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Optimization of In-service Professional Training and Development: A Study of Secondary School Mathematics Teachers in Plateau State, Nigeria

[1]Prof. Thomas D. Bot (PhD), [2]Bako Jonathan Doyin (PhD)
[1]Department of Science and Technology Education, Faculty of Education, University of Jos, Plateau State, Nigeria
[2]Department of Mathematics, Kaduna State College of Education Gidan Waya, Kaduna State, Nigeria

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Abstract: There is currently decay in Nigeria's education system which affects mathematics teachers' effectiveness in implementing teaching and other activities in the classroom. However, it is believed that the problems can be mitigated with proper in-service training or provision of quality professional development, and mathematics teachers are made to explore it with full support and motivation of their employers and the relevant authorities. This study, therefore, examined the extent to which secondary school mathematics teachers explore and engage various in-service training programs for their professional development. Focus was placed on availability of options, opportunity, proportion, quality, preference, frequency, challenges and benefits. The research design used was exploratory survey due to the descriptive nature of the variables studied. Sample comprised of 315 mathematics teachers chosen by purposive sampling technique from North, Central and South of Plateau state, Nigeria. Professional in-service training questionnaire for mathematics teachers tagged PITQMT was used for data collection while the analysis was carried out using frequency counts and simple percentages. Findings of the study among others revealed that in-service training options and preference for mathematics teachers exist in the education system in Nigeria. These include workshops (100%), conferences (100%) and regular courses in the school (100%). Others (i.e. visits, reading committee, etc.) were not perceived to be available; the quality of in-service training from workshops and conferences was perceived to be on average, and low in the remaining training areas; the perceived opportunities and proportion of the in-service training were few in workshops, conferences and regular courses, little and very little in the remaining areas with none of the chances up to 50%; and the perceived frequency of attending in-service training was always in regular (F=315) and correspondence (F=156) courses and rarely for attending workshops (F=305), seminars (F=303) and other opportunities (F=313). It was recommended among other things that mathematics teachers should explore other in-service professional training options while the in-service training options and opportunities should be encouraged among them. This will help update and upscale their knowledge to be able to face emerging challenges and changes in mathematics education, and also to ensure better classroom teaching efficiency.

Keywords: Professional training, Mathematics teachers, Secondary school, Education

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1. INTRODUCTION

The provision of education to citizens at different levels in Nigeria is critical for scientific and technological development of the country. Teachers play a significant role in the process to achieve the goals of the education by appropriate manpower training. It is said that no education system can rise above the level of its teachers (Federal Government of Nigeria [FGN], 2014), thus the better a nation is endowed with qualified teachers in the right quantity and time, the better the education system would be and equally the better the type of envisaged development. Among the numerous key duties of teachers is the training of students to acquire sound knowledge, life skills and cultivate good acceptable behaviors. Osamwonyi (2016) highlighted that teachers serve as the hub of educational

development that equip students with knowledge, skills and good positive moral values. This is suggestive of the fact that without well-trained and highly qualified teachers, and with little or no periodic attempt to up-scale their skills and competences, it will be difficult to get good education and attain meaningful and sustainable science and technology development. Similarly, without highly qualified, motivated, conscientious and committed mathematics teachers who are up-to-date in their knowledge, skills and values, it will be difficult for a nation to transform into a modern society because of the indispensability of mathematics in driving developmental processes in different fields of study. In the primary and secondary schools in Nigeria, mathematics is taught on a day-to-day basis as compulsory school subject due to its critical importance in problem solving and indispensability in training professionals such as accountants, engineers and technologists required for building and emerging with modernized societies (Bot, 2012). The importance attached to mathematics in recent years has made the subject to be stereotyped variously as precursor, bedrock, cornerstone, queen of science and technology, backbone of all sciences, science of all sciences and arts of all arts, queen and language of science, and most important subject for the intellectual development and career choice of individuals (Ojimba, 2013, Bot, 2014).

However, it is unfortunate that mathematics is faced with daunting challenges despite the importance and stereotyping of the subject. Research evidence revealed that nowadays the subject is bedeviled with acute shortage of teachers, negative disposition, lack of suitable learning environment, low intelligence and commitment of students, examination malpractice, poor teaching, poor achievement, disinterested and disenchanted learners and frustrated man power (Bot, 2014; Federal Ministry of Education [FME], 2006). These problems undermine the predetermined plan of Nigeria to develop strategically with a high literacy rate among the citizenry in the 21st century and beyond giving that mathematics is crucial in the process.

