Impact of Professional Learning and Development Activities Participated in by Secondary School Mathematics Teachers Through Kirkpatrick's Evaluation Levels

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Abstract
This study delved into the various learning and development (L&D) activities either provided or partnered by the Department of Education and attended by the secondary school mathematics teachers (SSMTs) of the Schools Division Office of Nueva Vizcaya. It involved 117 teachers, profiled along variables such as the level and number of L&D activities participated in for the last five years (beginning 2015), and the foci and content of the L&D based on the domains of the Philippine Professional Standards for Teachers (PPST) and Mathematics content standards. The study explored on understanding the SSMTs' L&D through the Kirkpatrick's levels of evaluation with the use of a mixed-method approach, particularly concurrent-triangulation. Survey questionnaire, interviews and document review were utilized as data gathering procedures. The study revealed that the SSMTs, considering the utility and relevance of the L&D, learned teacher and learner-centered approaches of teaching and technology-aided instruction to teach mathematics content which they were previously weak at. Derived learnings of the SSMTs from the L&D activities contributed to determining improvement of their individual and organizational performances. Also, the attainment of the four levels of Kirkpatrick's evaluation was the same regardless of the SSMTs participation in the 12 L&D activities in Mathematics.

Keywords: Behavior, Mathematics Content Standards, Performance, PPST Domains, Reaction, Results

Introduction

In the field of Human Resource Management (HRM), learning and development (L&D) is always linked with organizational activity with an aim of developing and improving the individual, group or organizational performances. L&D plays a crucial role in wake of the technological advancement, effectiveness of the organizations, and to the experiences of human resources in their job.

The same situation is applicable and is expected to the teaching sector. Teachers, being the backbone of the Education Sector, need to continuously engage in any professional development since this becomes extremely necessary especially in coping with the changing demands of the teaching industry.

In the Philippine context, teachers have deep regard from educating themselves to many training programs provided by the government or other public and private agencies and institutions a manifestation that education occupies a central place in Philippine political, economic, social and cultural life and has always been strongly viewed as a pillar of national development and a primary avenue for social and economic mobility.

To note, today's government has been very open with its continuing efforts in intensifying policy dialogues along these issues, especially at the onset of K to 12 program encapsulated in Republic Act No. 10533, otherwise known as "*The Enhanced Basic Education Act of 2013.*" It is very clear that the utmost aim of the Philippine educational system is a world where everyone has the opportunity and equal access to benefit from quality education.

In response to the rapidly changing learning environment of present and future learners DepEd's battle for quality education, the department introduced aggressive reforms to globalize the quality of basic education in the Philippines which is "*Sulong Edukalidad"* that has four key reform areas: (1) K to 12 Curriculum review and update; (2) Improvement of learning environment (3) Teachers' upskilling and reskilling; and (4) Engagement of stakeholders for support and collaboration, known as the KITE.

Further, to complement reform initiatives on teacher quality in line with the new professional standards for teachers, DepEd, through the Teacher Education Council (TEC), issued DepEd Order No. 42, s. 2017, which is the "*National Adoption and Implementation of the Philippine Professional Standards for Teachers (PPST).*" The PPST makes explicit as to what teachers should know, be able to do and value to achieve competence, improved student learning outcomes, and eventually, quality education.

The Schools Division Office of Nueva Vizcaya was recently accredited and attained maturity level 2 along PRIME-HRM of the Civil Service Commission. Being at maturity level 2 of the PRIME-HRM, the division has a defined process of monitoring and evaluating L&D interventions given to its human resource through the utilization of the Quality Assurance, Monitoring and Evaluation (QuAME) Tools. The utilization of the QuAME is a manifestation that monitoring and evaluating L&D adopts the levels of the Kirkpatrick's Evaluation Model in the same manner the Civil Service Commission does. To ensure the effectiveness of a L&D and to maximize learning by the trainees, an evaluation of the said activity shall be undertaken after its conduct. Evaluation should likewise be part of the program design preparation.

