Bridging the Gap Between Theory and Practice: The Research Productivity and Utilization of Research Outcomes Among Secondary Mathematics Teachers

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Abstract: Mathematics teaching is viewed as an inquiry process and a powerful context and practice for professional development with the goal of providing greater access, challenge, and support for every learner. This paper stems from a larger research project that investigates the research productivity and processes of integrating research in the curriculum delivery of high school mathematics. This descriptive work through survey, interview and documentary analysis involved 211 high school mathematics teachers in the quantitative component and four purposively selected in the qualitative section. Findings show that mathematics teachers demonstrate suboptimal level of research productivity but have shown promising potential for growth. Research is employed in various layers but typically as a mean to revisit teaching practices, as a basis of a teaching strategy, as a source of another research, and as a motivation for a research-oriented mindset. Research is strongly linked to the mathematics teaching and learning process and thus, have policy implications on nurturing and sustaining mathematics teacher-researchers. It is recommended to develop professional development plans that enhances the productivity and incorporation of research in the teaching-learning process.

Keywords: Professional Development, Research Integration, Teaching and Learning Math, Utilization of Research

INTRODUCTION

The 'teacher as a researcher' movement has been of interest to mathematics education because of the impact it can create. It highlights the concept of teachers as researchers and claims key roles for teachers in the production of knowledge about teaching (Adler, 1997). The mirror of co-learning agreement asserts teachers as active counterparts in the process of inquiry, and the practice of being a researcher (Ruthven, 2002). It is seen as a vital link in improving teaching quality and instructional delivery (Carlsson, Kettis, & Soderholm, 2013; Ayala & Garcia, 2013; Jusoh & Abidin, 2012; Cabral & Huet, 2011; van den Akker, 2010; Prince, Felder, & Brent, 2007),

institutional changes and administrative policies (Ayala & Garcia, 2013), job satisfaction (Silver, 2009; Thomas & Harris, 2001). Without research, teaching would be little more than a trial-and-error process (Cabral & Huet, 2011; Thomas & Harris, 2001).

Linking research and practice in mathematics education is necessary for addressing critical issues of mathematics teaching and learning (NCTM, 2012; NCTM, 2011; Clements, 2007) especially in an educational system where the vision for *No Child is Left Behind* is thriving. High quality mathematics research plays a central role in any effort to improve mathematics learning (Battista et al., 2009; Goos, 2008; Carnine & Gersten, 2000) and improvement of school performance (Goos, 2008; Chval, Reys, Reys, Tarr, & Chavez, 2006). The results of research could also be a basis for policy-making (van den Akker, 2010; Craig, 2009) which shows that the problems of school mathematics necessitate the value of research given the right human energies and other resources (Ball, 2003).

In the Philippine basic education system, teachers are required to conduct researches specifically action researches or AR. Most authorities (e.g., Afify, 2008; Chant, Heafner, & Bennett, 2004) describe AR as a systematic, cyclical, and educative activity which is problem-focused, content-specific, and future-oriented involving a change intervention aimed at understanding, improvement, and involvement. The emphasis of AR or problem-centered approach as originally proposed by Kurt Lewin (Burnes, 2004) lies on the idea of knowledge generation as it provides a way for basic education teachers to investigate issues of interest perpetuating the classroom or the school environment. In essence, based on Afify (2008), AR attempts to solve problems and bring about change. It is a crucial part of school's performance review (Gao, Barkhuizen, & Chow, 2011) and links theory with praxis (Megowan-Romanawicz, 2010) which ignites a change or solves a problem in a social system (Crespin, Miller, & Batteau, 2005).

Relationally, the nexus between research and teaching has stirred continuous conversations in the country much more when the Department of Education (DepEd) has strengthened and institutionalized research-related policies such as the Basic Education Research Agenda, Research Management Guidelines, Basic Education Research. Local studies have shown that there is a very low proportion of teachers in the elementary and secondary level who engaged in research (Tupas, 2019; Ulla, 2018; Gepila, Rural, Lavadia, Nero, Palillo, & Besmonte, 2018; DO 43, s. 2015). Limited knowledge on research, voluminous academic and non-academic works, limited resources and opportunity for mentoring and networking were some of the reasons divulged in research findings (Cardona, 2020; Oestar & Marzo, 2022; Ulla, 2018). Capability building programs to addressed some of the concerns were limited on conceptual understanding of AR instead of its articulation and integration in the actual setting (Tupas, 2019; Basilio & Bueno, 2019).