To achieve significant progress in instructional delivery and learning outcomes in mathematics to promote sustainable development in Nigeria, it is important to consider and provide effective professional in-service training opportunities for mathematics teachers. In-service training is the on-going continuous training that is given to fully-employed teachers to exercise their teaching jobs and responsibilities satisfactorily. Also, it is concurrent training to official teaching responsibilities cum duties for teachers to improve on their qualifications and practicing skills. Further, it is the relevant courses and activities which serving teachers participate so as to upgrade their professional knowledge, skills and competencies; a form of education and training given to a teacher who is already on the job of teaching and learning (Osamwonyi, 2016); a workshop for employed teaching professionals, para-professionals and other recognized practitioners to acquire new knowledge and better methods (Amadi, 2013); and the process of improving the level of knowledge, skills and competencies of teachers for improved experience and processes (Sugumarie, Razak, Ghavifekr, 2016). Sugumarie, Razak and Ghavifekr submitted further that names such as professional and staff development and continuous education are the terms used interchangeably to describe in-service training of teachers.

In spite of these various descriptions, the basis of on-the-job training of mathematics teachers cannot be overemphasized in the present dispensation in Nigeria. Foremost, they are expected to be committed to effective teaching with stricter supervision and support in the classroom. Beyond ordinary using chalk and talk method, they need to cater for students by creating good learning atmosphere, rapport, motivation, guidance, counselling, connecting mathematics and delivering good lessons (Bot, 2020; Yang, 2012). Also required is the need for them to be upright, coherent, confident, simple, and

captivating in spoken language; good in questioning, engaging students actively and use of practical examples. Many teachers lack these qualities resulting from their poor training.

Secondly, mathematics teachers generally require regular or periodic professional in-service training not only to upscale their knowledge but to also avail themselves of the forms of training and opportunities to include workshops, seminars, conference, exhibition, research, reading, writing, publication and so on. Beyond acquiring new knowledge most especially pedagogy, the training is necessary to foster critical thinking and logical reasoning, effective use of resources including new technologies like computers and other e-learning resources, improve their qualifications and advance their status especially for those with the minimum Nigeria Certificate in Education (NCE).

Furthermore, in-service training provides many other benefits. Omar (2014) posited that it is the catalyst for effectiveness, handling new challenges, changes and improved professionalism. For instance, research by Izci and Goktas (2017) revealed that teacher participants in in-service training on various teaching methods and techniques for mathematics, information exchange, refreshing of previous knowledge and acquisition of new information rated positively high during training encounter. Similarly, Nyamwange, Kyalo and Opakas (2017) discovered that in-service training changes teacher and students' attitudes positively, improves teachers' pedagogical content knowledge and ability in selecting and using appropriate materials for instructional purpose, and also improves students' performance in mathematics. In a related but earlier study, Borg (2011) revealed that in-service teacher education had a considerable impact on language teachers' beliefs by allowing for more and explicit thinking about, become more aware of, and articulate and consolidate their beliefs.

Gleanings from the literature highly suggest that in-service training has advantages including improved confidence, competencies, achievement, performance and so on both for teachers and students. But it is not certain if mathematics teachers in Nigeria are aware of these significant benefits due to their poor training and preparation as well as paucity of funds to access any available in-service training. More so, in Nigeria and outside the shores of the country, researches have pointed to the fact that despite the advantages of in-service training from workshops, conferences and seminars with capacity to augment on-the-job deficiencies, these media have not been explored sufficiently; mathematics teachers have not patronized them significantly because of lack of proper awareness, poor incentives, little time, lack of confidence, low self-esteem, lack of support, lack of interest, non-availability and insufficient opportunities (Levenberg & Patkin, 2014). Therefore, except in-service training programs for mathematics teachers and opportunities are provided; necessary awareness, encouragement and support are created, provided and promoted, a large number of the teachers may continue to suffer lack of professional growth and their in-and-outside classroom effectiveness and output may continue to be challenged.