While the government spends much to various L&Ds to its human resource, most especially to the teachers, it is vital to know how these interventions have contributed to the learning outcomes – the achievement of learners as one of the measures of quality basic education. This endeavor falls part of the result level of the Kirkpatrick's model.

The researcher believed that one of the many ways in attaining the goals of mathematics education is through exposure of teachers to L&D activities as interventions. The study of Mahulo (2012) on the influence of teacher's training on the performance of students found that there were improvements in the mean score performance of every subject for the learners who came from the trained teachers and that major reductions in the mean score performance came from the untrained teachers.

Stemmed from the context of L&D as interventions to teachers and the aspects of evaluating these interventions through the four levels of Kirkpatrick's Evaluation Model, the study explored the various L&D activities participated in by the secondary school mathematics teachers of DepEd Nueva Vizcaya in the last 5 years beginning 2015. The study gauged how far DepEd has been successful in providing L&D interventions to its mathematics teachers despite low results of performances in various assessment conducted from among the learners. Also, this discourse to the various components of the L&D interventions provided to the SSMT anchored along the domains of the PPST and the content and performance standards of the K to 12 Mathematics. The study provides the division to strengthen and enhance its policies toward improving learning and development services to its human resource most especially on providing L&D interventions to teachers which can improve their individual, peers and organizational performances, and eventually, the improvement of the learners' achievement.

The study was thus, conducted to shed light on the various learning and development activities participated in by the secondary school mathematics teachers of DepEd-Nueva Vizcaya from the year 2015 to 2019, and their attainment of the four levels of Kirkpatrick's Evaluation Model.

Methodology

This study evaluated the learning and development (L & D) activities provided by DepEd and other training institutions participated in by 117 secondary school mathematics teachers (SSMT) of the Schools Division Office of Nueva Vizcaya. The Kirkpatrick's Training Evaluation Model was used which involved four levels, namely: reaction, learning, behavior and impact. These levels were related to level and number of L&D activities participated in for the last five years (2015-2019), the foci and content of the L&D based on the domains of the Philippine Professional Standards for Teachers (PPST) and Mathematics content standards. The mixed-method approach, particularly concurrent-triangulation was used with survey questionnaire, interviews and document review.

Results and Discussion

Section 1. Learning and Development Activities Participated in by the Secondary School Mathematics Teachers from 2015 to 2019

The L&D activities participated in by the secondary school mathematics teachers of SDO-Nueva Vizcaya in the last 5 years were either provided or partnered by the Department of

Education mostly in the division and regional level addressing their development needs. These L&D activities were conducted along personal growth and professional development, curriculum and planning, and content knowledge and pedagogy focusing on the contents of Statistics and Probability, Geometry and Patterns, and Algebra. SSMTs have limited participation in L&Ds that dwell on the diversity of the learners, assessment and reporting, and community linkages and professional engagement.

Section 2: Extent to which the Secondary School Mathematics Teachers' Participation in L&D Activities contributed in the Attainment of Four Levels in Kirkpatrick's Evaluation Levels

Applications of the various L&D programs participated in by secondary school mathematics teachers were assessed using Kirkpatrick's Evaluation Levels. The data collected from each evaluation levels were evaluated using different instruments and results of data analyses were elaborated for the four level evaluation aspects. Each level evaluation aspect was analyzed to obtain information on the teachers' application on the various L&D they participated in.

Ttable 1: Summary Table of the Mean, Standard Deviations and Qualitative Descriptions on the Four Levels in the Kirkpatrick's Evaluation Model

Level	Highest Value	QD**	Mean	SD*	QD**
Reaction Level	3.58	HMTE	3.17	0.93	MMTE
Learning Level	3.69	HE	3.51	0.63	HE
Behavior Level					
1.Assessment from the Classroom Observation Tools					
Proficient Teachers	4.55	VS	4.46	0.60	VS
Highly Proficient Teachers	4.70	O			
2. Assessment from Learners	3.78	HP	3.57	0.65	HP
Results Level					
1. Assessment from the teachers	3.34	A	3.09	0.73	A
2. Achievement of Learners	88.31	VS	87.62	4.85	VS
3. Performance of Teachers	4.425	VS	4.30	0.12	VS

SD- Standard Deviation, QD**- Qualitative Description*

Reaction as assessed by the SDO-NV teacher-participants about the L&D they participated in from the year 2015 to 2019 has the highest mean value of 3.58 which is qualitatively described as highly met the expectation and with an overall mean of 3.17 with adjectival rating of moderately met the expectation. In general, the results show that the L&D activities were delivered with very good facilitators/speakers utilizing various learning methodologies and approaches.