Thus, two important points emerged for the case of Filipino secondary teachers: knowledge generation *through* action researches and knowledge transfer *out* of action researches. The former

deals on teachers' research involvement and constraints they face in conducting ARs while the latter focuses on the process of integration and utilization of research in the learning delivery. However, the connections between research and practice are perplexing because of the lack of available research findings that are easy to grasp, context-dependent, lack of interest to research results, tremendous pressure to focus on short-term results that contradict what research talks about how children learn mathematics, and increasing narrow understanding of research (Seeley, 2005).

This study aims to contribute on the body of knowledge by probing on ways and means how mathematics teachers used research in their profession and how research can enhance their professional development. Also, the findings of this study contribute to development of policies on the professional development programs for teachers. This article is focused on answering two core questions: 1) what is the level of research productivity (RP) of secondary teachers, and 2) how do secondary teachers utilize research in the mathematics teaching-learning process.

Literature Review

There are three known perspectives regarding the relationship of research and teaching - complementary, antagonistic and disconnection. The Convention Wisdom Model (Neumann, 1992) and G Model (Hattie & Marsh, 1996) both alluded that teaching and research are positively associated. Not only do teachers perceive the benefits of action research and research in general but also do students (Kinash, 2015; Carrlson et al., 2013; Ayala & Garcia, 2013; Jusoh & Abidin, 2012; Hughes, 2004) who can be better constructors of knowledge if exposed to empirical analysis (Robles, 2016; Lerman, 1990). It facilitates the enthusiastic interest in teaching of up-to-date courses and promotes deeper understanding of relevant topics (Artes, Pedraja-Chaparro, & Salinas-Jimenez, 2017; Duff & Marriot, 2017; Carrlson et al., 2013), and self-improvement as well (Silver, 2009). The ripple effect prevails when the excitement and involvement in research is connected to students and they can see knowledge as constantly growing. The inclusion of research findings and evidences in teaching can also be performed as a mode of linking research in teaching (Markides, 2007) or utilizing past research experiences as an entry basis for teaching a subject or a basis for another research (Pawar, 2015). Navarro and Santos (2011) also highlighted that by using research as a basis, teachers can be able to change some aspects of their teaching, proceed to self-monitor the effectiveness of the changed strategy, and deepen their understanding towards the adoption of the changed strategy.

In the basic education of the country, the second key result area (KRA) of the Basic Education Sector Research Agenda (BESRA) mandates teachers to enhance their contribution to learning outcomes by coming up with informed decisions through action or applied researches. Action research is regarded as the convergence between theory and praxis (Afify, 2008) that transforms teacher attitude and approach to instruction (Bonner, 2006), pushes for personal theorizing (Chant, Heafner, & Bennet, 2004), and ultimately, brings about change (Afify, 2008; Evitts, 2004). This is strengthened with the creation of Basic Education Sector Reform Agenda (BESRA), Policy

Development Process (PDP), Research Management Guidelines (RMG), and the provision for Basic Education Research Fund (BERF) through DepEd Order (DO) Nos. 24 s. 2010, 13 s. 2015, 43 s. 2015, 4 s. 2016, 39 s. 2016, and 16 s. 2017. These efforts of the agency which is tasked to supervise the basic education are all gearing towards the engagement of teachers in problem-solving within their classroom environment.

METHOD

Design and Sample

This descriptive study took place in the northeastern part of Luzon, Philippines using multistage sampling and purposive sampling.

In the survey phase, five out of eight cluster-schools' divisions in Cagayan Valley region were chosen. Then, a cluster sampling was utilized with the Grade 10 mathematics teachers as group of samples. In the next stage, another cluster sampling was conducted with specific schools as basis. All mathematics teachers in those schools were provided with the questionnaire which resulted to a response rate of 80 percent or 211 samples. The sample consisted of 151 from Isabela province, 15 from Cauayan City, 12 from Santiago City, 22 from Quirino province and 11 from Batanes province.

In the interview, four grade 10 public high school mathematics teachers, one from each division except Batanes, were purposively selected using maximum variation approach. A set of inclusion-exclusion criteria was utilized to determine the key informants. This resulted to the selection of two females and two males who are on average 32 years old. Sample documents such as the actual research outputs were also gathered.

