chalk ... Before they [referring to students] were involved, but less and individually.
> (Art, final individual interview).

These teachers indicated that the use of blackboard and chalk had lessened because of the inclusion of hands-on activities for students. It was apparent that the teachers had become aware that there were alternative teaching strategies to exposition.

The beliefs of the participating teachers about mathematics, mathematics teaching and learning, and professional development were considered. In the initial interviews, some of the teachers mentioned that in mathematics teaching, the teacher is the "supplier" of knowledge and students are just the "receivers". However, this belief seemed to change as this study progressed. "We have this before that *I'm sir* so you can't do that to me. It was like that before. But now you can also accept from a student" (Teresa, Final group interview). This can be interpreted to mean that before, students should consider teachers as people in authority who cannot be questioned. Now the teachers seemed to welcome students' ideas. They talked further on this issue.

Bert:	A student could also give you knowledge, right?
Cindy:	Give and take.
Bert:	Yes, that can be, remember? Like that one ...
Cindy:	It's now give and take. But our role as a teacher, that's the basic ... Because, suppose to be it should really come from us. But this does not necessarily mean that we can't learn from the students. The teacher could also learn from the students as long as the students could learn from them.
Researcher:	So now, what do you think? How about you, Teresa?
Teresa:	Facilitator.
Researcher:	Facilitator. What do you mean by facilitator?
Teresa:	You have to guide the students.

(Final group interview on beliefs and practices)

It emerged from the above discussion that at this stage, they believed that students could learn from both their teachers and classmates. Teachers could also learn from their students. In this way, the teacher's role was viewed as a facilitator in the classroom. In learning mathematics, some of the teachers' beliefs in the early part of the study had to do with students' approaches towards learning. They believed that students should listen and be attentive to the teacher's discussion. They should also try to solve more problems or exercises and do more practice. Towards the end of this study, they appeared to have changed their beliefs on mathematics learning.

> Learning? Ah- they can easily understand because they saw it on the figures, in your examples, materials. They've seen it and they even got ideas from it. Before, math learning, when they entered [the classroom], what's on the blackboard, that's it. They just listen, they didn't have participation. Unlike now, they even volunteered [to participate]. (Alex, Final initial interview on beliefs and practices)

The teachers now appeared to believe that students could be encouraged to participate in the learning of mathematics by varying the teaching strategies such as the inclusion of activities. These teachers also changed their views, not only on how students learn, but also how they learn. With their involvement in this study, they were exposed to different forms of professional development activities. When asked on their comments about action research as a form of professional development, these were their statements:

> Cindy: Much better! Because the time allotment, more time to really absorb it. You could absorb what you do and really you could try it.
>
> Bert: But, ma'am [referring to the head of school], it's really better to have an in-service which is like this, the one we're doing. It seemed informal. As if we're just telling each other a story ... As if there's professional sharing, you're really reporting. As if the impact is different, it's "nakakatuwa!" [good feeling!]
>
> (Cycle 3 meeting)

These teachers seemed to view this form of professional development activity as better than the ones they were involved in the past because of the longer time allotted for them to work and reflect. Also, the informal way of organizing the group discussions seemed to suit them enabling them to talk freely about their ideas.

Constraints

In discussion with the teachers, four main areas on the constraints to change were identified: personal constraints, classroom constraints, system or institutional constraints and students' constraints.

It emerged that one of the most frequently mentioned personal constraints was the teachers' lack of experiences in using activities with their students. For most of the teachers, this was the first time they had used activities with their classes. Consequently, they found it difficult to prepare materials, to find a variety of activities, or to decide which ones were suitable for the type of students they had. Their attitude towards change could also be considered as one of the constraints. At times, resistance to innovations was observed. For example, an activity was suggested but was not tried. Their hesitation in trying to make changes in the teaching practices could also be attributed to their understanding of the subject matter.

