

Learning from teaching: Teacher sense-making on their research and school-based professional development

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With the recent curriculum reform in basic education (elementary to senior high school) in the Philippines, developing the research capacity of teachers is seen as a key factor in enhancing their instructional practices. The professional development (PD) design which was the data source of this qualitative study was conceptualised to follow a sustainable research and school-based model. The PD model had two phases, each incorporating collaborative and reflective components where the teachers were scaffolded by university-based science education specialists, who acted as both collaborators and experts in the processes of reflection and sense-making the impacts of the PD. Phase 1 was the five-day seminar-workshop whose main output was a collaboratively-planned and constructed, tried out, presented, observed, critiqued, and reflected inquiry-based lesson from each of the six Grade level teams (five teachers in each team from Grades 1-6) of elementary school science teachers. Phase 2 was the follow-up comprising school visits for lesson observation, collaborative reflection, and constructive critiquing of the research lessons. From collaborative reflections, findings revealed that teachers regarded their PD as a simultaneous social and cognitive process of adult learning, a venue for shared ownership which yielded commitment towards enacted practices, and an experiential learning environment with the provision for suitable prompts for reflective practice. It further created their sense of professional identity as they established a shared leadership and feeling of effectiveness and improved sense of teacher identity.

Introduction

Efforts to update teachers' knowledge and practices have been focused particularly on teacher professional development (PD), with emphasis on the roles of teachers as active agents of the learning process. With on-going implementation and assessment of curriculum reform in the Philippines, various forms of PD aim to improve teachers' skills aligning with reform objectives. Scaffolded practitioner research and school-based PD is one form that deeply engages groups of teachers in the same school who utilise their own lessons and their classrooms as epistemic tools for inquiry.

Inspired by the concept of community of practice (CoP) as a PD model, the research and school-based PD model is becoming popular in the Philippines, recognising teachers' effectiveness as research practitioners who can utilise their lessons for research purposes (Gutierrez, 2017). It embodies the premise of collaborative professional inquiry that is embedded in the teachers' daily routines and contextualised from students' responses. In the process, teachers engage in a collaborative activity to hypothesise and explore effective and meaningful instructional practices. As a school-based PD activity, it is aligned with Ufnar and Shepherd's (2019) hypothesis that teachers in the same school would be likely to create a shared professional culture, thus building collective learning resulting from the collegial exchange of ideas.

Practitioner research has been regarded as a promising activity for any institutional group, especially in relation to exploring the emerging needs of the stakeholders. For teachers, it is essential for their regular professional updating which becomes meaningful when they focus on the classroom setting (Raphael, Vasquez, Fortune, Gavelek & Au, 2014) especially on understanding students' holistic needs. Focusing on the educational setting, it supports the idea of 'research engaged schools' which possess the potential for establishing 'a learning culture in which staff work together to understand what appears to work and why' (Brown & Zhang, 2017, p. 383). Its effectiveness can particularly be highlighted when structured to focus on students' learning in a collaborative, sustainable, and reflective process (Lieberman & Miller, 2014).

Teacher practitioner research resembles the concept of action research, which also captures the idea of professional learning with an aim to inquire, research, and reflect on the best practices over an extended period of time (Smeets & Ponte, 2009, van Swet, Smit, Corvers & van Dijk, 2009). With frequent interaction with colleagues and outside experts, both practitioner research and action research empower teachers to examine their own beliefs and practices. With practice, they eventually establish an inquiry which will benefit their students when their instructional approaches are enhanced. Because of collaboration, teachers in isolation are encouraged to share knowledge and experience that impact student learning outcomes. Given enough sustainability through scaffolding, teachers are empowered to exercise inquiry into their own practice, at the same time establishing collegiality and collaboration in a non-threatening environment.

As a form of cross-professional collaboration, teachers participate in a research and development activity with the willingness to explore, understand, and share their practice-oriented knowledge with experts. It is a promising form of PD, but understanding the protocols of research work, having the skills and the time to do research, and doing it concurrently with the usual classroom tasks are just few of the challenges teachers face (Davies, 2017). Similar challenges can be observed in Philippine school settings as teachers are also struggling with everyday teaching loads and insufficient knowledge and exposure to the dynamics of research. Thus, teachers need a collegial cooperation and an organised collaborative network in order to establish a professional learning community whose output is an authentic inquiry of their own practices for students' improvement. Collegial cooperation may include recognition of the roles of teachers, administrators, and even university education researchers, so as to gather multiple perspectives to bridge gaps between educational theory and practice.

In the Philippines, teacher research and school-based PD is an emerging model whose impacts are evident when teachers are properly scaffolded in the inquiry process. However, considering the research component, teachers need enough supervision from more expert researchers to optimise their involvement in the PD process. Thus, this PD model incorporates the scaffolding of the science education specialists who guided the teachers in their year-long PD activity. It was hypothesised that collaborative reflection was a robust source of knowledge, thus making it a significant component of PD activities. Considering the diversity of ideas and the significant learning points that can be obtained from the scaffolded collaborative reflections of the teachers, this study

articulated the impacts of the PD on the teachers' professional identity. In particular, the study investigates the following questions:

1. What significant lessons were articulated by teachers as a product of their scaffolded and collaborative reflections and sense-making of their year-long practitioner research?
2. How did the scaffolded and collaborative reflections and sense-making create an impact on teachers' professional lives?