Instrument

Research Productivity Tool. The mathematics teachers reported their RP for the last three years. The sources of data include: articles published in refereed or non-refereed journals which circulate locally or internationally; published reviews of books, conference proceedings, book abstracts or compendiums, articles, and chapters, textbooks, monographs, and any other types of books; research presentations or technical reports at professional meetings like conferences, trainings, other research-based innovative projects, programs and workshops; speakership or being a trainer in any professional development programs, memberships in mathematical and research-related associations/societies; and professional services like research consultation, conduct of language editing and statistical analyses. The scope of RP is based from the conducted literature review and was validated by experts using Content Validity Index (CVI). The CVI showed acceptable levels of validity.

Interview Guide. The researcher prepared an interview guide, validated by experts and its results were analyzed using CVI. Both the item- and scale-levels CVI are 1.0.

Procedure

Permission from the regional office of the DepEd and consent from the participants were sought. The survey information was gathered personally or through mail. The interview was conducted either personally or through phone. The researchers depended on the self-reported information of teachers regarding their research production. Teachers who did not responded immediately with the invitation were asked until three attempts. Enumerators were also asked to float the questionnaire in unreachable places.

Data Analysis

The researcher developed a weighting scheme to quantify RP. He distinguished whether the activity was performed in solo or jointly (Abouchedid & Abdelnour, 2015). For joint RP, there are no sub-classifications for second, third and succeeding authors though. The researcher separated single presenter versus multiple presenters, participant versus trainer/speaker versus organizer, international level against local, among others. Greater weights were also assigned to manuscripts that were completed, juried, published, DepEd and externally funded, and competitive research awards than on materials that were just proposed, non-refereed and non-competitive awards. The raw score can go limitless but the weighted score only allowed each teacher a maximum of 100 points. The highest possible source of RP is in publication. The data generated were processed using descriptive statistics.

The qualitative data generated from the interview were thematized (Clarke & Braun, 2013) using inductive approach (Nowell et al., 2017). It includes the following phases: familiarizing with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the reports. Documentary analysis was also performed to validate claims of respondents (Nowell et al., 2017).

FINDINGS

Research Productivity of Mathematics Teachers

The involvement in research-related activities of Grade 10 mathematics teachers is generally in the early development phase and highly skewed. They are primarily engaged in research-related trainings, seminar-workshops, and conferences (raw mean = 1.65, weighted mean = 0.25). Second on the list is writing of research manuscripts which only manifests that some are also writing researches (proposals, on-going, and completed) with raw score mean of 0.60 (SD = 1.62) and weighted mean of 0.15 (SD = 0.41). Joining mathematics and research-related professional organizations (raw mean = .07, weighted mean = 0.00) is not on their priority list. The skewness and kurtosis indices display that accomplishment on research

publications is badly skewed to the right (Sk = 9.33) and leptokurtic (Ku = 96.55) which means that only few them are performing as teacher-researchers.

Table 1. Research Productivity of Grade 10 Mathematics Teachers

RP Indicators	Raw		Weighted		Sk	Ku	Remarks	Rank
	Mean	SD	Mean	SD				
Research publications (35%)	0.37	2.48	0.13	0.87	9.33	96.55	Beginning	3
Research manuscripts (25%)	0.60	1.62	0.15	0.41	3.02	9.45	Beginning	2
Research presentations (10%)	0.10	0.52	0.01	0.05	5.53	33.20	Beginning	5.5
Research- and math-related affiliations (5%)	0.07	0.35	0.00	0.02	4.72	20.98	Beginning	7
Research- and math-related trainings (15%)	1.65	2.47	0.25	0.37	2.07	4.87	Beginning	1
Research- and math-related awards (5%)	0.11	0.52	0.01	0.03	4.66	20.65	Beginning	5.5
Research-related professional services (5%)	0.49	1.47	0.02	0.07	4.21	20.33	Beginning	4

Ave Weighted RP Index: 0.57 (Low) SD: 1.26 Max: 11.93 Min: 0.00 Sk: 5.82 Ku: 43.25

On Research Publications

The research publications revolve on the performance of students in the National Achievement Test (NAT) as a basis for strategic intervention and the impact of mathematics drills on the students' proficiency in integer operations. These two materials were published by a single teacher who acted as a co-author. There were also other teacher-respondents who submitted their articles for publication. These materials were on curriculum, educational leadership, mathematics learning, academic performance, and math manipulatives. Notably, only four teacher-respondents were able to publish these 11 outputs.