> But sometimes I want to try, but then I became negative. It might be that my teaching will fail, right? It's a mistake! Or I would think if it's related to my topic. Sometimes I'd like to do something but I didn't do it because my mind is confused. Also sometimes I have something I'd like to teach, but it seemed I don't know. I would think, what if the students will question me about it? At times my students would ask me and I don't know, especially my students in Sampaguita, there are so many of them there that would ask you.
>
> (Teresa, Final individual interview on beliefs and practices)

Teachers may have also resisted change in not wishing to deviate in their "comfort zone". These teachers were used to a classroom environment where students sat quietly and appeared to be listening. Teachers were unaccustomed to noise being made from a group activity or students' discussion. In one of the teacher's diary, he wrote: "Students really knew how to evaluate logarithms. Only on the last part of the contest, the teacher was so irritated on the arguments of the students" (Bert, Class diary). Teachers also

appeared unaware of what could be changed in themselves when teaching mathematics. This was shared when the group viewed the video lessons that were taken during one of their teaching sessions.

> The one which is good first. Here, I changed my style with my students. I saw myself. The first thing, when there was this video session, you saw yourself. So, this is how I teach, that can be changed. [Laughter from the group.] That's true, yes! ... I realized it. Oh, there is still something to change in me! [Laughter from the group.] ... Sometimes it's funny and also frustrating when I saw myself. (Art, Cycle 1 meeting)

It appeared here that the teacher considered this a "good" way to critique himself and to identify the changes to be made in his teaching.

It also appeared that teachers' willingness to change their teaching practices was also hindered by these two classroom constraints: class size and the space to do it. The class size would vary depending on the year level. For a large class, a teacher would find it difficult to conduct group work or do an activity that enabled sufficient materials to be given to all the students.

> For example, you have a group activity, so you have to group the students first. Just in grouping them, all the time has been used ... The other constraint is the class size, it's too large. They're too many but the room is small. About seventy five students in a class on the average.
> (Teresa, Final individual interview on teaching and changes)

This large class size also created a problem of space for a teacher to monitor students' work during group activities and also to store the materials that they used in these activities.

Teachers indicated that time, materials, workloads and students' groupings are some of the system or institutional constraints to change. The 45 minutes allotted to a mathematics lesson was seen as inadequate. They said that some lessons could not be finished, more so if they used group activities. Some of them believed though that the use of activities was helpful in students' learning. However, although they have this belief, there is a tendency for them not to use it as often as they want to because they felt an "obligation" to finish the syllabus.

> We're following the DLC [Desired Learning Competencies]. If I couldn't finish the activity, the next day I make it as a review. So what happened, I wouldn't think of other activities because I'll be left behind. So as if that's a constraint. The constraint is really in time.
> (Teresa, Final initial interview on teaching and changes)

Further time pressure occurred with school activities such as sports meetings, periodic testing, a drugs symposium, or suspension of classes due to typhoons and flooding. The availability of materials was mentioned as another constraint. The school had no library facilities nor a mathematics laboratory when this study was conducted. It was not surprising then that teachers would mention this as one of the constraints to changing the way mathematics should be taught. It was even learned that mathematics textbooks for fourth year students were not available. To overcome this, the teacher formed groups of students where each group would "give" one mathematics book to be used by all. Also, the school did not provide teachers with the materials needed for the activities and sometimes buying it from their own budget seemed impractical. As one teacher remarked in one of the earlier meetings "That one, the one where you have to

connect the sticks. I said it's good to do it, but I can't, no materials. It's really frustrating!" (Cindy, Cycle 1 meeting). She made a similar statement in one of the final interviews: "And sometimes, too, there's one that I would like to use but the materials are expensive, so that's a real constraint" (Cindy, Final initial interview on teaching and changes).

Heavy workload was mentioned as a further constraint. This includes teaching loads and involvement in other school activities and roles such as scout chairman, sports trainer and so on. They indicated that their heavy workload, usually at least six hours of teaching a day, affected them physically.

> Ah, for me, mostly the constraints will still be on the preparation. For example, I'd like to do it, but you know that we have 9 loads, it's really difficult for me. We really don't have the time to do it. At home, supposed to be this is our time to rest, but we still prepare the activities. You even observed it, that really time is not enough.
> (Bert, Final initial interview on teaching and changes)

Students' background, attitudes and language emerged as further constraints to change. Students' content background created a problem for teachers to make the desired changes in their teaching of mathematics. They observed that some students lacked the necessary skills to understand the concepts that were discussed at their year level. Students' lack of exposure to different teaching styles also became a factor for teachers wanting to make changes. The usual classroom environment can be described as students appearing to be listening to teachers. So, changing the environment to allow for students working in groups and using manipulative materials for the activities, required an adjustment period for both the teachers and the students.