Theoretical perspective

The professional development model employed in this study acknowledges the limitations of the transmission type of professional learning (Johnston, Hadley & Waniganayake, 2019). It embodies the concept of sustainable engagement where educators engage in critical thinking and evaluative stances for their own beliefs and practices (Hadley, Waniganayake & Shepherd, 2015; Sumsion et al., 2015). It incorporates the idea of a research-engaged school and is considered a promising PD strategy that views knowledge production as situated and contextualised, and inviting immediate response in terms of application and evaluation. It supports Jao and McDougall's (2016) contention that teachers must update continuously, under the circumstances of changing educational standards, coupled with increasing diversity in students' cultural and social backgrounds. Thus, in the PD model employed in this study, teachers' participations were lauded as they continued to be engaged in an authentic data reporting which referenced their improved classroom practices (Dimmock, 2015). As practitioners who are engaged in the research process, their collegial evaluation may include their personal beliefs, social and cultural constructs, and collegial interactions which are fundamental factors that shape professional identity.

Having opportunities for scaffolded collaborative reflections, practitioner research as employed in this study cultivated common understandings, that shifted the solitary process of knowledge acquisition into a social activity mediated by the shared understanding of their experiences (Trabona, et al., 2019). As it highlighted "continuous professional development of teachers and leaders for improved quality teaching and learning outcomes", it reinforced "shared values among staff, collective responsibility for pupils' learning, collaboration focused on learning, continuous individual and collective professional learning, reflective professional enquiry, openness, networks and partnerships, inclusive participation, and mutual trust, respect and support" (Dimmock, 2015, p. 48).

Considering the impact of self-directed learning, the PD model employed in this study supported professional meaning-making as teachers became accountable for their own learning, and became faithful in implementing the products of their collaborative inquiry (Cochran-Smith & Lytle, 2009). It can also fall within the bounds of adult learning theory which highlights research that is socially situated and constructed (Ben-Peretz, Kleeman, Reichenberg & Shimoni, 2010) in the process of iterative inquiry through sharing of ideas and practices. In the process teachers, who are the key players, were empowered to

identify their learning needs, critically appraise new information, reflect, and express their views on their learning process.

Practitioner research-based professional development: Its significance

With continuing curriculum changes in recent years, teacher professional development has been of increasing interest, to support demands for enhancing teacher pedagogical skills. Active learning has been a primary feature of most PD efforts, with an aim for teacher involvement in hands-on professional learning through actual lesson design and instruction (Darling-Hammond, Hylar & Gardner, 2017). Part of teachers' involvement is integrating research where they video record their classroom activities for analysis, collaboratively critique, and reflect in order to identify the best features and potential learning gaps using their actual lessons. However, as this PD model is still an emerging trend in the teaching profession, coaching or scaffolding by experts was recognised as a step needed for attaining sustainability.

Practitioner research as a form of PD aims to empower teachers to own their learning and build confidence on their work. However, demands of the research process and the unfamiliarity of teachers in its nature creates a gap for teacher practitioner research-based inquiry. Thus, university education researchers are tapped to become professional scaffolds to support teachers in their journey of understanding the broad and dynamic nature of the profession. In the process, they become the experts who facilitate the deepening of the inquiry (Gallagher, Griffin, Parker, Kitchen & Figg, 2011) and who lead the negotiation when diverging opinions arise in collaborative critiquing and exchanging of ideas.

Practitioner research is typically conducted as a collective pursuit of inquiring and experimenting with new pedagogical principles as well as the dynamics, constraints, and affordances for knowledge and professional development (Hermansen, 2016). Its prime relevance is embedded in teachers' reflection on their own practices, making them a critically-inquiring community of professionals. It becomes more beneficial and productive when their autonomy is established and their motivational drive is powered by a sustainable impact on their own classrooms. In the study by Hilton and Hilton (2017), practitioner research as a PD model had a profound effect on various aspects such as their knowledge, instructional practices, and research knowledge and skills.

Scaffolded research and school-based teacher professional learning

Encompassed within the concept of the zone of proximal development (ZPD), scaffolded research-based teacher professional learning is characterised by diagnosis of instructional difficulties, responsiveness, and future autonomy in the research practice among teachers (Smit, Van Eerde & Bakker, 2013). It bridges the gap between teachers' willingness to develop their professional expertise, minimises reluctance, and develops confidence to share their work, because each was made comfortable through scaffolded professional inquiry (Lieberman & Pointer Mace, 2010; Skerrett, 2010). Scaffolding, as supplemented by collegial interaction, brings out each teacher's personal and professional expertise,

which facilitates the dispersion of social and intellectual accountability in supporting each other's growth in practice (Koellner-Clark & Borko, 2004).

