

IMPACT OF THE PROFOUND UNDERSTANDING OF FUNDAMENTAL MATHEMATICS (PUFM) PROFESSIONAL DEVELOPMENT TRAINING-WORKSHOP OF MATHEMATICS TEACHERS

Vima Socorro J. Tandog¹, Dennis B. Roble¹, Christina V. Maglipong¹, Charita A. Luna¹

¹University of Science and Technology of Southern Philippines, Lapasan Highway, Cagayan de Oro City, Philippines

*For Correspondence; Tel. +639174701569, Email: dennis_robles@ustp.edu.ph

ABSTRACT: This study investigated the impact of the three-year teacher's training on the Profound Understanding of Fundamental Mathematics (PUFM) for K- 5 and 6 mathematics teachers of the Department of Education (DepEd) in the Division of Cagayan de Oro City on the pupils' achievement in mathematics. The researchers analyzed the pupil's score in the National Achievement Test (NAT) in mathematics by categorizing the pupils' score in terms of being taught by teachers in schools who participated in the PUFM thrice, once, and none at all and the on-site interview of the teachers trained by PUFM. The data gathered were analyzed using frequency, mean, standard deviation and analysis of variance (ANOVA). Results revealed that PUFM training failed to show remarkable evidence to impact on pupils' mathematics achievement in the NAT, however, based on the post-interview, the participants revealed that the training has improved their teaching competence in content, pedagogy and problem-solving techniques because many of them, even a Filipino language teacher became coaches in mathematics contest like the annual Metrobank-MTAP Math Challenge. The researchers then recommend that the college may design a training to conduct every summer for two-week training-workshop for all elementary mathematics teacher from Grade I to VI to strengthen the mathematics concepts of teachers so pupils will have strong foundation in mathematics and construct its own assessment instrument to make an appropriate evaluation of content effect on pupils from the training. Furthermore, content reading in elementary school is emphasized to improve reading comprehension.

Keywords: Profound Understanding of Fundamental Mathematics (PUFM), professional development, achievement, mathematics

1. INTRODUCTION

During the past decade, teachers' mathematical knowledge in content and pedagogy has been used as one of the key policy basis for reform initiatives. In view of this, the mathematics faculty of the University of Science and Technology of Southern Philippines (USTP) some years ago did a survey to determine the Grades V and VI mathematics teachers' profound understanding of fundamental mathematics. The results of the analysis revealed that the teacher-respondents were deficient on the content knowledge and appropriate pedagogy on fundamental mathematics [1].

The social responsibility of the university as an institution of higher learning with programs in Science, Technology, Engineering and Mathematics (STEM) is to support teacher development of mathematical knowledge for teaching (MKT). A well-funded mathematical knowledge for teaching advanced exhort for the support to the development of that knowledge which is of prime importance to society [2].

As a response to the challenges of support and responsibility, the university conducted the three-year training of the profound understanding of fundamental mathematics for Grades V and VI teachers. This was done twice a year in May and October for 81 hours for 40 teacher-participants. The training was called Profound Understanding of Fundamental Mathematics (PUFM). The training was aimed to engage teachers on how to model to their pupils' deeper understanding of concepts in fundamental mathematics using appropriate pedagogy for better assimilation. The series of training ended last October 2016. After the training, the researchers believed that the teacher-participants have implemented what they have learned in the training to their pupils which needs verification.

Irvin [3] believed that teachers play a key role in pupils' learning and have a great influence on their pupil's achievement. Mizell [4] also revealed that professional development yields expected results, that if teachers learned new knowledge and skills because of their participation, and they use what they have learned to improve teaching and leadership. Pupil's learning and achievement also increased because teachers used what they learned in professional

development. Higgins [5] stated that professional development efforts needs assessment, hence this study.

This research aims to assess the impact of the PUFM training among K-5 and K-6 teachers of Cagayan de Oro City on pupils' national achievement tests in mathematics for three years. The study sought to answer the following problems:

1. What are the elementary pupils' of Cagayan de Oro City school's achievement score in mathematics in the National Achievement Test (NAT) in terms of their teachers' participation in the PUFM?
2. How does the pupils' achievement in the NAT compare as impact of the teacher's participation in the PUFM training?

2. LITERATURE REVIEW

Research on professional development has shown promises of having an impact on teachers' practices and pupils' learning [6]. In like manner, teacher training has promises impact also on pupils learning which can be assessed through their achievement. Stegler and Hiebert [7], support teachers' effectiveness through assessment. Inevitably large-scale assessments like the National Achievement Test (NAT) can measure the impact of teachers' effectiveness as a result of the training. Gathering information about pupils' understanding is integral to all aspects of mathematics instruction [8].