On Research Manuscripts (Proposed, On-going, Completed)

Almost all topics and titles self-reported are action researches (ARs) delving on teaching and learning issues across all learning areas.

According to Teacher Charlie, his students cannot cope in algebra specifically in multiplying binomials. If one were to analyze, this concept is a pre-requisite to major concepts in math. Struggling with it means a greater problem in the advance courses and topics. This is probably a triggering factor why majority of the papers' criterion variable is academic performance. Their initiatives target a better performance across mathematics competencies like in polynomials, word problem solving, inscribed and central angles, intersecting secants, and integers, among others. For instance, some researchers evaluated students' performance in problem solving through Newman's Error Analysis and some devised interventions like using

jigsaw model, tutorials, drills, differentiated instruction, peer tutoring, and collaborative reading interventions to support at-risk students. One even considered team games tournament as a strategy in improving the performance of his students in polynomials. Some also explored and embraced the concept of lesson study (LS).

Relationally, Teacher Beth showed her research paper and as far as the background of the study is concerned, she initially presented the elegance of mathematics. As the paper unfolds, she placed it in the context of the Trends in International Mathematics and Science Study 2003 and 2008 results where the Philippines was a participating country and cited observations and experiences in her actual classrooms with respect to mathematics learning before clarifying the proposed intervention and objectives of her study.

Meanwhile, in the research where Teacher Angelo was a co-researcher, the paper commenced with:

> Mathematics is considered by many as a difficult subject. Many students had a negative perception about math and end up disliking the subject up to the extent of falling (2018, p. 1).

The discussion was followed by the relevance of a support system to help students become engaged in mathematical tasks. Then, they logically presented the idea of their intervention which is also considered by the researchers as a support to enhance students' critical thinking skills and collaborative interaction.

Clearly, the research topics and the way they were conceptualized reflect the situation G10 mathematics teachers are facing in their classrooms and they were conceived because there is a need to improve classroom learning. On the other side, however, the number of research proposals both on-going and completed researches illustrate a very low turnout, which means that only few are participating in research production tasks This affirms studies like Ramos' (2017) as well as the DepEd report in the Research Management Conference 2018 and the DO No. 43, s. 2015.

On Innovation Projects. While the respondents feel responsible of their students' learning as proven by their intervention programs in their researches, they also believe in holistic learning as some of them were engaged in environmental-related projects. One teacher also demonstrated her skills in programming when she developed an electronic system for the checking of attendance. Evidentially, they perform multiple tasks in the appreciation of the fact that being a math teacher does not only reside in the mathematical formulas, problems and calculations, but also on solving real-life situations.

On Research Presentations

The presented papers are the same researches and projects that were completed by the teacher-respondents. Analyzing further, all are ARs except for the performance in NAT as a basis

for an intervention which is presumed to trigger an AR. Likewise, it was established that completed researches both funded and self-initiated were given opportunities to be presented in the district, division, and even in the regional conferences usually conducted by DepEd.

On Research- and Mathematics- Related Affiliations

The teachers are limited to Mathematics Teachers Association in the Philippines (MTAP) as their professional national organization. This is due probably to the fact that MTAP has programs like the MTAP-Metrobank-DEPED Math Challenge that is conducted annually as well as scholarship programs for teachers. A lone mathematics teacher is connected to SCAAP, an organization consisting of science club advisers in the Philippines.

When asked about the limited membership with mathematics- and research-related organizations, teacher Beth had a striking response, "*Wala, bakit ako magme-member? Ano ba iyong pwedeng maging advantage o benefit ng pagiging member mo?* ("*None." "Why would I do so?" "What advantage or benefit will I gain from being a member?")*

Teacher Beth commented further, "*Ire-require iyong time ko eh wala na nga akong time para sa sarili ko."* ("*It [being a member of a professional organization] requires my time, but I barely have time for myself*.")

Apparently, the teacher cannot accommodate active participation in a professional organization because of the volume of other priorities.