2. STATEMENT OF THE PROBLEM

Mathematics is a fundamental requirement for scientific and technological development to the extent that no nation can afford to neglect it. One of the ways of assisting students in the secondary school to improve their overall performance is effective teaching. To teach mathematics effectively with the national certificate of education (NCE) as the minimum qualification required for teaching in Nigeria, one needs germane qualities such as mastery of subject matter and contents, pedagogic knowledge, good rapport, humility, dedication, confidence, interest, orderliness and commitment. Unfortunately, many of the mathematics teachers lack these critical qualities and periodic on-the-job cum

in-service professional training and development which presumably should have been used as scaffold to scale up the deficits are not available. This makes it difficult for the teachers to carry out their job satisfactorily. For instance, whereas Adewale (2000) stated that existing criticisms abound that mathematics teachers with NCE certificates are not suitable for the job giving the complex nature of mathematics and its instruction, Odili and Osuru (2010) remarked that most NCE holders lack competence and mastery of mathematics contents and subject matter dealing with concepts, procedures and processes. This suggests that NCE holders who constitute the bulk of teachers in the secondary school in Nigeria do not teach mathematics effectively. Thus except this problem is resolved, the teachers will continue to experience low output and persistent complaints from stakeholders over poor performance of students. One of the ways to overcome this challenge is to create, provide and encourage active participation in regular in-service training by teachers. This study is mainly focused on the in-service training opportunities and options available for mathematics teachers including the benefits and challenges involved which could be explored extensively. The problem of this study, therefore, is centered on the question of the extent which mathematics teachers understand and attend in-service training in the secondary school that is critical for their professional growth and development.

Objectives of the study

The study was premised on two main objectives as follows:

1. Investigate the professional in-service training and practices of mathematics teachers in terms of options, opportunities, proportion, quality, preference and frequency.
2. Examine the challenges and benefits involved in the professional in-service training.

Research Questions

The following research questions were raised to guide the study:

1. What options exist for professional in-service training of secondary school mathematics teachers?
2. To what extent do secondary school mathematics teachers prefer professional in-service training options available?
3. What is the nature of the quality of professional in-service training of secondary school mathematics teachers?
4. How do secondary school mathematics teachers see opportunities for their professional in-service training?
5. What proportion of secondary school mathematics teachers attend in-service training for their professional development?
6. How frequent do secondary school mathematics teachers attend professional in-service training?
7. What benefits are derivable from professional in-service training of secondary school mathematics teachers?
8. What are the challenges affecting professional in-service training of secondary school mathematics teachers?

3. METHODOLOGY

The study used exploratory survey design in examining the options, opportunities, preference, proportion, frequency, benefits and perceived challenges affecting the in-service training of mathematics teachers in secondary schools in Plateau state, Nigeria. This was done against the backdrop that in-service training and development of teachers professionally is critical in effective curriculum implementation but there has been no deliberate attempt at examining the extent which mathematics teachers utilize and benefit from such training programs in recent times in Nigeria. Sample comprised 315 representing 43% of mathematics teachers from junior and senior secondary schools in

Plateau state. The sample was selected using purposive sampling technique. A high percentage (92.70%) of the sample had participated in a training workshop on mathematics teaching methodology for junior and senior secondary schools organized by the Mathematical Association of Nigeria (MAN), Plateau state chapter in the North, Central and Southern parts of the state. The workshop training made the sample readily accessible and suitable for the research. Also, the sample had the minimum teaching qualification of NCE as employed and serving teachers in their respective secondary schools with average of 10 years teaching experience thereby making it a subject of research interest.

Professional in-service training questionnaire for mathematics teachers (PITQMT) was used for data collection based on options/preference, quality, opportunities/proportion, frequency, benefits and the challenges of in-service professional training. The frequency part was designed on a nominal scale of Always, Rarely and Never. Respondents were expected to indicate their acceptance level only. The parts on options/preference, quality, opportunities/proportion, benefits and challenges used open-ended questions with clear instructions to the respondents. The PITQMT was face-validated by two experts in test construction and measurement and one seasoned mathematics educator to ensure its validity and reliability to measure what it was designed to measure. After minor corrections, the PITQMT was administered to the respondents within a short period of two weeks. The procedure was simple introduction of the purpose for which the study was conducted followed by distribution of the PITQMT to the respondents. The data collected was analyzed using frequency counts and simple percentage due to the exploratory nature of the research design.