Aclan [9], studied the influence of teacher training with follow-up and classroom observation of the mathematics supervisor and principal on content and pedagogy of Grades V and VI mathematics teachers in Camiguin on pupils' achievement. The result revealed that pupil who was taught by a teacher who underwent training in subject matter knowledge (SMK) and pedagogical content knowledge (PCK) significantly performed better than those who did not undergo the training. This implied that training has an impact on pupils' achievement. Her study has a semblance to the present study.

Lomibao [10] said that the efficiency and effectivity of the learning experience are dependent on the teacher quality, thus, enhancing teacher's quality is vital in improving the

students learning the outcome. She studied the impact of Lesson Study on Bulua National High School mathematics teachers' quality level in terms of SEARS-MT dimensions. Results of the analysis revealed that her Lesson Study effectively enhanced mathematics teachers' quality and promoted teachers' professional development. Also, the teachers positively perceived Lesson Study to be beneficial for them to become a better mathematics teacher.

Lu [11] also studied the impact of teacher professional development programs on student achievement in rural China. She evaluated the impact of a PD program-National Teacher Training Program (NTTP) on the academic achievement of students in rural China. She further examined the causal chain through which the program does or does not impact student achievement. By analyzing data on 84 teachers and 3,066 students from one Western province, she found out that at a minimum, the NTTP has no effect on mathematics achievement. In fact, it may even harm student academic achievement. She also found that while the program has a positive effect on math teaching knowledge of teachers, it has no significant effect on teaching practices in the classroom. Taken together, these results indicated that teachers may have improved their knowledge for teaching from NTTP, but did not apply what they learned to improve teaching practices or student learning. This result of the study of Lu [11], might be a possible result if the teachers who attended the training did not apply what they have learned during the training of the PUFM in their classroom teaching.

The studies mentioned in the review demonstrate that professional development can lead to an improvement in pupils' learning. This information is important to be considered by policymakers in order to plan novel teachers' training interventions that can improve pupils' performance in NAT as well as other high stake examinations in mathematics especially for those pupils possessing the vulnerable mathematical ability.

3. METHODOLOGY

Like most survey research in education, this study has its primary purpose to evaluate the impact of teacher training in a profound understanding of fundamental mathematics at USTP for three years. This was done for Grades V and VI mathematics teachers and it intends to help their pupils improve mathematics performance in the National Achievement Test (NAT). The evaluation was done to draw critical decision on the intervention done by the university as support and responsibility to the society it served.

This evaluation survey research was done in the city of Cagayan de Oro primary division. It includes all schools including the hinterland barangays. The participants of the PUFM training for three years were elementary mathematics teachers. This was done twice a year for 81 hours with 40 participants each training period who were Grade V and VI teachers. The pupils of the teachers who attended the training were also part of the evaluation survey because they were the

product of teachers who attended the PUFM training. The researchers' thought the pupils' performance in the National Achievement Test (NAT) in mathematics can show the impact of the PUFM training on their teachers. The data gathered were analyzed using frequency, mean, standard deviation and analysis of variance (ANOVA).

4. RESULTS AND FINDINGS

Table 1. Mean and standard deviation of the pupils' scores in the NAT classified in terms of school participation in PUFM

	School PUFM Participation		
	Thrice	Once	None
Mean	63.14	60.78	61.52
SD	14.96	13.78	13.53
Highest Score	90.03	83.20	86.26
Lowest Score	38.41	43.49	40.27
<i>n</i>	16	13	40

Table 1 shows the result of the analysis of the pupil's NAT scores in terms of mean, standard deviation and the highest and lowest score of every category. It can be observed that the mean score is very close to each other. Those pupils whose teachers have attended the training are only higher by 0.62 which is very little compared to those pupils whose teachers are without attendance in the PUFM. It can be noticed further that those pupils whose teachers have attended once are lower than those who have not attended by 0.74. This result is disturbing since it seems that the teacher's training has not caused any chain effect on pupils' performance. It can be observed further that the pupils' NAT scores are all widely dispersed which means that the pupils' scores are very varied. There are those who got very high but some are also very low. However, it is quite encouraging that the highest score is coming from those schools who have attended the training, but it is also disturbing again because the lowest is coming from the same school who have attended the training.

Those pupils whose teachers are without training came second to the highest score than those teachers trained only once. However, comparing the lowest score in NAT, the pupil's mean score for those teachers have attended thrice got the lowest and those whose teacher attended only once got the highest.

From the interview of the participants their reasons for their difficulty in the implementation are the nature of their pupils who are always absent from their classes, they were not assigned to teach mathematics after the training but in other subjects and many activities which caused them not to attend classes. Although they said that they learned many topics which were not discussed thoroughly with depth and with visual aid when they were students, their additional ability to explain and interpret were futile because of the unfavorable environment to help the pupils improve their achievement. They suggested that it may be better than all of them will be trained so that all of them will be upgraded because they were not mathematics majors.