On Research- and Mathematics-Related Trainings

The math teachers were immersed in trainings mandated or endorsed by the DepEd especially matters on K to 12 curriculum. These trainings focused on the content and pedagogical content knowledge needed by them. These include the Regional Mass Trainings in Grade 10 and in senior high school which were cascaded down to teachers who were not accommodated in the major training. They called this as training for untrained teachers. Aside from these, trainings on localization, contextualization, spiral curriculum, calculus, and effective and contemporary strategies of teaching mathematics in the 21st century were provided.

The four key informants appreciated the importance of trainings in their professional development activities. One of the trainings was on LS to which Teacher Angelo was a participant. LS is a Japanese practice of sharing teaching practices by conducting systematic inquiry into their pedagogical practices (Fernandez, 2002). Teacher Angelo described the program:

> *Iyong lesson study for students, iyon kasi, gagawa kayo ng lesson plan na mas appropriate sa mga bata. Kung paano mo iniisip iyong higher order thinking and skills nila doon.* (In lesson study, you will develop lesson plans

appropriate for the students by reflecting on their higher-order thinking skills.)

As an output, they were tasked to develop a lesson plan. They were closely monitored by external and internal partners until they accomplished one. They documented their practices and were able to craft research out of the training outputs. They were as well given the chance to present their outputs for public verification and dissemination.

Also, AR-related activities were organized that aim to propel the teacher-researcher role like training workshops on research, statistics, probability, quantitative and qualitative researches, basic education researches, and action researches. In the interview, some of them claimed that the research trainings were geared towards conceptual development only. Further, they said that sustainable technical assistance is needed as well as decongesting some school activities to help them translate their learning into an output. Some remarked about voluminous trainings which are not related to their field of specialization, but certainly a component of teacherhood. Aside from the use of SPSS, they had trainings on the use of Microsoft Excel and a special kind of scientific calculator.

On Research- and Mathematics-Related Awards

It is shown that the teachers' efforts also paid off as they achieved awards like best in research proposal, poster presentation, and innovation. The researchers of these papers received funding from the DepEd and even the outstanding teacher awardees had researches listed in their vitae. Also, few of them were accorded distinguished secondary math teachers.

On Research-related Professional Services

Mathematics teachers are also data analysts, research consultants and advisers, and language editors. The number of clients served however, reveals that they are more into performing data analysis than being research consultants and language editors. From the informal interview, most of these *pro bono* professional services were intended to help senior high school students taking up Practical Research 1 and 2. Some were sought for the graduate studies and by their colleagues as well.

Link of Research Productivity and Mathematics Teaching and Learning Process

It is found out that teachers utilize research in various layers and levels. The link of RP and mathematics teaching-learning process is presented for each teacher and then were summarized into themes thereafter.

Teacher Angelo

He stressed that participating in research-related activities is driven by his will to improve himself and as well as his students. He stated, "*…to improve the class and the students."*. For

instance, his research being a co-author about lesson study (LS) allowed him to thoroughly design lesson plans that integrate higher order thinking skills and how to smoothly scaffold these to the learning situations. In other words, the way teacher Angelo integrates research in teaching and learning situations is by considering the intervention as a teaching strategy. After the research, he used the concept in developing his succeeding lesson plans. As he pointed out, *"I used it in planning my class especially in problem solving situations."*.

Consequently, he claimed he was able to improve the content, presentation of his lessons, and elicitation of responses from his students explaining that, "*I usually lectured my topics but in LS, I use problems that are considered of a higher level.*

There was also an admission that through research-related activities, it became instrumental in updating himself in content and pedagogies. He shared that during research- and mathematics-related seminars, they are taught on how to develop instructional materials and according to him, he utilized those materials inside his classes.

Teacher Beth

She acknowledged that participating in research-related activities are avenues to improve herself as she opined*, "I attend trainings to strengthen my knowledge and skills on research and in math."*

Not only did she improve herself through research-related activities but also her students. She further said*, "I conduct researches so that I have knowledge to impart to my students."*. She explained that the learnings she gained from research were also applied in the class when these are proven effective. In a way, research becomes a mode of reflecting on her own teaching practices. She exemplified their Program LOVE which is related with child protection policy. They continued it until it became a part of their school culture. This is also like her peer learning strategy. She also stressed that to teach is to read and find ways on what techniques are best suited to the learners and this never ends.

Further, the product of a research can be another research. She cited for instance her plan on her peer learning strategy which is action research. She acknowledged that the strategy can become a research as well in other learning areas and other learning situations.