4. RESULTS

Table 1. Perceived In-service Training Options/Preference for Mathematics Teachers

ITO	N	Freq.	Percentage	Preference	Remark
Workshops	315	315	100%	1st	Identified
Conferences	315	315	100%	2nd	Identified
Regular Courses	315	315	100%	3rd	Identified
Correspondence Courses (P/T)	315	113	35.87%	3rd	Identified
Symposium/Seminars	315	315	100%	2nd	Identified
Others (e.g. committee, visits)	315	-	-	4th	Not-identified

Key: I=In-service, T=Training, O=Option, N=Number, P/T=Part-Time, Freq.=Frequency

In Table 1, the respondents identified a number of in-service training options and preferences to include workshops (100%), conferences (100%) and regular courses (100%) in that order but could not identify others such as visitation, committees, personal or individual reading and so on. Order of the preferred ones was workshops (1st), conferences (2nd), regular courses and correspondence courses (3rd), and symposium/seminars (2nd).

Table 2. Perceived Quality of Professional In-service Training for Mathematics Teachers

ITO	N	Quality (L, A,

			H)	
Workshops	315	-	A	-
Conferences	315	-	A	-
Regular Courses	315	L	-	-
Correspondence Courses (P/T)	315	L	-	-
Symposium/Seminars	315	L	-	-
Others (e.g. committee, visits)	315	-	-	-

Key: I=In-service, T=Training, O=Option, N = Number, L = Low, A = Average, H = High

Table 2 revealed that the quality of professional in-service training of mathematics teachers is on average in workshops and conferences only and low for the remaining ones. None of the training options or aspects is perceived to be high in quality probably due to their non-prioritization.

Table 3. Perceived Opportunities/Proportion of In-service Training for Mathematics Teachers

ITO	N	Chance	Percentage	Remark
Workshops	315	Few	≥ 40%	Not Many
Conferences	315	Few	≥40%	Not Many
Regular Courses	315	Few	≥40%	Not Many
Correspondence Courses (P/T)	315	Little	≥20%<40%	Little
Symposium/Seminars	315	Little	≥20%<40%	Little
Others (e.g. committee, visits)	315	Very Little	<20%	Very Little

Key: I=In-service, T=Training, O=Option, N=Number

In Table 3, the perceived opportunities and proportion of in-service training of mathematics teachers is few in three areas (works, conferences and regular courses), and little and very little in the remaining areas, none of the chances is up to 50%. This suggests that many teachers do not attend in-service training for their professional development.

Table 4. Perceived Frequency of In-service Training for Mathematics Teachers

ITO	N	Always	Rarely	Never
Workshops	315	10	305	-
Conferences	315	21	294	-
Regular Courses	315	315	-	-
Correspondence Courses (P/T)	315	156	159	-
Symposium/Seminars	315	12	303	-
Others (e.g. committee, visits)	315	2	313	-

Key: I=In-service, T=Training, O=Option, N=Number, P/T=Part-time

From Table 4, the perceived frequency (PF) of attending in-service training by mathematics teachers is always in regular (PF=315) and correspondence (PF=156) courses and rarely in the remaining areas especially others (PF=313), workshops (PF=305) and seminars or symposium (PF=303). This is suggestive that in-service training does not feature frequently besides the regular and part-time training of mathematics teachers from institutions of higher learning, and despite the availability of various options for in-service training of teachers, the patronage is not frequent in most cases.

Table 5. Perceived Benefits of In-service Training of Mathematics Teachers

Benefit	Percentage

Teachers increase their knowledge and understanding of students' mathematics needs in the classroom	64.03%
Teachers learn new and better means of helping students to learn mathematics with renewed and sustained interest	56.12%
Teachers update their knowledge to be able to create and provide a comfortable and encouraging/attractive environment for teaching and learning of mathematics	43.50%
Teachers gain deeper and more knowledge of mathematics content, strategies and skills for effective teaching in the classroom	78.41%
Teachers learn to understand effective and efficient ways and means of using new technologies in mathematics teaching and learning	66.35%
Teachers learn and understand new ways of improving learning and achievement in mathematics among students	93.97%
Teachers gain experience towards enhancing greater dedication or commitment and interest in teaching mathematics in the classroom	36.51%
Teachers learn to improve on their teaching profession or professionalism relative to mathematics	68.25%
Teachers gain knowledge to increase their critical thinking and sound reasoning in mathematics	88.25%
Teachers gain knowledge and ability to increase their effectiveness in handling mathematics leading to better performance and acceptability on the job	72.06%
Teachers gain understanding of better means to face new challenges and changes in mathematics	63.81%
Teachers gain understanding of new ways to handle difficult mathematics concepts practically to demystify the subject to learners	91.74%
Teachers gain better knowledge to create good relationship/rapport with students in teaching and learning, motivational skills and ways of guiding and counselling students in mathematics in the classroom	29.21%
Teachers gain understanding of better lesson planning and new ways of connecting or applying mathematics in practical real life situations	73.97%
Teachers develop and increase their confidence, communication and questioning skills and techniques in teaching mathematics	53.97%
Others	0.95%