Scaffolding the professional learning community requires the involvement of educational experts who share their specialised content or pedagogical expertise in the research process. This facilitates the shift of professional learning from traditional PD models to a more experience-based model, so that learning becomes authentic as teachers assume the roles of both practitioner and researcher. This PD form yields a job-embedded professional inquiry which makes teachers reflect on their own professional practice, enhances their professional identity, and makes them appreciate the teaching profession as a scholarly endeavour (Dana & Yendol-Hoppey 2009). It negates the notion that "... teachers are primarily technicians; the goal of teacher learning initiatives is to make teachers more faithful implementers of received knowledge and curriculum; subject matter is a more or less static object to be transmitted from teachers to students" (Cochran-Smith & Lytle, 2009, p. 2).

Especially for the teaching profession, scaffolded practitioner research has been claimed to be motivating, given enough opportunities for collegial discussions and sustainable support from mentors (Hilton & Hilton, 2017). With on-going mentor support from experts, they further claimed that practitioner research is a potential PD where teachers are valued as knowledgeable professionals in their field. As structural supports, mentors serve as collaborators in the inquiry process who become readily available for teachers in "navigating the complex situations and reflect on difficult dilemmas" (Spratt, 2019, p. 325). Scaffolded research-based professional learning therefore can close gaps between theory and practice, through recognition of the teachers' contribution in the development of knowledge.

Method

Expert-initiated research and school-based professional development design

With the goal of moving away from the traditional "one-shot" PD models that have been running over some years with disappointing impact on teaching and learning practices, a university-based research institute concerned with teacher training and curriculum development in science and mathematics initiated this PD program. It had two phases: (1) seminar-workshop on research and school-based practitioner professional development; and (2) school-based follow-through for the implementation of the collaboratively constructed and critiqued inquiry-based lessons (Figure 1). Phase 1 was a five-day seminar workshop on the importance of research and school-based PD and the advantages of teaching science through inquiry. The PD design initiative of the university science education specialists is characterised by lectures and workshops where teachers were exposed to theoretical knowledge, immediate hands-on experience, collaborative reflections, and constructive criticism (Figure 1).

Based on the PD design, the experts' involvement was mainly as lecturers providing theoretical knowledge updating for teacher-participants, and as mentors in most of the

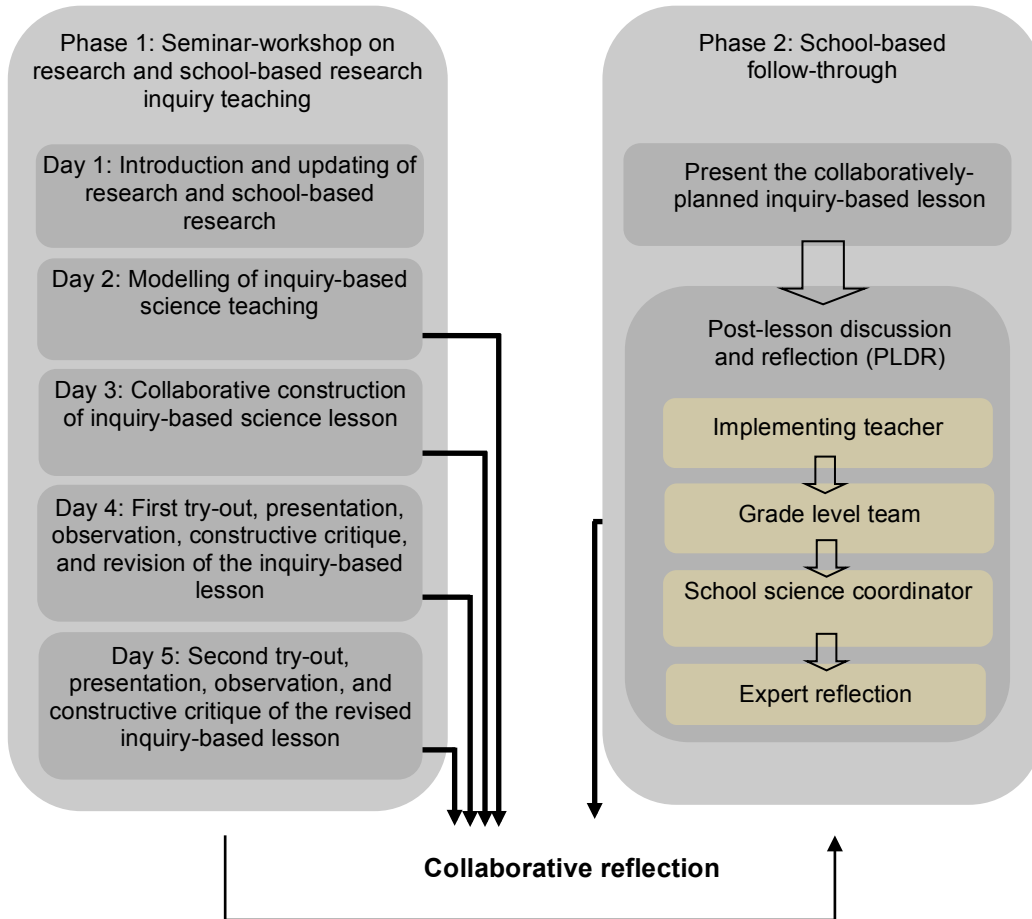


Figure 1: The research and school-based professional development initiated by the university-based science education specialists.

activities. Teacher-participants, on the other hand, were deeply involved as reflective practitioners in all of the activities of the training-workshop. During the seminar-workshop, collaborative reflections focused on how teachers perceived the significance of the collaborative lesson planning, and ensuring sustainability through school-based follow-through of their lessons, with an embedded research component. Informal reflections were done by the teachers themselves and formal reflections were conducted together with the assigned facilitator in the group.