The observed attitude of students towards mathematics caused another problem for teachers wishing to make changes in their teaching. Teachers observed that students did not like mathematics and displayed negative attitudes towards the subject. "They don't have the initiative. What they know is that, it's math and they are scared of it" (Teresa, Initial group interview on beliefs and practices). Language was another difficulty that was mentioned. It was observed that there were many times when students could not proceed with a given activity because they could not understand the instructions. Teachers are often obliged to give further instructions, sometimes using bilingual language, that is in Filipino and English.

> Because the usual problem in Math, English is the medium of instruction, so sometimes you'll be forced to speak in Filipino [the national language] or else they would not understand.
> (Cindy, Initial individual interview on beliefs and practices)

Comprehension of instructions by the students was also considered by teachers as a constraint in activity work. Some of these teachers mentioned that this could be because the instructions were not clear or students were not used to following instructions on their own.

Conclusion

The results indicated that the involvement of these five teachers in the action research had an effect on their professional growth. There were noticeable changes in their pedagogical knowledge, teaching practices and beliefs. They all became aware that mathematics in secondary schools could be taught in different ways such as the use of practical work. They recognized alternatives to the use of blackboard and chalk and teacher-centered lessons. Teaching practices also accompanied this change. It was observed that they used a variety of resources and allowed students to do group activities. Teachers' beliefs also appeared to have changed. For example, they changed their view of

mathematics teaching from one based on a teacher-centered classroom to one where there was sharing of learning between a teacher and students. Additionally, teachers seemed to prefer an action research approach to professional development. Several constraints were mentioned by these teachers while they were implementing the changes. The teachers' main concerns arose from their students, classrooms and the educational system. Some of these concerns were also mentioned by Ulep (1993) as significant problems in the teaching of secondary mathematics in the Philippines. These identified constraints could be taken into consideration when planning for professional development programs or conducting further research on secondary mathematics teaching.

In the Philippines context, the budget for professional development activities is limited. With the approach adopted in this study, expenses were minimal. No accommodation costs and transportation costs were involved so access of everyone to this form of professional development activity was possible. In addition, interruptions to classes were minimal. It may be worth comparing the costs associated with different forms of professional development required to demonstrate equivalent degrees of professional growth as shown by these teachers.

Finally, the research has demonstrated that the action research process as described by Kemmis and McTaggart (1988) can be successfully carried out by secondary mathematics teachers in the Philippines and this form of professional development has positive effects on teachers' professional growth. This is quite different from many of the professional development programs that have been conducted in the Philippines. These programs were often held in venues where expenses for accommodation and transportation are needed, resulting in only a few teachers gaining access. Furthermore, the focus of the training may not be what is needed in the school where the teacher originates. It would be worthwhile then, for professional development designers to look more closely into other forms of professional development activities that directly address the needs of the teachers. Action research programs appear to offer a number of significant advantages.

References

Castle, K., & Aichele, D. (1994). Professional development and teacher autonomy. In D. Aichele & A. Coxford (Eds.), *Professional Development of Teachers of Mathematics, 1994 Yearbook.* Reston, VA: NCTM.

Cohen, L., & Manion, L. (1994). *Research methods in education. (4th ed.)* London: Routledge.

Fullan, M. (1991). *The new meaning of educational change.* New York: Teachers College Press.

Herrington, A.J., Sparrow, L., & Swan, P. (1995). Professional development: Whose problem is it anyway? In Atweh, B. & S. Flavel (Eds.), *Galtha: Eighteenth Annual conference of the Mathematics Education Research Group of Australasia* (pp. 338-344). Darwin: MERGA.

ISMED (1988-1991). *Trainers training program report.* University of the Philippines.

Kemmis, S., &. McTaggart, R. (1988). *The action research planner (3rd ed.)* Victoria: Deakin University Press.

Pascua, L. (1993). The mathematics education in the Philippines today. In G. Bell (Ed.), *Asian Perspective in Mathematics Education.* (pp. 160-172). New South Wales: Northern Rivers Mathematics Association.

Ulep, S. (1993, July). *Problems of teaching and learning secondary school mathematics in the Philippines today.* Paper presented at the Annual Conference of the Psychology in Mathematics Education, Tsukuba, Japan.