Teacher Charlie

In the interview, he confessed that he has yet to explore the beauty of research because he perceives it as interesting and beneficial to his students. He only attended few mathematics-related trainings that allowed him to have a better understanding of the K-to-12 curriculum. He

acknowledged that research- and mathematics-related trainings helped him with a variety of strategies that can be used in different teaching and learning situations. He elaborated, "*I became aware of what should be learned. During trainings, I become updated and see myself a critical thinker.".*

Like teacher Beth, he reads to supplement things that he learns from other venues. Apparently, the transcripts showed that for Teacher Charlie, the connection of teaching and research or the integration of research and teaching is unclear. There were several points in the interview where he could hardly clarify his ideas in the way he integrates research-related ideas in teaching. The teacher-researcher role is therefore, a thinking yet to be achieved in reality. Teacher Charlie is about to propose his first ever research paper after almost a decade of teaching.

Teacher Dindin

Among the four, together with Teacher Beth, she was strong in acknowledging the benefits of research particularly as a way of determining the problems encountered by her students. In her words:

> What I like in action research is that we identify the problems of the students for us to address those problems.

According to her, research-related activities such as trainings and research writing helped her in revising instructional materials. So, other than helping her students to learn through her enhanced learning materials as by-products of research-related activities, she also got updated and developed the mindset of a researcher. Essentially, her being a research teacher made her more vigorous to learn and become skilled in research to enable her to develop the same skills among her students. She mentioned, "*Because what they learn from us are also the things, we teach them.".*

She sees to it that research findings related to classroom discussions are spilled over her to her class to supplement the ideas coming from the books. She averred,

> What we learn from research and other related activities are utilized inside the classroom. We become updated, we become critical, we explore our learning environment, and we become reflective.

Like Teacher Beth, she never stops learning new things. Moreover, the recommendation of the previous researcher, be it herself or other researchers, can become again a basis of an intervention which in turn, can become another action research.

From the individual cases discussed, the following themes were generated. The themes are presented visually in the next figure.

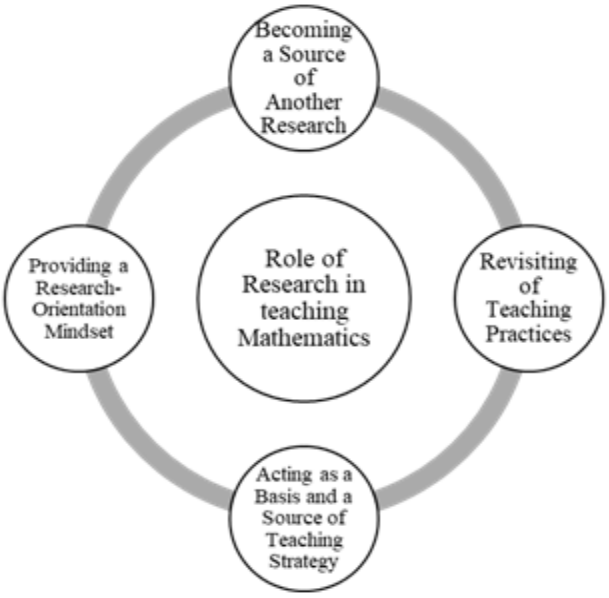

Figure 1. Integration of Research in Teaching-Learning of Mathematics

Acquiring a Research-Oriented Mindset

The four teachers were engaged in different research-related activities because they sought to update themselves and stimulate deeper understanding in terms of content and processes in their field (Artes et. al., 2017; Carlsson, et al., 2013; Hughes, 2004). For instance, Teacher Charlie shared his views of the present curriculum as compared to the previous curriculum. Because of trainings, although he yearns for more trainings, he distinguished the expectations of both curricula. Accordingly, they gave importance to reading as an important element to teaching. By reading, he grew professionally. Hence, through readings, trainings and other research-related activities, commitment to learning is refreshed (Duff & Marriot, 2017) which in turn allows them to become critical thinkers. Teacher Charlie explains it this way:

> I become more aware of what competencies ought to be learned that have application in real life. During my trainings, I am updated and I became a critical thinker.