In the seminar-workshop, teachers were involved in collaborative lesson planning, try-out and presentation of the lesson, and constructive critiquing. During the planning of the lesson, the experts allowed the teachers to collaborate by themselves and ponder on their teaching practices, identify specific science and mathematics lessons which they regarded as challenging lessons to teach at the elementary school level, and design lessons aligned to their chosen topic, to serve as research lessons during Phase 2 of their PD activity.

Topics were chosen considering two main factors: (1) a lesson that usually is challenging for teachers and students, and (2) a lesson with no overlapping schedule of implementation with the others. Expert ideas were sought after they conceptualised their pedagogical approaches and their comments and suggestions were considered and incorporated in the revised lesson plans. Finalised lessons were prepared for actual implementation in their classes in the follow-through of the PD (Phase 2).

In the try-out, presentation, and critiquing of the lesson, one teacher representative in each group was tapped to implement the lesson while the other members of their respective teams, the other Grade level teams, and the experts observed the implementation. It is worth mentioning that the other teachers were not only observers but also assumed the role of students during the lesson implementation in the Phase 1. Thus, they were asked to accomplish all student worksheets and respond to the teacher's questions in the Phase 1. Collaborative critique and reflection followed the try-out and implementation of the lesson which followed the dynamics in Figure 1.

Phase 2 of the PD activity was devoted mostly to lesson implementation, observation, collaborative reflection and constructive critiquing, and revisions (where necessary) of the lessons. As shown in Figure 1, one teacher implemented their collaboratively constructed lesson while the rest of the team, together with the experts observed the implementation, paying attention to students' responses. After the presentation, lesson debriefing was conducted and critical areas for improvement were noted. As an epistemic site, collaborative reflection was strictly implemented in order to gain insights from each other, particularly on how students responded to the lesson.

During the debriefing, two main aspects of the reflection were considered: reflection on the content to address misconceptions that arose from both teacher and students, and pedagogical reflections which were focused on how the students were responsive to the teaching strategy.

In Phase 2, experts' involvements were mostly as mentors, facilitators, and collaborators in the activities. The implementation periods were spread across the academic year to accommodate the actual schedule of the lesson in the curriculum. Each grade level team implemented their lesson twice, thus two different teachers implemented the collaboratively-designed inquiry lesson (Figure 2). The inquiry lesson was usually a product of the consolidated comments and constructive critique after a cycle of implementation, and post-lesson discussion and reflection. As six grade levels were involved in this PD activity, 12 lesson implementations were required (two implementations per lesson) in Phase 2.

Research context

The present study was conceptualised from an on-going school-based professional development of elementary public school science teachers in the Philippines which was geared towards research and school-based PD activity. The PD design incorporated collaborative reflection in both phases which served as the stimulus for the

conceptualisation of the research rationale. Since the PD activity was fully documented from Phase 1 to Phase 2, the collaborative reflection component of the PD activity was taken as the research object of this study. As a form of in-service PD for the teachers, Phase 1 was conducted for five days during their school summer break (April-May). It is important to note that one of the basic activities for teachers in the Philippines during the school summer break is to attend professional development activities. Especially during the implementation of the new K-12 Basic Education Curriculum, teachers are particularly mandated to attend PD programs for familiarisation and professional updating in order to grasp the objectives of this new curriculum.