Kirkpatrick's Level II determined what the SSMTs learned during the training with the highest mean score of 3.69. The extent to which their knowledge and/or skills are at high extent as manifested by an overall mean of 3.51. Further, based on the conducted assessment and interviews, these L&Ds they participated in provided them skills needed in the teaching and learning along the PPST domains which are essential in teaching Mathematics. The L&Ds they attended also increased their awareness and knowledge about the topics discussed during the seminars.

Level III of the model evaluated the behavior of the SSMTs after training. Specifically, it attempted to evaluate how the teachers applied what they have learned. Results from the proficient teachers' COTs reveal that the learnings from the L&Ds they participated in were applied very satisfactory with the highest mean of 4.55 while the highly proficient SSMTs, outstandingly applied the learning they have gained from the L&Ds with the highest mean score of 4.70. The overall mean of behavior from the COTs of the SSMTs was 4.46 which means that they applied well-connected pedagogical aspects of all the objectives consistently aligned with student's development. This also validates the results of the study of Eugenio and De Gracia (2019) that employees who attended L&Ds applied their derived learnings and these contributed to their individual and organizational performance.

Further, the highest mean results from the assessment of the learners on the level of practice of the SSMTs was 3.78 with adjectival rating of highly practiced and with an overall mean score of 3.57. This means that the gained knowledge from the L&D activities participated in by the SSMTs were highly practiced in the teaching and learning process.

To trace the applications of the learnings of the SSMTs about their participation in the various L&Ds they have participated in, they were asked about their output after the trainings, and results revealed with the highest mean of 3.34 which means that they were "accomplished" in applying the gained knowledge from the L&D. Moreover, their practices were assessed by the students under them and results revealed a mean score of 3.09 that affirmed the findings that they are at "accomplished" level. Further, the results sustain the findings in the study of De Gracia (2017) that recognized secondary school Mathematics teachers described as "accomplished" on mathematics content and pedagogical knowledge. In terms of Mathematics Content Knowledge, the Recognized SSMTs at an "accomplished" level on mathematical concepts, processes, communication and connections. In terms of the mathematical pedagogical knowledge, they were at an "accomplished" level along school mathematics curriculum, students' cognition of mathematics, mathematics teaching and mathematical disposition.

Meanwhile, in the year 2019, the SSMTs have the highest performance level with a mean of 4.425 which is qualitatively described as very satisfactory. The overall mean performance rating is 4.30 which means that the SSMTs performed very satisfactorily in applying what they learned during the L&D in the workplace and or in the organization.

On the other hand, the learners performed very satisfactorily (88.31) at Grade 9 level and the overall mean performance of the learners is 87.62 with adjectival rating of very satisfactory.

Section 3: Combinations of the L & D Activities Participated in by the SSMTs and Levels of L&D Predicting the Levels of Attainment of the Levels of Kirkpatrick's Evaluation Model

Table 2: Summary of the Simultaneous Regression Models in the Attainment of the Four Levels of the Kirkpatrick's Evaluation Model

MODEL	DEPENDENT VARIABLE	F	Sig.	R^2
1	Reaction	1.47	.14	.16
2	Learning	.94	.52	.11
3	Behavior 1(Assessment from COT)	1.49	.13	.16
4	Behavior 2 (Assessment from Learners)	1.99	.03*	.20
5	Results 1 (Assessment from Teachers)	.60	.85	.07
6	Results 2 (Achievement of the Learners)	.66	.80	.08
7	Results 3 (Performance of the Teachers)	1.08	.39	.12

*significant at $p<0.05$ (two-tailed)