Table 5 revealed that the benefits of in-service training for mathematics teachers are multi-dimensional and multi-faceted as perceived by the respondents. These include teachers learn to understand new ways of improving learning and achievement in mathematics (93.97%), understand new ways of handling difficult concepts practically to demystify the subject for learners (91.74%), teachers increase their critical thinking and sound reasoning (88.25%) in that order, and lastly they also learn other means that are beneficial (0.95%) in assisting learners. Presumably, this may include increased ability to handle misdemeanors, and socialization (knowing each other, exchanging pleasantries and so on).

Table 6. Perceived Challenges of In-service Training of Mathematics Teachers

Challenge	**Percentage**
Few chances/opportunities of selecting mathematics teachers to participate in in-service professional training	84.12%
Lack of funds to organize in-service training on regular basis for mathematics teachers	96.19%
Some conferences are rear because they are annual-based making in-service training difficult for mathematics teachers	47.61%
Lack of advocacy on in-service professional training opportunities/options for mathematics teachers	34.50%
Lack of financial incentives/motivation for in-service training of mathematics teachers	89.36%
Lack of sponsorship for in-service professional training of mathematics teachers	51.54%
Non-localization of in-service professional training for mathematics teachers	25.07%

In Table 6, a large number of the respondents representing 96.19% perceived lack of sufficient funds for in-service professional training of teachers on a regular basis, 89.36%

perceived lack of financial incentives/motivation for in-service professional training in that order with the least perceived rate of 25.07% indicating non-localization of in-service professional training for mathematics teachers.

5. DISCUSSION

In Nigeria, in order for the teaching of mathematics to be made fully effective in the secondary school, it is necessary for the teachers to be involved fully in in-service professional training on regular and continuing basis. It is not strange information that at the present time, the society is witnessing lots of scientific and technological revolutions and breakthroughs. Some of these include increased sourcing and application of new information and communication technologies in teaching and learning, introduction of new subject matter and novel topics into the school curriculum to enrich it, the high impact of science and technology in the society, for instance IoT-internet of things, drones, robotics, artificial intelligence, block-chain, server-less computing, 3D printing, biometrics, virtual and augmented realities on businesses, data storage, data analysis and so on and so forth. This makes it necessary for mathematics teachers to keep abreast of the current happenings in these areas to be able to fit into the rapid changing society. In-service training is supposed to create the enablement for mathematics teachers to achieve this objective so that not only will they be able to modernize their teaching style, content knowledge and skills to be effective, they would be able to increase their interest in teaching and boost their competencies and confidence as professional teachers.

However, findings from this study on in-service training of mathematics teachers revealed the existence and perceived in-service training options and preferences for teachers. These are workshops (100%), conferences (100%) and regular professional courses (100%) in that order but 'others' such as institutes, visits, committees, personal/individual reading tend to be unknown and unperceived (Table 1). Table 2 revealed lack of perceived quality in in-service training provision while Table 3 revealed 'few' teachers have opportunity to attend in-service training (workshops, conferences, regular courses) with 'very little' opportunity in the remaining options but none of the chances is up to 50%. This suggests many teachers hardly attend in-service professional training thus lack some of the qualities required for effective mathematics teaching. This agrees with Guskey (2002) that attendance of teachers in programs designed to support their professional development is not sufficient to guarantee anticipated change in their professional practice. Similarly, this agrees with Levenberg and Patkin (2014) who opined that programs designed to develop and support the growth of teachers' professional knowledge are not sufficient. Also, the findings tend to agree with Odili (2006) that most teachers lack sound knowledge of mathematics required for effective teaching owing to insufficient training in both regular courses and in-service training. Related to this, Levenberg and Patkin (2014) pointed out that in-service training of teachers is particularly not sufficient because many lack opportunity to attend as most schools select only individual representatives as opposed to teams of teachers. To mitigate this problem, it is necessary for teachers to be provided with more in-service training opportunities, at the same time, there should be encouragement and sponsorship for them to participate actively. This concurs with Fresko and Ben-chaim (1986) who suggested frequent in-service training of mathematics teachers in the secondary school in order for students' achievement to improve significantly since teachers effectiveness is said to be directly related to students' learning and achievement with a high predictive value.