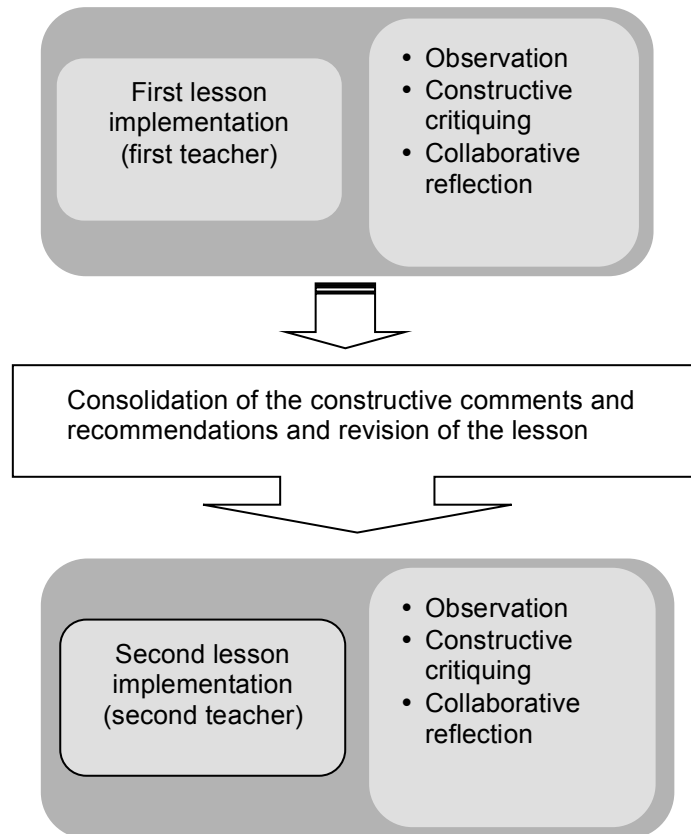


Figure 2: The cycle of lesson implementation in the Phase 2 of the PD model

Participants

Elementary science and mathematics teachers from the school with the largest population of elementary students in Metro Manila in the Philippines were the participants in the study. This was purposively chosen with much consideration on the PD design particularly for the Phase 2. Each of the lessons was implemented twice so there was a need to have enough classes for observations. Teachers were grouped into two large groups: science and mathematics. Each of these large groups were subdivided into smaller

groups of five teachers, who represented each level from Grades 1-6, referred to as the study groups to address gaps in instructional practice. Therefore, a total of 30 participants composed the science group.

However, only the science teachers were included in this study as the author was assigned as a mentor-facilitator in the science group, particularly involved in the collaborative workshops and reflections with the Grades 1, 4, and 5 Grade level teams. Thus, 15 teachers were the main focus of this study. The participants were mostly females but selection was not done purposively. Their average length of teaching experience was 9 years, ranging from five months to over 30 years. As most of the teachers in the chosen school were required to attend in-service PDs during their summer break, the teacher-participants in this PD activity were the ones who were available to represent their grade levels during the scheduled dates of seminar-workshops.

As mentioned, five teachers comprised each group to represent their Grade level. In both phases, the author was a close collaborator who acted as mentor and facilitator for the groups in their collaborative activities. Validations of expert opinions were ensured as the author was joined by another expert in the entire PD process. During the follow-through periods, each member of the study group attended and observed the lesson implementation, taking notes on lesson impact, based on students' responses. In a few times during implementation and observation, the school's science coordinator joined the group and participated in the debriefing session. At least two facilitators were present during the implementation and observation to ensure a good amount of content ideas during the constructive critiquing of both science content and pedagogical approaches.

Research design and sampling of the study

This study utilised a qualitative research design. Robust amounts of data obtained from audio and video recordings of the reflections conducted during Phases 1 and 2 of the PD activity were coded, and thematically analysed using the constant comparison method of grounded theory (Strauss & Corbin 1990) in order to explicate the co-constructed learning points of the teachers from their research-based and school-based PD. In the coding process, themes were developed using a combined inductive and template approach which merged the a priori and data-driven codes. A priori codes were generated from the rationale of the PD program, while data driven codes were those that emerged from the constant coding and recoding process during the data analysis. The codebooks that were generated were particularly focused on the significant lessons which were articulated by the teachers as a product of their scaffolded sense-making from their year-long practitioner research, as well as the impact of this PD on their professional lives.

Participants involved in this study were purposively selected from the total of 30 teacher participants for the science group. The 15 participants who were the representatives of the Grades 1, 4, and 5 level teams and who were directly mentored by the author became the participants in this study. As the PD asked them to reflect collaboratively in most of their PD activities, the author sought their consent for allowing their reflective data to be

analysed and studied. Their participation in the data analysis was limited to the validation of their verbatim statements soon after the final transcripts for analysis were prepared.

Data collection

Various data sources were used throughout the year-long PD activity. Since the teachers were guided by the experts who acted as facilitators and mentors in the various activities, the author, who was one of the experts, documented the collaborative reflection in both phases of the PD activity. The collaborative reflections were audio and video recorded and transcribed. Since bilingual (English and Filipino) collaborative reflections and discussions occurred, transcripts in Filipino were translated in English.

Most of the reflection data were obtained from the formal, collaborative reflections of the study groups, with the involvement of the facilitators supplemented by informal, collaborative reflections of the study group by themselves, especially during the seminar-workshop. As the science coordinator was encouraged to join in Phase 2 of the PD activity, her constructive critique and reflections were welcomed, but were not treated as part of the data. Thus, these were trimmed from the final transcripts which were subjected to a coding and re-coding process. A total of six hours of audio and video recordings captured during the seminar-workshop and 24 hours during the implementations, were recorded and transcribed. These recordings were primarily the section where the study groups reflected upon their on-going PD. The author organised all these data which was verified by the other facilitator assigned to the Grade level teams who, together with the author, was present in all of the activities of the PD activity.

Data analysis and interpretation

In this study, the constant comparison method was used to develop themes from the coded data transcripts. A combination of inductive and template coding approaches was used to compare the a priori codes generated from the rationale of the PD model and the data-driven codes. These codes were then merged to form the final codebooks that were utilised in the iterative coding. Related codes were grouped together in the iterative coding, to make a synthesis and finally establish the themes for the significant lessons articulated by the teachers as a product of their scaffolded sense-making of their research-based and school-based collaborative practitioner research, and how this impacted their professional lives.