For further analysis of the impact of the training, the analysis of variance with an unequal number of cases is used. The results are shown in the following table.

Table 2. Summary Table of the One-way Analysis of Variance (ANOVA) of the Pupil's Mean Score in the NAT

Sources of Variation	Sum of Squares	df	Mean Squares	F-ratio	Probability-value
PUFM	45	2	22.5	0.12	0.89
Training	12779	66	193.62		
Error	12824	68			
Within Total					

Table 2 shows the summary table of one-way analysis of variance of pupils mathematics score in the NAT to determine the impact of PUFM. The analysis yielded an F-ratio of 0.12 with a probability value of 0.89 which is greater than the critical value of 0.05 level. This led to the researcher to accept the null hypothesis that there is no significant difference in pupils' achievement in NAT as an impact of the PUFM training. This implies that the training did not cause a big influence on the pupils' mathematics achievement in NAT. This result may be due to the limited teachers who were trained and the participants were different every training period. The teacher-participants in May were not sent in October hence they did not finish all the content supposed to be discussed for the whole year in their grade level. Since there are few participants in the training the majority of the pupils were under those who were not trained. The high scores of the pupils who were taught by a teacher with training do not suffice to cover up the score of pupils whose teachers did not experience training on content and pedagogy. This implies that the training to cause an impact needs to be massive. This implies further that to cause an impact, all teachers must be trained on content and pedagogy. This result contradicts the findings of Aclan [9] which has a significant effect on pupils' because her study used teacher-made tests to determine the effect of the training on pupils' achievement while the present study used NAT results. In addition, all their teachers were trained with follow-up and observation. Furthermore, this result is similar to Lu [11] where the professional development is done did not have an impact also on students' academic achievement in rural China instead it did more harm than good. This present study is better because the mean score is a little higher and it just fails to reach the significance level.

ACKNOWLEDGEMENT

The researchers would like to extend their sincere expression of gratitude to the USTP administration for generous financial support. Dr. Ambrosio B. Cultura II, the Vice-Chancellor for Research and Innovation and Dr. Oliva P. Canencia, the Director of Research and Development Unit of the university for their encouragement, guidance and support in the conduct of the impact assessment; Elena M. Borcillo, CESO V, the schools division superintendent of DepEd CDO division for sending her teachers to participate the PUFM training and for allowing the researchers to gather the data. Mr. Marlon Francis Serina, Dr. Marife Ramos, Dr. Shirley Merida, and Mr. Rey Maghuyop, the DepEd CDO division mathematics supervisors for their support and providing the researchers the National Achievement Test (NAT) result. The Grades V and VI teacher-participants in the training for

their unreserved cooperation and patience. Finally, the mathematics faculty and the graduate students who trained the teacher-participants on the PUFM.

REFERENCES

[1] Tandog, V. et al (2017), "Profound Understanding of Fundamental Mathematics (PUFM) among-5/6 mathematics teachers" *Journal of Scientific Research and Development* 4 (1): 35-38, 2017.

[2] Hills, H. et al. (2008). "Unpacking pedagogical content knowledge; conceptualizing and measuring teachers' specific knowledge of students". *Journal of Research in Mathematics Education*.

[3] Irvin, K. (2012). "Teachers' are the key". *Notices of American Mathematical Society*. Vol. 59, No. 4, pp. 556 – 557.

[4] Mizell, H. (2010). *Why Professional Development Matters*. Learning Forward. 504 South Locust Street, Oxford, OH 45056.

[5] Higgins, T. et al. (2007). "Measuring the impact of professional development in mathematics knowledge for teaching numbers and operation to elementary students. Paper presented to the annual meeting of NCTM, Atlanta, CA.

[6] Cai, J. et al. (2017). "Improving impact of educational research". *Journal of Research in Mathematics Education*. January, Vol. 48, No. 1.

[7] Stegler J. and Hiebert (1999). "The learning gap. Best ideas from the Worlds' teacher for improving education in the classroom". New York, NY.

[8] Fernandes, A. et al. (2017). "Assessing students' understanding mathematics teaching in the middle school". February, Vol. 22, No.6.

[9] Aclan, E. & Luna, C. (2015). "The influence of teachers' mathematics pedagogy content knowledge training on pupils' mathematics achievement", Retrieved September 2016 from <http://pubs.sciepub.com/education/3/10/16/>.

[10] Lomibao, L. S. (2016). *Enhancing mathematics teachers' quality through Lesson Study*. SpringerPlus, 5(1), 1590.

[11] Lu, M. (2017). "The Impact of Teacher Professional Development Programs on Student Achievement in Rural China". Retrieved from reap.fsi.stanford.edu.