The findings in Table 4 show that the perceived frequency of attending in-service training by the teachers is rare except in regular courses where the perceived frequency is high. This means teachers having minimum teaching qualification of NCE or diploma certificate in education have high chance of going for further education to get higher

qualifications such as bachelor's degree (BSc.Ed.), higher national diploma (HND) and masters' degree (MSc.Ed.) with little opportunity for in-service training in the system. This trend need to be reversed less students continue learning mathematics poorly with negative impact on their achievement and overall performance due to ineffective instruction by teachers having little in-service training chances.

The findings in Table 5 revealed that in-service training is beneficial in many ways including understanding new ways of improving learning and achievement in mathematics (93.97%), understanding new ways of teaching and handling difficult concepts practically (91.74%) and critical thinking together with sound reasoning (88.25%). This agrees with the submissions of Obioma (2008); and Omar (2014) that in-service training has many benefits for both teacher and students; hence teachers should be encouraged to participate in it on regular basis. If this is done, it will go a long way to fulfil one of the conditions and demands from the report of the Chief examiners for WAEC mathematics examinations in Nigeria which states that teachers should endeavor to handle the teaching of mathematics practically to help remedy the problem of poor performance of students whereby this can be done by providing refresher training to the mathematics teachers (WAEC Chief Examiners' Reports, 2013, 2014, 2015).

From Table 6, the findings revealed that even though in-service training has many benefits for mathematics teachers, it is associated with some challenges which include lack of enough funds for training on regular basis (96.19%), and lack of incentives or motivation for teachers that may be interested (89.36%). This agrees with Adewale (2000), Eyiche (2012), Nwachukwu (2014), and Odili and Osuru (2010) that the education system in Nigeria is poorly funded with a lot of consequences since mid-70s into the 2000s; hence there is no sufficient funds to provide in-service training for teachers, sponsor many to acquire higher qualifications and procure high quality instructional materials and so on. Thus except education in Nigeria is prioritized and funded very well by the critical stakeholders to address these challenges, it would continue to witness unnecessary backwardness thereby affecting the teaching of mathematics negatively.

6. RECOMMENDATIONS

Based on the findings of the study, the following measures are recommended:

1. Mathematics teachers should learn to identify and explore the various other types of in-service training options for their professional development.
2. In-service training options and opportunities should be encouraged among mathematics teachers. This will help in updating the knowledge of the teachers especially on how to tackle emerging challenges in mathematics education.
3. One of the main concerns of mathematics teachers is to see to improving students' achievement and overall performance in the subject to meet national expectations. Thus mathematics teachers should be encouraged by the government with proper funding to undergo regular in-service professional training to improve their knowledge, skills and techniques.
4. Planners of in-service professional training programs especially various associations such as MAN, CON, STAN and higher institutions of learning should try and localize them. This will help increase their accessibility by mathematics teachers with reduced financial cost.

7. CONCLUSION

The importance of mathematics in national development and hence the need for mathematics teachers to regularly acquire more knowledge on effective means of teaching to enhance achievement of students in the subject cannot be overemphasized based on the quest for the scientific and technological development of Nigeria.

Professional in-service training is taken as catalyst to optimizing teaching professionalism, thus it is needful for mathematics teachers to avail themselves at the slightest opportunity of such training periodically. Doing so, the quality in achievement of students in mathematics will be attained eventually. However, it is concluded in this study that a number of in-service training options and preference exist for mathematics teachers such as conferences, regular courses and visitation; the quality of the training is low in many respect; the perceived opportunities and proportion of the training is less than 50% irrespective of the type, while the benefits are huge but not without some challenges such as lack of funds, financial incentives, motivation, and non-localization of the training; hence recommendations are made accordingly.

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