In Grade 10 mathematics, one expected outcome in the last quarter is a mini-research. Students according to Teacher Beth craft investigations that encourage them to apply their knowledge in math. She believes that her knowledge in research motivates her to imbue research thinking among his students to carry out their investigation. Teacher Dindin shared the same

viewpoint as Teacher Beth in her class in statistics. Because of her knowledge on the power of research, she wanted her students to develop a similar research mindset. She declared:

> In my statistics class, I required them to develop quantitative researches. I told them to identify problems in the school and propose so that the awareness of the students will improve. That is what we wanted for our researches.

She further remarked that she infused research findings in her class to supplement the information given in the books. This reduces assumptions in the classroom (Magidson, 2005) and the tendency to work towards facts and information. This finding concurs with Markides (2007) and Burke & Rau (2010, as cited by Pawar, 2015) as a mode of linking the two. Teacher Beth aptly concludes, "*You become intelligent if you do research*." The teachers' critical thinking and commitment for continuous learning is sustained because of research.

Revisiting of Teaching Practices

The multiple data revealed that teachers utilized research in teaching and learning situations to monitor their own teaching practices (Ulla, 2018; Navarro & Santos, 2011; Segal, 2009; Kane, Sandretto & Heath, 2004; Lerman, 1990).

Their proposed and completed classroom researches as well as innovation projects unravels the urge of teachers to determine the impact of their interventions to learning outcome. Their trainings allow them to self-revisit their practices especially in the mathematical pedagogical content knowledge (MPCK). Teacher Charlie consistently seeks for more MPCK trainings and research orientations as opportunities to revisit his teaching practices.

The key informants also believed that research is an avenue to assess their teaching practices if effective or needs some calibration. Teacher Beth remarked, "*What we do is to apply what we have discovered to determine if it is effective or not.".*

Further, because of an LS training program, Teacher Angelo and his colleagues utilized the concept of LS in developing their math lessons. After the first implementation of the first teacher, the group sat down and analyzed the implementation to see what improvement can be done in the next execution. After a thoughtful reflection, one can determine what works and what does not work in a classroom set-up leading to new perspectives (Afdal & Spernes, 2018). They used the knowledge gained from the first execution to polish their practices in teaching a particular lesson. He further expressed the value of research processes in teaching, when he said, "*Because you know how to teach a particular lesson. Knowing how to teach it guarantees understanding.".* It can be said then that he was ensured of self-improvement in terms of pedagogy because of his participation in research and research-related activities (Silver, 2009) which may also guarantee students' success. He pointed out, "*If I attend, my lesson and lesson presentation are also improved.".*

In the case of Teacher Beth, she conducted the $5x + y$ shepherding style to investigate whether pairing of high- and low-ability students in mathematics help improve the academic performance. Through this, it allows the teacher to do self-introspection on the effectiveness of the strategy. Teacher Dindin affectingly points out, *"In teaching, I am able to assess whether my strategy is effective and, in that way, we become more reflective."*.

Generating a Basis and Source of a Teaching Strategy

If a researcher finds evidences that a particular strategy is effective, then it gives him or her confidence to adopt such strategy. In this case, trainings and seminar become relevant grounds for teachers to understand the K-to-12 Curriculum and to explore ways and means to support every learner (NCTM, 2016; Willis, 1995).

Teacher Beth was driven to conduct the research by her desire to determine a strategy that will impact the learning of her students because of the perennial struggles in mathematics. This similar view was raised by NCTM (2012), Rasmussen et al. (2011), Battista et al. (2009), Goos (2008), Clements (2007), NRC (2001) and Carnine and Gersten (2000) on the link of teaching and research. Before implementing the shepherding style, one must meet the rigors of reading to gain knowledge on the strategy and what can be done with such a technique. After finding out that the $5x$ + y shepherding style is effective, Teacher Beth adopted it in her remediation activities to students who are considered at-risk in mathematics. It also gave the opportunity to high-ability students to master the content of the lesson through the shepherding act. Not only did she effect learning in her class, but she was able to produce knowledge about teaching (Adler, 1997) by aligning the learning opportunities and learning outcomes (Cai, Morris, Hohensee, Hwang, Robinson, & Hiebert, 2017). According to her, this is also the same concern of her planned Project LOVE. If it will provide evidence of a favorable impact, she will consider the strategy in her actual instructional process.

For Teacher Dindin, she puts emphasis on instructional materials as a possible by-product of research activities. Understanding the students shapes the way a teacher develops instructional materials. According to her:

> For example, today's age is technological so we maximize the use of cellphone. We need to keep abreast on things we think will help them.