The combinations of the 12 learning and development activities participated in by the SSMTs and the weighted level of L&D do not significantly predict the level of attainment of the Kirkpatrick's evaluation level along reaction, $F(13, 103) = 1.47$, $p = .14$, $R^2 = .16$; along learning, $F(13, 103) = .94$, $p = .52$, $R^2 = .11$; along behavior based on the classroom observation, $F(13, 103) = 1.49$, $p = .13$, $R^2 = .16$; along results as assessed by the SSMTs, $F(13, 103) = .60$, $p = .85$, $R^2 = .07$; along results based on teachers' performance, $F(13, 103) = 1.08$, $p = .39$, $R^2 = .12$; and along results on the achievement of the learners, $F(13, 103) = 1.66$, $p = .80$, $R^2 = .08$. These mean that the attainment of Kirkpatrick's evaluation model along these levels is the same regardless of their participation in the other learning and development activities in mathematics from the years 2015 to 2019.

Whereas, there is a combination of the 12 L&Ds that significantly predicts the attainment of level of behavior as assessed by the learners in the Kirkpatrick's Evaluation Model, $F(13, 103) = 1.99$, $p = .03$, $R^2 = .20$. The beta weights of the L&D 2 (-.012), L&D 5 (.087) and L&D 8 (-.190) suggest that participation of the SSMT in the *Regional Training of K to 10 Teachers on Critical Contents* (L&D 5) and participation in other L&Ds aside from the *Seminar-Workshop on Content Teaching and Methodologies in Statistics and Probability (L&D 2)* and *Pedagogical Retooling in Mathematics, Language and Science for Junior High School* (L&D 8) contributed to the prediction with adjusted R square value of 0.20, indicating that 20% of the variance in attaining the level of behavior as assessed through SSMT teaching practices was explained by the model, which according to Cohen (1988), is a small effect.

A stepwise regression analysis was conducted to determine which particular L&D contributed to the prediction of the attainment of behavior as assessed by the learners. The stepwise regression model was computed.

Table 3: Stepwise Regression Model Predicting the Attainment of the Level of Behavior in the Kirkpatrick Evaluation Model as Assessed by the Learners

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	ß		
1	(Constant)	3.575	.019		193.211	.000
	L&D8	-.153	.076	-.186	-2.026	.045

Results revealed that using stepwise method with probability F-value of .05 for the entry and .10 for removal of variables, only *Pedagogical Retooling in Mathematics, Language and Science for Junior High School* (L&D 8) significantly predicted the attainment of the level of behavior of the SSMTs as assessed by the learners, $F(13, 103) = 4.10$, $p = .045$, $R^2 = .034$ with beta weight of -.153 suggesting SSMTs participation to other L&D activities aside from L&D 8.

Further, based from the results, the model is $y = -.153x_8 + 3.58$ where y is the level of behavior of the SSMT according to their teaching practices and participation in the *Pedagogical Retooling in Mathematics, Language and Science for Junior High School* as x_8 which is the independent variable and 3.58 as the constant value. If the SSMT participated in the L&D- *Pedagogical Retooling in Mathematics, Language and Science for Junior High School (L&D 8)*, then the level of behavior of the SSMT according to their practices is moderately practiced, while if the SSMT participated to other L&Ds aside from L&D 8 then the behavior level of the SSMT in the application of the learning gained from the other L&Ds is highly practiced. Accordingly, Heydari et al. (2019) put premium on the idea that an increasing learning on the new teaching and learning methods from workshops becomes more integral in performing tasks in the workplace.

Section 4. Issues, Challenges, and Proposed Solutions of the Secondary School Mathematics Teachers and the Researcher for the Improvement of Mathematics L&D

Each year, thousands of teachers participated in a range of L&D that reflects substantial investment of time and money (Haslam, 2010). Yet despite widespread reliance on professional learning as a core component of efforts to meet the challenges of educating the learner, educators have little systematic information to allow them to assess the quality of L&D or gauge their contribution to professional practice.