In the iterative thematic analysis, classroom transcripts were divided into segments: (1) sense-making of the research-based and school-based collaborative practitioner research as a PD model, and (2) impact of the PD model on their professional lives. The rationale of the PD model guided the analysis and interpretation, especially in establishing the a priori codes which served as the initial themes. Using these themes, final coding was established; common categories that emerged and the categorical clusters were collapsed together (Bogdan & Biklen, 2006; Creswell, 1997). Themes were then created by fusing related codes from both the a priori and emerging codes. Representative quotations from both the formal and informal individual reflections were used to support the findings that

offered direct accounts from each of the study group. Summarised reports were prepared by the university researchers and shared with study groups and the school.

Research ethics

As mentioned, the data for this study was obtained from the collaborative reflections of the teacher-participants as part of the activities in their PD activity. As this study emerged from the PD activities and the documentation of the seminar-workshop already taken, teachers' assents were sought after the Phase 1 of the PD activity. They were asked to signify their willingness that their collaborative reflections in the seminar-workshop (Phase 1) and Phase 2 be used in a research that was conceptualised by the author. Each teacher-participant was made aware that all of their collaborative reflections would be used for research purposes only. Transcripts were kept by the author, making sure that pseudonyms were used in the final forms after verification from the participants about their utterances. These pseudonyms were used later, in the data analysis of this study.

Results

In their scaffolded collaborative reflections, findings revealed that the teacher participants made sense of their PD activities as a: (1) simultaneous social and cognitive process in an adult learning environment; (2) venue for shared ownership where learning yielded commitment towards enacted practice; and (3) form of experiential learning which provided suitable prompts for reflective practice. As teachers positively articulated their PD, their reflections created impacts on their teaching profession in two ways: (1) shared leadership and increased feeling of effectiveness; and (2) an improved sense of teacher agency.

Sense-making the PD as a product of their scaffolded collaborative reflections

Professional learning communities are usually centred on activities that link social relations, experiences, and individual identities which may influence the learning process. In this study, collaborative reflections lead to several themes which represented the knowledge structures on how the teacher participants made sense of their scaffolded research and school-based PD. As a community, they treated their PD not just an individual process but more as a collective effort in a continuous and reciprocal interaction (Ng & Tan, 2009).

Simultaneous social and cognitive processes in an adult learning environment

Of prime importance, a significant sense-making process of the study group was that their learning was situated and knowledge construction involved cognition and social interaction. This refers to how they collaboratively interpreted their students' responses. According to Teacher Mina,

... it pays to have an interaction with other teachers especially those who already have experience in teaching the lesson. As a new teacher, I may have similar encounters in the future ... hmm and as a member of this group, I already know how to address those similar problems.

Considering Teacher Mina's statement, her involvement in the study group served as an extension to her pre-service knowledge. She regarded the PD activity as an on-site inquiry in a negotiated investigation about her actual practice. Moreover, Teacher Jeff stated that,

I did not know that each student's responses on the lesson gives meaning regarding how the lesson was constructed and how it was delivered ... but because we are dealing with large number of students in our classes, we fail to see these. In our study group, other observers were able to notice them and together we can learn from those.

This statement implied that the collaborative PD helped to calibrate his understanding of the pedagogical approaches against student's responses.

Based on the verbatim teacher reflective statements, the teachers were able to make sense of the value of peer scaffolding established from a system of network resulting from practice. Their reflections, as scaffolded by the experts, were elicited through a shared dialogue, which when shared with others, became crucial sources of ideas for enhancing instructional capacities. Within a continuous and collegial learning process, their informal conversations turned into a scholarly way of knowledge exchange and critical inquiry. Through expert guidance, their cognition into sense-making of the impacts of their participation in the PD activity was made legitimate and experience-based, with authentic references from their own classrooms.

Shared ownership of learning yields commitment towards enacted practice

Robust analysis revealed that the teachers believed unanimously that their equal participation and acknowledgement of their expertise during the reflective process enhanced their sense of ownership of their learning. In fact, Teacher Nida, who acted as a team leader in the Grade 3 level team said,

... working as a group guided by the experts was beneficial for us to build solid interpretation of our students' responses.

Through collaboration, each one contributed to build the 'recipe for the best teaching practices'. Compiling all of their best teaching practices, which are products of both knowledge and experience, they were given ideas on how to ease the complex dynamics of the classroom and better understand the diversity of student behaviours.

As mentioned in the structure of the PD design, the inquiry process was top-down. The experts depended on the teachers' current capacities as obtained from their collaborative reflections. During their discussions, these were reinforced and appropriated with due acknowledgement of the teachers' ownership of ideas. As such, the teachers' motivation to participate in the knowledge construction was sustained. Since they were recognised to be more knowledgeable in terms of practice, the theories that were shared by the experts were supported and/or verified. Thus with the scaffolding from the experts, they were mediated to understand the value of their PD as a combination of theory and practice, built from contextualised and experience-based knowledge.