Unstated explicitly, Teacher Angelo to a certain degree has this same intention for why he conducts research. During the interview, he repetitively sent the message that his students could hardly grasp higher order thinking competencies. When asked of the add-on learning research provided him, he responded, "The problem-solving based teaching.".

So, sustaining his participation in LS programs can be regarded as a way of attuning his mathematics lesson to achieve higher order thinking skills among his students.

Becoming a Source of another Research

Teacher Dindin believes that research is a cyclical process pointing out that research becomes a basis for another research. The recommendation section of a paper signifies that much must be done on a certain investigation. The research of Teacher Beth on child protection policy became the foundation of Program LOVE – a program on values integration which aims to change the untoward attitudes of the students.

Teacher Angelo immersed himself on the concept of LS and designs such program in some math lessons. The same program encouraged him to repeat conducting one. According to Pawar (2015), past researches become a basis of another research.

DISCUSSION AND CONCLUSION

Generally, the high school mathematics teachers are considered beginners or have limited experiences in terms of research production, presentation, and publication (Besmonte et al., 2018) and therefore, have an immense potential room for growth. As opined by teacher Angelo, "*Sa tingin ko hindi pa ako ganoon ka-productive. Kasi for the sake lang na umattend and maki-participate."* ("I think I am not that productive because I only attend for the sake of attending and participating.") Unfortunate it may seem for Teacher Angelo, but teacher Beth's words are promising:

> *Productive siguro, in the sense na nag-iistart na ako ng research. This SY, I started two researches. Unang una, about bullying and iyong isa is learning strategies in mathematics na kaka-submit ko sa DO. About pairing of students para in terms of academic achievement para mai-share ko sa ibang teachers kasi I think hindi lang siya sa math applicable.* (Perhaps, I am productive in the sense that I am starting to conduct researches. This SY, I started two researches. The first is about bullying and the other one is about learning strategies in mathematics which I just submitted to the DO. It [referring to the latter] is about pairing of students so that in terms of academic achievement, I will be able to share to other subject teachers [research results].)

These results substantiate various studies (e.g., Abramo, et al., 2017; Milburn and Brown, 2016; Tagaro, 2015) as well as local reports like those of Dullas (2018) Ulla (2017), Ramos (2017) and from DO No. 43 s. 2015 stating the right skewed distribution in participating in research related activities which means that only few of the teachers are actively participating in research-related tasks. The low number of publication manifests either or both of the following: firstly, few are joining the rank of teacher-researchers; and secondly, it is still true that researches are made for

incubation instead of presentation and publication. Hence, studies on what enable or disable teachers to conduct should be studied thoroughly.

Further, it seems clear that the level of integration of research in teaching varies from one teacher to another which is primarily a function of the prior knowledge and experience in research as well as the level of constraints each of them felt in the conduct and participation in research-related activities. Hence, they have demonstrated varied, personal, and non-linear ways of integrating, linking, and utilizing research in the learning delivery of mathematics curriculum. The disparities of integration between respondents relies heavily on the orientation and previous experiences of a teacher in the realm of research and teaching. The integration of research commenced with the teachers' process of growing as a better facilitator of learning and with the terminal point for student development. It transforms teachers more reflective of their teaching and their students' learning, and effective in understanding and addressing the needs of students.

Teacher Charlie who was limited to only few mathematics- and research-related trainings spoke only of the add-on learning he derived in those activities and how those activities helped him in teaching mathematics. He could not speak of the fourth theme (Becoming a source of another research). Meanwhile, Teachers Beth and Dindin who had experiences on research writing were both evolving in ideas and outspoken about the potential benefits of research in teaching. Teacher Beth's experience on action research was however, more solid than teacher Dindin's, whose immersion was more on basic types of research. Teacher Angelo, a millennial, had some uncertainties in the integration process. For him, together with Teacher Charlie, there is a mixed notion of research as a source of knowledge production and symbolic act of compliance.

The flurry of disempowering conditions tends to skew their action towards accommodating the idea of research. The promising aspect however, is that while they lean on the idea that their participation is a function of the organization's expectation there are strong contentions that their wanting for professional development pushed them to slowly embrace the role of a teacher-researcher. Provided with a favorable institutional and leadership atmosphere, their commitment to participate in research-related activities to impact their professional development and the students in general is expected.

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