Table 4: Issues, Challenges, and Proposed Solutions of the SSMTs for the Improvement of Mathematics L&D

Issues and Challenges	Proposed Solutions
1. Time constraint	-Conduct the L&D during weekends -Limit travel requirements -Optimize online L&D
2. Different learning levels and habits	-Conduct a survey on teachers' L&D preference -Incorporate different strategies to cater to the different -learning levels of the teachers
3. Financial a. Financial constraints	-Online training (OT) – OT minimizes the need for travel and venue costs and often lowers facilitation costs
b. Lack of funds in the reproduction of activity sheets and worksheets	-Soft copies of activity sheets/ worksheet may be shared through internet
4. Division training venue	-Video Conferences, Webinar and Online fora
5. Level of readiness of the learners	-Provision of L&D addressing different learning styles of learner
6. The use of technology in teaching	-More trainings on the use of ICT in teaching and learning
7. Tools on data analysis	-Provision of longer days on L&D of doing data analysis

Time constraint on the part of the teachers is the top-most disturbing factor to consider in conducting L&D program. To arrest such concern, virtual modality may be considered. L&D proponents should optimize the use of online seminars and/or training called "webinar." Employing online modality of carrying out L&Ds will not require teacher participants to travel to join in face-to-face engagement. Doing so, especially during weekends, will reduce the burden of teachers to adjust to their full-packed teaching and teaching-related loads and/or schedules. Travel time, especially for teachers who are stationed in far-flung or distant schools to the venue, really challenge them. Hence, online L&D will greatly reduce the problem on time adjustments.

Also, the table shows that diversity along learning levels, habits, and interests matters in any learning engagement, and the conduct of a survey on teachers' training preference and incorporating different strategies to cater the different learning levels of the teachers may greatly resolve these challenges. Hervie & Winful (2018) recommended a periodic learning needs assessment to be conducted before training programs are designed for teachers to address individual differences.

Financial constraints can never be an exception. According to the teachers, they find some L&Ds cost. So, online approach may reduce the problem on finances and on printing and reproduction of activity sheets and worksheets. Being given the soft copy will surely lessen the expenses of teachers.

The fourth element that challenges much the teachers is the venue of the activity; that when done online/virtually, optimized learning may be achieved. McCullen (2016) hypothesized that choosing the right venue, and closely attending to details such as learning environment, amenities and technology will help guarantee a successful learning experience for the employees.

Levels of readiness on the part of learners also matter. Teachers find some challenges in dealing with diverse learners. Training on addressing different learning styles of learner will help resolve the issue. As ascertained by Deunk, Smale, de Boer, Doolaard and Bosker (2018), differentiated instruction practices in primary education show that differentiated instruction has the potential of improving student outcomes, when implemented well.

Another problem, is on the use of technology in teaching for which teachers can be provided with more L&D using ICT in teaching and learning for this will make them more productive in their field of work.

Finally, the teachers admit that they find difficulty in understanding the statistical tools used in data analysis which made them suggest and propose that a three-to-five-day training on data analysis will greatly help them enhance their prior knowledge about it.

Table 5: Proposed Solutions of the Researcher for the Improvement of Mathematics L&D

Findings	Proposed Solutions	Link Policy Guidelines
	PRIME-HRM L&D Practices	
1.The L&D activities participated in by SSMTs were mostly conducted in the division level and lasted for three days. These L&Ds captured personal growth and professional development, content knowledge and pedagogy, curriculum and planning, focusing on Patterns and Algebra, Geometry and Statistics and Probability.	1.a. Inclusion of L&D activities for at least 3-day (DO No. 42, s. 2007) to capture commitment to practice the derived learnings through REAP and capturing on Learning Environment, Diversity of Learners, and Community Linkages and professional engagement.	1.a. -Civil Service Commission-PRIME HRM Core Area – L&D CSC Memorandum Circular No. 3, s. 2012 DO No. 42, s. 2007 -The Revised Guidelines on Selection, Promotion and Designation of School Heads
2. In the conduct of document review, none of the documents was seen on the SSMTs' portfolio about REAP or LAP of the SSMT participation in L&Ds and these are very essential for attaining at least level 2 of the PRIME-HRM.	1.b. Re-entry Action Plan of Teachers with at least 3-day Attendance in L&D shall be included together with its monitoring report and the certificate in the MOVs for the RPMS-PPST Portfolio	1.b. RPMS-PPST _ Domain 7 DO No. 42, s. 2017 CSC, 2018 DO No. 5, s. 2015- The RPMS
3. The knowledge gained was applied to improve the SSMTs' performance and helped them contribute to their school performance through the technical assistance of their colleagues, and for the professional growth of teachers.	Review of documents for assessment particularly on the promotion of teachers (T- I, T-II, T- III and MTs) may capture REAP plus its Implementation Report, for L&D activities of at least 3 days and or any level with equal point as evidence of applications of training or L&D in general.	Revised Guidelines on the Appointment and Promotions of other Teaching Related Teaching and Non-Teaching Positions (DO No. 66, s. 2007)