Together with the theoretical knowledge that the experts brought into the discussion, their commitment to implement what they learned in the study group rooted from their reflection on what worked and what did not. This supports the generalisation from previous authors who have stated that professional commitments to implement a set of agreed upon activities in a community of practice are shaped through social relations. Through continued use, these will be naturally incorporated in the daily activities which will eventually become part of their habitual practices that can be perpetuated in time (Lave & Wenger, 1991).

Experiential learning provides suitable prompts for reflective practice

Considering the collaborative reflections that were sustained from Phase 1 to Phase 2, the study groups were given enough opportunities to review critical learning points that can be beneficial for their profession. In order to come up with a deeper meaning from their reflections, the experts scaffolded their discussions towards topics such as identifying instructional problems, reviewing, and connecting theoretical knowledge to actual experiences. Teacher Chris said,

I would not know all these if not for the reflection of this group ... and one thing I appreciate about this group is that we just don't focus on the problem but also on the good points that were observed.

Based on this statement, their individual experiences became their object of inquiry. The post-lesson discussions were therefore understood to be a significant component of the PD activity. This became a venue where each member of the team shared their unique perception on the effectiveness of the lesson based on students' responses. As they were scaffolded to make sense on the cycle of activities that they were exposed to, they became convinced about the importance of classroom research. Their direct exposure to professional inquiry strengthened their commitment, which was a crucial element in any PD activity. This supports Wiliam (2010) in his argument that changing a teacher's knowledge or belief is insufficient unless teachers make their commitment to change their practice.

Implications for the teaching profession

While willingness is regarded as a key factor to achieve success, results of this study show that expert support from the university-based science education specialists is also essential. With growing interest in teacher professional updating, the PD design as conceptualised in this study is promising in empowering teachers to recognise their potential as knowledge sources through research. Analysis showed that the PD design, coupled with expert-mediated reflective activities and sense-making resulted in the improvement of various aspects such as increased feeling of effectiveness, shared leadership, and enhanced teacher agency.

Shared leadership and increased feeling of effectiveness

In recent research, the development of teacher leaders has been linked to job-embedded collaborative practices (Hunzicker, 2012). In the PD design which inspired this study, teachers were asked to harness their leadership potential from their own grade level teams

through collaboration. Utilising the sustainability of collegial interactions through the reflective discussions, diverse insights were exchanged and became sources of information in knowledge building. With collective negotiation, their interactions fostered a healthy dialogue. Combined with expert ideas from the science education specialists, theory and experience were articulated and their joint reconstruction of knowledge was intellectually stimulating.

Thus, they developed a shared leadership with a commitment to improve each other's expertise.

We have the reason why we are doing this ... we know each of our lesson will create impact in every child's life and it's our responsibility to help them. (Teacher Ben)

Together we assess the gaps of our teaching practice ... since we each bring a piece of what we know, we are encouraged to work as a group. (Teacher Rina)

In the training design, the value of the sustainable reflections scaffolded by the experts is worth mention for its giving time for teachers to think about their potentials to become leaders and co-leaders, especially in the exchange of ideas from one grade level team to another. Research says that teachers need some time to understand the situations of their school but they need guidance in identifying the areas that need interventions (Postholm, 2016). Thus, collegial interaction with their mentors (Teacher Rina's statement) was helpful in keeping track of their progress and these were expressed during their scaffolded reflections. As practitioners who were working towards being researchers, it was evident in Teacher Ben's statement that they also articulated their role as leaders who are able to personally lead their own development.

Trust was also a key component to sustain the teachers' participation in their year-long PD. This intensified the building of positive relationships where it was grounded on their willingness to take risks and continuously come together to try out activities for improved instructional practices. Given the direct impact of collaboration, they developed a collective leadership which was aligned with Childs-Bowen, Moeller and Scrivener (2000) when they said that,

... teachers are leaders when they function in professional learning communities to affect student learning, contribute to school improvement, inspire excellence in practice, and empower stakeholders to participate in educational improvement. (p. 28)

Improved sense of teacher agency

In conjunction with the sense of shared ownership, the scaffolded reflections enhanced teachers' willingness to seek improved practices. Their year-long exposure to the PD project made them understand the purpose of sharing their teaching, to generate understandings about their instructional practices. This was supplemented by the mentors who facilitated their anticipations for collective negotiations during collaborative reflections. Three teachers mentioned:

I now appreciate the dynamics of our lesson planning ... everyday is an achievement (Teacher Aila)

We now have a model lesson, something what we can be proud of. (Teacher Josie)

... the fact that we decide on our own ... but you (the experts) are always there to assist
... that motivates us. (Teacher Nympha)

Much as the objective of the PD activity was building teachers' capacity, acknowledging what lies in this capacity through the scaffolded reflections, helped them to manoeuvre towards making collective and evidenced-based decisions and framing future actions. In setting their goals, their exchange of ideas was centred on how they valued their professions in creating a positive and sound learning atmosphere, as well as in trying to accommodate new information that might influence their existing knowledge and beliefs. As in Teacher Nympha's statement, their collaborative decisions established interdependence and in the process, they become 'agentic' teachers with a strong social relationship and support from peers and other professionals (Etelapelto, Vahasantanen & Hokka, 2015; Tam, 2014). Thus, their PD activity developed a sense of collective agency which was enacted "when coaches exerted influence, and took stances in ways that affected their work and their professional identities" (Hokka, Vahasantanen, & Mahlakaarto, 2017, p. 38).

Discussion

A close collaboration between teachers and outside experts supported by good communication is an essential component of practitioner research (Edwards, Lunt & Stamou, 2010; Taylor, 2008). The collegial approach and experts' high regard for the teachers' leadership capacities and contributions in the development of practical knowledge sustains the endeavour. In this study, it was evident that the teachers did not show resistance but rather they saw the program as an opportunity for collective learning. Taken together, the scaffolding role of the experts empowered the teachers to a higher degree of ownership in their professional identity which amalgamated the collective efficacy of the study group. Moreover, their discussions were facilitated by the fusion of theoretical and practical knowledge. This was observed when the teachers were treated as equally-knowledgeable in the process of identifying and planning what particular challenges in their instructional practices needed solutions. As they were given opportunities to express their ideas, the teachers were empowered to exercise leadership over their professional development which led to the feeling of effectiveness.

Rather than focusing on examining the outcome of an initiative, the PD activity implemented in this study highlighted a sustained, collective learning in which deliberate analyses of actual lesson implementations were distributed with a shared vision of turning empirical information into new knowledge. An interesting finding was that the PD process accommodated the sense of interdependency among teachers in the cycle which included conceptualisation, data gathering and analysis, and interpretation of results—a process which embraces the concept of learning by doing. Through interdependency, teachers enhanced their interactions and professional worth when their opinions were acknowledged in the collaborative inquiry.

Another feature of the PD activity in this study was reflective practice. Discussions were expert-facilitated but were encouraging enough for the teachers to express their ideas regarding both problems and solutions in the classroom. The social exchanges did not only interpret meaning but more so established a continuous interaction which served as a foundation for productive relationships. From their accounts, reflections were understood as interdisciplinary activity which included exchanging best practices and ideas. Thus, this practitioner-based inquiry process can fit into being a PD activity and a research design where participants were valued as both teachers and scholars.

In this study, sense-making was a collective effort in a discussion-rich environment which “broke the traditional authority relationships”, allowing the study groups to take initiatives and decide on the support they needed with immediate feedback from experts (Juutilainen, Metsapelto & Poikkeus, 2018, p. 121). Thus, this study illustrated that despite the several factors that contributed to hesitation such as time, teachers’ willingness to participate in a long-term engagement of professional development, and experts’ guidance through collegial interaction sustained the experiential and professional learning. Moreover, with joint reflections, teachers were able to perceive a safe environment with enough compromise on possible areas of improvement. Part of their PD is looking into the lens of their own teaching practices in order to facilitate ‘learning how to learn’ while taking the role as both a teacher and learner for understanding the dynamics of their instructional practices (Avalos, 2011; Darling-Hammond & McLaughlin, 2011).

Conclusions and implications

The aim of this research was to unveil the lessons of the teachers, through collaborative reflection as one of the components of their PD activity. Through scaffolded sense-making, they were guided to understand the impacts of the practitioner research that was embedded in the PD activity and hypothesised to create continuous opportunities to improve their practical knowledge. The study concludes that practitioner-research based PD extends professionalism of teachers through a proximate and non-hierarchical collaboration with university experts. In the process, both parties immersed themselves in the school setting, while maintaining their focus on improving pedagogical practices. While taking responsibility for particular roles, their unique contributions and freedom to express in a mediated environment provided them opportunities to gain insights from each other. This study contributes to the growing research in teacher education by recognising the researcher roles of teachers. Given enough scaffolding, outside experts opened the gateway for collaboration and broke the gaps of authority relationships. Alongside support from experts, a learning community can establish local innovation in their own practices in a climate of trust which encourages them to experiment in their own practices.

By strengthening teachers’ awareness of their potential to become practitioner researchers, their reflections on their actions pooled their ideas and through expert scaffolding, everyone played a role in building their professional community with a unified goal and shared interest. The essence of collaborative reflections was articulated to empower teachers with dichotomous roles, both as academic experts and researchers — a way to

enrich their agency and effectiveness. Lesson planning and implementation, as the primary means of teacher collaborative activity and reflective practice, and the consultation sessions assured support and convergence of ideas as potential routes to uplift the professionalism of teachers.

This study is considered a further step towards exploring the role of experts in the development of teacher practitioner research. However, generalisations were constrained by factors such as the number of participants involved and the number of lesson implementations and observations. Thus, future studies can expand to involve more study groups and more cycles of lesson planning, implementation and observation, and collaborative reflections. Future research can also be focused on understanding the impacts of the experts' contributions as facilitators of teaching learning in the shared repertoire, and constructive appraisal of their tasks leading to a sense of purpose.

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