	Addressing Developmental Needs	
4.Proficient teachers were at emerging level in conducting action researches on teaching-learning to improve learning outcomes.	School Heads, Department Heads or Master Teachers may device mechanism of closing out or addressing developmental needs of teachers attending various L&D and may become a referencing in sending teachers to L&D activities or programs	DO No. 2, s. 2015- RPMS Phase IV- Development Planning
5. The provision of technical assistance to peers is vital in the realization of RPMS-PPST in improving the performance of the less experienced/less knowledgeable co-teachers.	Strengthening provisions of Technical Assistance to teachers through reading circles, conduct of LAC among others captured in the implementation of School's L&D Plan	DO No. 35, s. 2016, LAC K to 12 Basic Education Program School-Based Continuing Professional Development Strategy for the Improvement of Teaching- Learning DO 2, s. 2015

Inclusion of L&D activities for at least 3 days may be captured through Re-entry Action Plan (REAP) and a monitoring report with MOV to be included in the teachers' RPMS-PPST portfolio, for IPCRF rating. Inclusion of REAP and implementation report as evidence for the application of learning from the L&D for the teachers be considered during assessment for promotion of teachers. The findings of this study serve as basis in devising a mechanism of sending teachers to trainings based on their development needs. There is a need of strengthening the provisions of TA to teachers through reading circles, conduct of LAC among other teachers as a school-based continuing professional development (CPD) strategy for the improvement of the teaching and learning process to improve learning outcome and teaching performance.

Conclusions

1. Learning and development activities participated in by the secondary school mathematics teachers addressed their development needs along content and pedagogy and have provided them learning avenues for their professional growth. They were equipped with concrete understanding of the curriculum frameworks from their participation in various learning and development activities either provided or partnered by the Department of Education and have utilized them for their personal growth and professional development. However, SSMTs need to be equipped on PPST domains on learning safety and security, assessment and reporting, diversity of learners and community linkages and professional engagement.

2. Secondary school mathematics teachers consider the learning derived from the L&D activities, its usefulness and its relevance to their profession. They were able to learn teacher and learner-centered approaches of teaching and technology-aided instruction to teach Mathematics content which they are previously weak at. The knowledge they have acquired were translated to improve their performance and helped them contribute to their school performance through provision of technical assistance to their colleagues. However, the SSMTs, particularly the highly proficient teachers (master teachers), still have difficulty

conducting classroom-based action researches on teaching-learning for the improvement of learning outcomes.

3. Attainment of the level of behavior based on the teaching practices of the SSMTs can be predicted by the regression equation given by $y = -.153x_8 + 3.58$ where y is the level of behavior of the SSMT based on teaching practices and participation in other L&D activities aside from the *Pedagogical Retooling in Mathematics, Language and Science for Junior High School* (x_8).

4. A proposed future L&D activity is recommended by the secondary school mathematics teachers along the PPST Domain such as on diversity of learners, content knowledge and pedagogy with mathematics content along Statistics and Probability, Patterns and Algebra. Actualization of derived learnings from L&D participation may be integrated along strengthening PRIME-HRM, L&D, assessment for promotion and addressing development needs of the teachers.

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